Manchester Community College
Knox Building Window Wall and HVAC
Manchester, NH

Project No. 11505
February 14, 2013
Issued for Bid
MANCHESTER COMMUNITY COLLEGE
KNOX BUILDING WINDOW WALL AND HVAC
MANCHESTER, NH

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PART 1  GENERAL

1.1  INFORMATION FOR BIDDERS

A. The information being provided is for the bidder's convenience and does not relieve the bidders from doing their own investigation to determine the accuracy of the information.

1.2  ASBESTOS TESTING

A. The Limited Asbestos Testing by RPF Associates, Inc. dated May 13, 2011 is attached at the end of this section.

END OF SECTION 000200
May 13, 2011

Mr. Scott Osgood  
Community College System of New Hampshire  
26 College Drive  
Concord, NH 03302

Re: Manchester Community College  
Limited Asbestos Testing  
RPF Project No. 114284

Dear Scott,

On May 5, 2011, RPF Associates, Inc. (RPF) conducted limited bulk material sampling of suspect window materials in the Manchester Community College Building A, president’s conference room and within various locations of Building B, as designated by you for analysis to determine possible asbestos content and polychlorinated biphenyl (PCB) content. The limited sampling was conducted in accordance with current State and federal rules and regulations. The analytical results and sample locations are enclosed with this letter.

Limited Asbestos Sampling

Six (6) homogeneous groups of accessible suspect material were sampled during this testing. In accordance with current industry sampling protocols, a total of fourteen (14) samples were collected and submitted for analysis using polarized light microscopy. Asbestos containing material (ACM) is defined by current EPA regulations as materials have greater than 1% asbestos content.

As you can see in the enclosed results, greater than 1% asbestos was detected in the interior window glaze and frame caulk and exterior window glaze. These materials are defined as ACM.

Please note that a full inspection of the area or building was not performed during this limited testing. In the event that other materials or areas of the building will be impacted by planned upgrades, maintenance activity, renovation or demolition activity, please notify our office to arrange for additional site inspections, testing and analysis.

Please also reference existing asbestos OSHA hazard communication documentation for this building for details of the accessible ACM and presumed ACM present. Prior to renovation activity, additional pre-construction surveys will be required to comply with current State of NH, EPA and OSHA requirements throughout affected areas.
Limited PCB Sampling

PCBs are known to have been used improperly in the manufacturing of various building caulk materials and are highly regulated by the US EPA. Representative samples were collected from interior and exterior windows, and were analyzed by gas chromatography (GC) via EPA Method 3540C / 8082.

PCBs were not detected in limited interior or exterior samples collected and all samples were found to be less than the detection limit.

If you would like further assistance or have questions, please call our office.

Sincerely,
RPF ASSOCIATES, INC.

Kara Forsythe
EH&S Consultant
Licensed Asbestos Inspector AI-211

Enclosures:
Appendix A: Sample Results
Appendix B: General Asbestos Information
Appendix C: Limitations

114284 051311 report
APPENDIX A
**TABLE 1**

COMMUNITY COLLEGE SYSTEM OF NEW HAMPSHIRE  
Manchester Community College

SUMMARY OF BULK MATERIAL SAMPLING AND RESULTS  
Polarized Light Microscopy – EPA 600/R-93/116 Method

Samples Collected: May 5, 2011

<table>
<thead>
<tr>
<th>Sample ID</th>
<th>Sample Description</th>
<th>Asbestos Content</th>
<th>Other Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>050511-HG01</td>
<td>Interior window glaze, dark gray, 1st floor, building A, presidents conference room</td>
<td>3% Chrysotile</td>
<td>97% Non-fibrous</td>
</tr>
<tr>
<td>050511-HG01b</td>
<td>Interior window glaze, dark gray, 1st floor, career center for academic support, room 216</td>
<td>*SFP</td>
<td>*SFP</td>
</tr>
<tr>
<td>050511-HG01c</td>
<td>Interior window glaze, dark gray, 1st floor, room 226, building B</td>
<td>*SFP</td>
<td>*SFP</td>
</tr>
<tr>
<td>050511-HG02</td>
<td>Exterior window glaze, gray, 1st floor, building A, presidents conference room, building B</td>
<td>3% Chrysotile</td>
<td>97% Non-fibrous</td>
</tr>
<tr>
<td>050511-HG02b</td>
<td>Exterior window glaze, dark gray, 1st floor, career center for academic support, room 216, building B</td>
<td>*SFP</td>
<td>*SFP</td>
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<tr>
<td>050511-HG02c</td>
<td>Exterior window glaze, dark gray, 1st floor, room 226, building B</td>
<td>*SFP</td>
<td>*SFP</td>
</tr>
<tr>
<td>050511-HG03</td>
<td>Window caulk, gray, exterior, ground floor, fitness center, building B</td>
<td>No Asbestos Detected</td>
<td>100% Non-fibrous</td>
</tr>
<tr>
<td>050511-HG03b</td>
<td>Window caulk, gray, exterior, ground floor, art room, building B</td>
<td>No Asbestos Detected</td>
<td>100% Non-fibrous</td>
</tr>
<tr>
<td>050511-HG04</td>
<td>Interior window frame caulk, gray, 1st floor, building A, presidents conference room</td>
<td>5% Chrysotile</td>
<td>95% Non-fibrous</td>
</tr>
<tr>
<td>050511-HG04b</td>
<td>Interior window frame caulk, gray, 1st floor, building B, room 226</td>
<td>*SFP</td>
<td>*SFP</td>
</tr>
<tr>
<td>050511-HG05</td>
<td>Exterior caulk, tan, exterior, fitness center, building B</td>
<td>No Asbestos Detected</td>
<td>100% Non-fibrous</td>
</tr>
<tr>
<td>050511-HG05b</td>
<td>Exterior caulk, tan, exterior, art room, building B</td>
<td>No Asbestos Detected</td>
<td>100% Non-fibrous</td>
</tr>
<tr>
<td>050511-HG06</td>
<td>Exterior window glaze, black, exterior, art room, building B</td>
<td>No Asbestos Detected</td>
<td>100% Non-fibrous</td>
</tr>
<tr>
<td>050511-HG06b</td>
<td>Exterior window glaze, black, exterior, art room, building B</td>
<td>No Asbestos Detected</td>
<td>100% Non-fibrous</td>
</tr>
</tbody>
</table>

Notes:
- Trace means less than 1%. SFP Means analysis was terminated because asbestos was detected on a previous homogenous sample during the survey work. Please reference the "HG" group number.
- Please reference the full report for discussions and additional information and limitations pertaining to these results.
### TABLE 2

**COMMUNITY COLLEGE SYSTEM OF NEW HAMPSHIRE**  
Manchester Community College

**Preliminary Analytical Results**  
For Polychlorinated Biphenyls (PCBs)

**Samples Collected: May 5, 2011**

<table>
<thead>
<tr>
<th>Sample ID</th>
<th>PCB-1016 (ppm)</th>
<th>PCB-1221 (ppm)</th>
<th>PCB-1232 (ppm)</th>
<th>PCB-1242 (ppm)</th>
<th>PCB-1248 (ppm)</th>
<th>PCB-1254 (ppm)</th>
<th>PCB-1260 (ppm)</th>
<th>PCB-1268 (ppm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>050511-PCB01</td>
<td>&lt;0.98</td>
<td>&lt;0.98</td>
<td>&lt;0.98</td>
<td>&lt;0.98</td>
<td>&lt;0.98</td>
<td>&lt;0.98</td>
<td>&lt;0.98</td>
<td>&lt;0.98</td>
</tr>
<tr>
<td>050511-PCB02</td>
<td>&lt;0.79</td>
<td>&lt;0.79</td>
<td>&lt;0.79</td>
<td>&lt;0.79</td>
<td>&lt;0.79</td>
<td>&lt;0.79</td>
<td>&lt;0.79</td>
<td>&lt;0.79</td>
</tr>
<tr>
<td>050511-PCB03</td>
<td>&lt;0.90</td>
<td>&lt;0.90</td>
<td>&lt;0.90</td>
<td>&lt;0.90</td>
<td>&lt;0.90</td>
<td>&lt;0.90</td>
<td>&lt;0.90</td>
<td>&lt;0.90</td>
</tr>
</tbody>
</table>

Notes:
- Results are presented as parts per million (ppm)
- Samples were analyzed per EPA Method 8082
- Results with < were found to be less than the lab detection limit
INDUSTRY AND REGULATORY OVERVIEW

General Overview

Asbestos is the name for a group of naturally occurring minerals that separate into strong, very fine fibers. The adverse health effects associated with asbestos exposure have been extensively studied for many years. Results of these studies and epidemiological investigations have demonstrated that inhalation of asbestos fibers may lead to increased risk of developing one or more diseases. In all cases, extreme care must be used not to disturb asbestos-containing materials or to create fiber release episodes.

Asbestos-containing building material (ACBM) that is in good condition, and is not damaged or otherwise disturbed, is not likely release asbestos fibers into the air if it is managed properly. When properly managed, release of asbestos fibers into the air or surrounding areas is prevented or minimized, and the risk of asbestos-related disease can be reduced to a negligible level. However, ACBM can become hazardous when, due to damage, disturbance, or deterioration over time, they release fibers into the air. In the event of fiber release without proper controls, elevated airborne concentrations of asbestos create a potential hazard for any employees and building occupants in the affected areas.

ACBM is classified by the different regulatory agencies based on friability. Friable ACBM, when dry, can be crumbled, pulverized, or reduces to powder by hand pressure. Considering that a primary concern when dealing with ACBM is airborne fibers or the potential for exposure to airborne fibers, friable ACBM is typically considered to present more of a health risk as compared with nonfriable ACBM. Nonfriable ACBM is further grouped by the EPA into Category I and Category II nonfriable ACBMS depending on the specific type of ACM. It should be noted that nonfriable ACBM that is rendered friable, or in some cases, subjected to certain activities and forces during work, may also be considered regulated as friable ACBM.

Health Issues

The three primary diseases most often related to asbestos exposure are asbestosis, mesothelioma, and lung cancer. Asbestosis is a fibrous scarring of the lung caused by scar tissue formations in the lung in response to the asbestos fibers. Mesothelioma is a rare cancer of the lining of the lungs or the lining of the abdomen. Exposure to all types of asbestos increases the risk of developing lung cancer and asbestosis. Other diseases found more often among persons exposed to asbestos include cancer of the esophagus, stomach, colon, and pancreas; pleural plaques and pleural thickening; and pleural effusion.

Exposure to airborne asbestos rarely causes immediate health problems. The diseases related to asbestos may develop over a period of 10 to 30 years. Studies have shown that there is dose-response relationship between exposure to asbestos and disease - or the more asbestos inhaled over an extended period, the greater the risk of developing an asbestos-related disease. Smoking, in combination with asbestos exposure, can increase the risk of disease by 50 percent.

Regulatory Overview

Asbestos is highly regulated at the federal, state, and local levels. To date, the two primary Federal agencies responsible for generating asbestos-related regulations are the U.S. Environmental Protection Agency (EPA) and the Occupational Safety and Health Administration (OSHA). Additionally, regulations regarding asbestos vary from state-to-state and, in some cases, locally.
Regulations promulgated by the Environmental Protection Agency (EPA) include:

Asbestos Abatement Projects; Worker Protection Rule
Title 40 Part 763, Sub-part G of the Code of Federal Regulations

Asbestos School Hazard Abatement Reauthorization Act (ASHARA)
Training Requirements of (AHERA) Regulation
Asbestos Containing Materials in Schools Final Rule & Notice
Title 40, Part 763, Sub-part E, Code of Federal Regulations

Asbestos Hazard Emergency Response Act (AHERA) Regulation
Asbestos Containing Materials in Schools Final Rule & Notice
Title 40, Part 763, Sub-part E of the Code of Federal Regulations

National Emission Standard for Hazardous Air Pollutants (NESHAPS)
National Emission Standard for Asbestos, Title 40, Part 61, Sub-part A,
and Sub-part M (Revised Sub-part B) of the Code of Federal Regulations

The US Occupational Safety and Health Administration (OSHA) has also developed regulations for asbestos (abatement and related issues) including:

Occupational Exposure to Asbestos, Tremolite,
Anthophyllite, and Actinolite; Final Rules

Title 29, Part 1910, Section 1001 and
Part 1926, Section 1101 of the Code of Federal Regulations

Respiratory Protection
Title 29, Part 1910, Section 134 of the Code of Federal Regulations
Other related sections of 29 CFR 1926 and 29 CFR 1910

Individual state agencies must also be consulted for current updated copies of state rules and regulations. Regulations and requirements can vary significantly from state to state.

In summary, based on current regulatory requirements, ACBM, which may be impacted or disturbed (such that asbestos fiber release occurs) by renovation, demolition, or other such activity, must be removed by qualified, licensed firms. ACBM, which will not be impacted or disturbed by renovation or demolition activity, may be left in place if managed properly and if the materials are maintained in good condition. A qualified, licensed project designer and certified industrial hygienist must design abatement work. All abatement should be monitored, tested, and inspected by a qualified EH&S firm/certified industrial hygienist. ACBM that will not be impacted or disturbed by renovation or demolition activity may be left in place if managed properly and if the materials are maintained in good condition.
APPENDIX C
LIMITATIONS

1. The observations and conclusions presented in the Report were based solely upon the services described herein, and not on scientific tasks or procedures beyond the RPF Associates, Inc. Scope of Work (SOW) as discussed in the proposal and/or the RPF. The conclusions and recommendations are based on visual observations and testing, limited as indicated in the Report, and were arrived at in accordance with generally accepted standards of industrial hygiene practice and asbestos professionals. The nature of this survey or monitoring service was limited as indicated herein and in the report or letter of findings. Further testing, survey, and analysis is required to provide more definitive results and findings.

2. For site survey work, observations were made of the designated accessible areas of the site as indicated in the Report. While it was the intent of RPF to conduct a survey to the degree indicated, it is important to note that not all suspect ACBM material in the designated areas were specifically assessed and visibility was limited, as indicated, due to the presence of furnishings, equipment, solid walls and solid or suspended ceilings throughout the facility and/or other site conditions. Asbestos or hazardous material may have been used and may be present in areas where detection and assessment is difficult until renovation and/or demolition proceeds. Access and observations relating to electrical and mechanical systems within the building were restricted or not feasible to prevent damage to the systems and minimize safety hazards to the survey team.

Although assumptions may have been stated regarding the potential presence of inaccessible or hidden asbestos and other hazardous material, full inspection findings for all asbestos and other hazardous material requires the use of full destructive survey methods to identify possible inaccessible suspect material and this level of survey was not included in the SOW for this project. For preliminary survey work, sampling and analysis as applicable was limited and a full survey throughout the site was not performed. Only the specific areas and/or materials indicated in the report were included in the SOW. This inspection did not include a full hazard assessment survey, full testing or bulk material, or testing to determine current dust concentrations of asbestos in and around the building. Inspection results should not be used for compliance with current EPA and State asbestos in renovation/demolition requirements unless specifically stated as intended for this use in the RPF report and considering the limitations as stated therein and within this limitations document.

Where access to portions of the surveyed area was unavailable or limited, RPF renders no opinion of the condition and assessment of these areas. The survey results only apply to areas specifically accessed by RPF during the survey. Interiors of mechanical equipment and other building or process equipment may also have asbestos and other hazardous material present and were not included in this inspection. For renovation and demolition work, further inspection by qualified personnel will be required during the course of construction activity to identify suspect material not previously documented at the site or in this survey report. Bordering properties were not investigated and comprehensive file review and research was not performed.

For lead in paint, observations were made of the designated accessible areas of the site as indicated in the Report. Limited testing may have been performed only to the extent indicated in the text of the report. In order to conduct thorough hazard assessments for lead exposures, representative surface dust testing, air monitoring and other related testing throughout the building, should be completed. This type of in depth testing and analysis was beyond the scope of services for the initial inspection. For lead surveys with XRF readings, it is recommended that surfaces found to have LBP or trace amount of lead detected with readings of less than 4 mg/cm² be confirmed using laboratory analysis, if more definitive results are required. Substrate corrections were conducted in accordance with the XRF manufacturer guidelines; however, substrate corrections involving destructive sampling or damage to existing surfaces (to minimize XRF read-through) were not completed. In some instances, destructive testing may be required for more accurate results. In addition, depending on the specific thickness of the paint films on different
areas of a building component, differing amounts of wear, and other factors. XRF readings can vary slightly, even on the same building component. Unless otherwise specifically stated in the scope of services and final report, lead testing performed is not intended to comply with NH Admin Rule He-P 1600 or other state and federal regulations pertaining to childhood lead poisoning regulations.

3. Air testing is to be considered a “snap shot” of conditions present on the day of the survey with the understanding that conditions may differ at other times or dates or operational conditions for the facility. Results are also limited based on the specific analytical methods utilized. For phase contrast microscopy (PCM) total airborne fiber testing, more sensitive asbestos-specific analysis using transmission electron microscopy (TEM) can be performed upon request.

4. For asbestos bulk and dust testing, although polarize light microscopy (PLM) is the method currently recognized in State and federal regulations for asbestos identification in bulk samples, some industry studies have found that PLM may not be sensitive enough to detect all of the asbestos fibers in certain nonfibrous material, vermiculite type insulation, soils, surface dust, and other materials requiring more sensitive analysis to identify possible asbestos fibers. In the event that more definitive results are requested, RPF recommends that confirmation testing be completed using TEM methods or other analytical methods as may be applicable to the material.

5. For hazardous building material inspection or survey work, RPF followed applicable industry standards; however, RPF does not warrant or certify that all asbestos or other hazardous materials in or on the building has been identified and included in this report. Various assumptions and limitations of the methods can result in missed materials or misidentification of materials due to several factors including but not limited to: inaccessible space due to physical or safety constraints, space that is difficult to reach to fully inspect, assumptions regarding the determination of homogenous groups of suspect material, assumptions regarding attempts to conduct representative sampling, and potential for varying mixtures and layers of material sampled not being representative of all areas of similar material.

6. Full assessments often requires multiple rounds of sampling over a period of time for air, bulk material, surface dust and water. Such comprehensive testing was beyond the scope of RPF services. In addition clearance testing for abatement, as applicable, was based on the visual observations and limited ambient area air testing as indicated in the report and in accordance with applicable state and federal regulations. The potential exists that microscopic surface dust remains with contaminant present even in the event that the clearance testing meets the state and federal requirements. Likewise for building surveys, visual observations are not sufficient alone to detect possible contaminant in settled dust. Unless otherwise specifically indicated in the report, surface dust testing was not included in the scope of the RPF services.

7. For abatement or remediation monitoring services: RPF is not responsible for observations and test for specific periods of work that RPF did not perform full shift monitoring of construction, abatement or remediation activity. In the event that problems occurred or concerns arise regarding contamination, safety or health hazards during periods RPF was not onsite, RPF is not responsible to provide documentation or assurances regarding conditions, safety, air testing results and other compliance issues. RPF may have provided recommendations to the Client, as needed, pertaining to the Client’s Contractor compliance with the technical specifications, schedules, and other project related issues as agreed and based on results of RPF monitoring work. However, actual enforcement, or waiving of, contract provisions and requirements as well as regulatory liabilities shall be the responsibility of Client and Client’s Contractor(s). Off-site abatement activities, such as waste transportation and disposal, were not monitored or inspected by RPF.

8. For services limited to clearance testing following abatement or remediation work by other parties: The testing was limited to clearance testing only and as indicated in the report and a site assessment for possible environmental health and safety hazards was not performed as part of the scope of this testing.
Client, or Client's abatement contractor as applicable, was responsible for performing visual inspections of the work area to determine completeness of work prior to air clearance testing by RPF.

9. For site work, including but not limited to air clearance testing services, in which RPF did not provide full site safety and health oversight, abatement design, full shift monitoring of all site activity, RPF expresses no warranties, guarantees or certifications of the abatement work conducted by the Client or other employers at the job site(s), conditions during the work, or regulatory compliance, with the exception of the specific airborne concentrations as indicated by the air clearance test performed by RPF during the conditions present for the clearance testing. Unless otherwise specifically noted in the RPF Report, visual inspections and air clearance testing results apply only to the specific work area and conditions present during the testing. RPF did not perform visual inspections of surfaces not accessible in the work area due to the presence of containment barriers or other obstructions. In these instances, some contamination may be present following RPF clearance testing and such contamination may be exposed during and after removal of the containment barriers or other obstructions following RPF testing services. Client or Client's Contractor is responsible for using appropriate care and inspection to identify potential hazards and to remediate such hazards as necessary to ensure compliance and a safe environment.

10. The survey was limited to the material and/or areas as specifically designated in the report and a site assessment for other possible environmental health and safety hazards or subsurface pollution was not performed as part of the scope of this site inspection. Typically, hazardous building materials such as asbestos, lead paint, PCBs, mercury, refrigerants, hydraulic fluids and other hazardous product and materials may be present in buildings. The survey performed by RPF only addresses the specific items as indicated in the Report.

11. For mold and moisture survey services, RPF services did not include design or remediation of moisture intrusion. Some level of mold will remain at the site regardless of RPF testing and Contractor or Client cleaning efforts. RPF testing associated with mold remediation and assessments is limited and may or may not be representative of other surfaces and locations at the site. Mold growth will occur if moisture intrusion deficiencies have not been fully remedied and if the site or work areas are not maintained in a sufficiently dry state. Porous surfaces in mold contaminated areas which are not removed and disposed of will likely result in future spore release, allergen sources, or mold contamination.

12. Existing reports, drawings, and analytical results provided by the Client to RPF, as applicable, were not verified and, as such, RPF has relied upon the data provided as indicated, and has not conducted an independent evaluation of the reliability of these data.

13. Where sample analyses were conducted by an outside laboratory, RPF has relied upon the data provided, and has not conducted an independent evaluation of the reliability of this data.

14. All hazard communication and notification requirements, as required by U.S. OSHA regulation 29 CFR Part 1926, 29 CFR Part 1910, and other applicable rules and regulations, by and between the Client, general contractors, subcontractors, building occupants, employees and other affected persons were the responsibility of the Client and are not part of the RPF SOW.

15. The applicability of the observations and recommendations presented in this report to other portions of the site was not determined. Many accidents, injuries and exposures and environmental conditions are a result of individual employee/employer actions and behaviors, which will vary from day to day, and with operations being conducted. Changes to the site and work conditions that occur subsequent to the RPF inspection may result in conditions which differ from those present during the survey and presented in the findings of the report.
Sealed Proposals must be completed in both words and figures on forms furnished by the College, or on previously approved, substantially identical forms generated by computer software, in envelopes plainly marked Proposal for: Knox Building Window Wall and HVAC Renovations Project # MC 11-03 addressed to:

Sarah Diversi, Chief Financial Officer
Manchester Community College
1066 Front Street
Manchester, NH 03102

Proposals will be received until 2:00 p.m. April 11, 2013.

The College System reserves the right to waive all formalities and reject any and all proposals or to accept any proposal.

The successful bidder will be required to furnish a 100% Performance Bond and 100% Payment Bond to cover the execution of the contract which shall be in conformity with the form of Bonds contained in Sections A312-2010 Performance and Payment Bonds of the project manual and shall be for the contract amount.

Companies, corporations or trade names, except sole proprietorships must be registered with the Secretary of State (Corporate Division, telephone number 603-271-3244) in order to do business with the State of New Hampshire.

The successful bidder will be required to comply with State of New Hampshire RSA # 21-1:81-a. (Att.)

The work includes replacement of an existing heating/ventilating system with a new system, new electrical upgrades to meet new mechanical system demands, replacement of an existing window wall exterior with new insulated wall system and aluminum windows. Estimated cost of work to be approximately $1,030,000.00.

Plans and Specifications will be available on the Community College System of New Hampshire website www.ccsnh.edu and at the following printers:

- Signature Press and Blueprinting, Inc. 45 Londonderry Turnpike, Rte. 28 Bypass, Hooksett, NH 03106.
- Reed Construction Data, 30 Technology Parkway South, Suite 100, Norcross, GA 30092
- Construction Summary of New Hampshire, Inc. 734 Chestnut Street, Manchester, NH 03104
- Infinite Imaging: 933 Islington Street, Portsmouth, NH 03801
- McGraw-Hill Construction, Dodge Plan Room: 880 Second Street, Manchester, NH 03102
- Minuteman Press: 109 Gosling Road, Newington, NH 03801
- Works in Progress: 20 Farrell Street, Suite 103, South Burlington, VT 05403

Pre-bid walk-through meetings are scheduled at the College, 1066 Front Street, Manchester, NH 03102 at 10:00 A.M. on Tuesday, March 26, 2013 and Wednesday, March 27, 2013. Attendance at one of the walkthroughs by a bidder or qualified representative is Mandatory and a sign-in sheet will be provided. Copies of plans and specifications will be available for viewing at the pre-bid meeting. Acquiring or reviewing plans and specifications prior to the meeting is advised.

Award:

Qualifications to perform the work: Bidders must show three recent years’ experience with installations of a similar complexity and cost and prior experience with installations of the materials within 50 miles of the project site.
Community College System of New Hampshire reserves the right to request a criminal background check on any employee of Contractor. The College, also in its discretion, may decide that anyone with a criminal history, other than traffic violations that have not been annulled, will not be allowed to work at the project site. Manchester Community College reserves the right to accept or reject any or all of the proposals.

The award will be based on the proposal that best meets the needs of the College. Factors included will be the cost, completeness of the proposal, quality of the technology provided, and experience of the contractor and installation team.

<table>
<thead>
<tr>
<th>Category</th>
<th>Possible Points*</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Cost of Base Proposal</td>
<td>40</td>
</tr>
<tr>
<td>2. Quality of the related projects/areas of expertise/experience</td>
<td>30</td>
</tr>
<tr>
<td>3. Quality of description of the firm’s construction approach</td>
<td>10</td>
</tr>
<tr>
<td>4. Response time to Construction and Warranty issues</td>
<td>20</td>
</tr>
</tbody>
</table>

Grand Total 100*

*Maximum points for the best and so forth. Difference between scores is based on how close they are to one another.

The College reserves the right to waive any and all informalities in its best interest.

The Community College System in all its activities subscribes and adheres to the provisions of the Civil Rights Act of 1964 as amended to date. General contractors, subcontractors, and product suppliers bidding on this project must subscribe and adhere to same. There shall be no discrimination in employment because of race, national origin, religion, immigration status, handicapped status, age, veteran's status, or sex, including transgender status or gender expression.

BIDDERS SHOULD ACT PROMPTLY AND SUBMIT ALL QUESTIONS IN WRITING TO MATTHEW MOORE, P.E., FAX 603-230-3598, E-MAIL memoore@ccsnh.edu (Tel. 603-230-3565) IN ACCORDANCE WITH “EXPLANATION TO BIDDERS” – INSTRUCTIONS TO BIDDERS, DOCUMENT 00204 – PART 7.

Manchester Community College
Matthew Moore, P.E., Director of Capitol Planning & Projects, Community College System of New Hampshire.
SECTION 002113 - INSTRUCTIONS TO BIDDERS

1. RECEIPT AND OPENING OF BIDS

See Section 001113 Invitation to Bid.

Bids for
Knox Building Window Wall and HVAC Renovations Project # MC 11-03
Manchester Community College
will be received by:

    Sarah Diversi, Chief Financial Officer
    Manchester Community College
    1066 Front Street
    Manchester, NH 03102

Proposals will be received until 2:00 p.m. April 11, 2013. Bids will be opened in private.

The Owner may consider informal any bid not prepared and submitted in accordance with the provisions hereof, and may waive any informalities in, or reject, any and all bids. Any bid may be withdrawn prior to the above scheduled time for the opening of bids or authorized postponement thereof. Any bid received after the time and date specified shall not be considered. No bidder may withdraw a bid within 60 days after the actual date of the opening thereof. Conditional Bids will not be accepted.

2. PREPARATION OF BID

Bids shall be submitted on the prescribed form. All blank spaces for bid prices must be filled in, in ink, in both words and figures with the unit price for the item or the lump sum for which the bid is made.

All bids must be submitted in sealed envelopes, bearing on the outside the name of the bidder, bidder’s address, and the name of the project for which the bid is submitted. If forwarded by mail, the sealed envelope, containing the proposal and marked as directed above, must be enclosed in another envelope addressed as specified, preferably by registered mail.

3. CONDITIONS OF WORK

Each bidder must inform themselves fully of the conditions relating to the construction and labor under which the work is now being or will be performed. Failure to do so will not relieve a successful bidder of his obligation to furnish all material and labor necessary to carry out the provisions of the Contract Documents and to complete the contemplated work for the consideration set forth in his bid. Insofar as possible, the Contractor, in the carrying out of his work, must employ such methods or means as will not cause any interruption of, or interference with, the work of any other Contractor, or with the Owner's operations.

Pre-bid walk-through meetings are scheduled at the College, 1066 Front Street, Manchester, NH 03102 at 10:00 A.M. on Tuesday, March 26, 2013 and Wednesday, March 27, 2013. Attendance at one of the walk-throughs by a bidder or qualified representative is Mandatory and a sign-in sheet will be provided.
Copies of plans and specifications will be available for viewing at the pre-bid meeting. Acquiring or reviewing plans and specifications prior to the meeting is advised.

4. ADDENDA AND INTERPRETATIONS

No interpretation of the meaning of the Plans, Specifications or other Contract Documents will be made to any bidder orally. Every request for such interpretation should be in writing, addressed to CCSNH to the attention of Matthew Moore, P.E., FAX 603-230-3598, E-MAIL memoore@ccsnh.edu (Tel. 603-230-3565), and to be given consideration, must be received at least 4 days prior to the date fixed for the opening of bids. Substitution requests must be received at least seven days prior to the date fixed for the opening of bids. Any and all such interpretations and any supplemental instructions will be in the form of written addenda. Bidders are responsible for verification of addenda before submitting their bid. Failure of any bidder to receive any such addenda or interpretation shall not relieve any bidder from any obligation under his bid as submitted. All addenda so issued shall become part of the Contract Documents.

5. AWARD OR REJECTION OF BIDS

The Owner reserves the right to reject any and all bids, and to waive any informality in bids received, whenever such rejection or waiver is in the interest of the Owner. Owner reserves the right to select any of the submitted bids. Owner will have no restrictions on selection.

6. OBLIGATION OF BIDDERS

At the time of the opening of bids, each bidder will be presumed to have inspected the site and to have read and to be thoroughly familiar with the Contract Documents (including all addenda). The failure or omission of any bidder to receive or examine any form, instrument or document, shall in no way relieve any bidder from any obligation in respect to his bid. The bidder is also assumed to have reviewed the various installation requirements.

7. SUBSTITUTIONS

(a) The bid shall be based on the materials or products as specified. Whenever in the Specifications a particular article is specified by proprietary name, the bidder shall base the bid on same.

(b) For an item to be considered as an approved equal where allowed, the request shall be made in writing, received at least 7 days prior to the bid date, with a complete submittal for the proposed item, and the identification of the item and specification section. All approvals will be issued as addenda. See Section 016000 for additional requirements.

8. DAYS AND HOURS OF WORK

The Contractor shall make such arrangements with his employees as not to conflict with the Wage and House Laws of the State and the United States of America. Be it further understood that, if in the opinion of the Owner and Architect, the Work is not progressing fast enough to insure completion by the date set, the Contractor will be required to work such additional shifts and overtime as, in the opinion of the Owner and the Architect, is necessary to complete the Work on the required date without extra cost to the Owner.
9. TIME OF COMPLETION

The Contractor shall prosecute the Work continuously until completion. The rate of progress shall be at least that shown on the "Schedule of Progress" which is to be submitted by the Contractor in a form satisfactory to the Architect and Owner.

10. TAXES

New Hampshire State and Use Taxes should not be included in your bid as the Owner is exempt from payment of such taxes. Upon request, the tax-exempt number will be furnished.

END OF SECTION 002113
PROPOSAL FORM FOR GENERAL CONTRACTOR

BIDDER

TO: Sarah Diversi  
Chief Financial Officer  
Manchester Community College  
1066 Front Street  
Manchester, NH 03102

No Later than: 2:00 P.M. April 11, 2013.

A. Having carefully examined the Form of Contract, General Conditions, Plans and Specifications dated February 14, 2013,

Prepared by: Harriman

For: Manchester Community College – Knox Building Window Wall and HVAC  
Manchester, NH

as well as the premises and conditions affecting the work, we, the undersigned, propose to furnish all labor, equipment and materials necessary for, and reasonably incidental to the construction and completion of this Project for:

$_______________________________________

Allowance, (30,000 dollars) ADD $ 30,000.00

Lump Sum Grand Total $_______________________________________

Lump Sum Grand Total in Words ______________________________________

Alternate

Please indicate the cost difference to provide HVAC systems with changes described under “Option 2” in the Plans and Specifications. Please indicate if this Alternate price is to be ADDED or DEDUCTED to/from the Base Bid listed above.

$__________________________ ADDED

$__________________________ DEDUCTED

Line Item Pricing – Please indicate the dollar value of each of these items in the line provided below:

Item No. 1 – Third Floor Corridor Windows $___________________________

Item No. 2 – Second Floor South East Office Window $_________________________

Item No. 3 – Controls for existing Third Floor fin tube radiation $_______________________
B. This proposal includes the following addenda to the Drawings and Specifications:

Addendum No.______, Dated______  Addendum No.______, Dated______
Addendum No.______, Dated______  Addendum No.______, Dated______

C. The undersigned agrees, if this Bid is accepted, to sign a Contract and deliver it, along with the bonds and affidavits of all insurance specified within twelve (12) calendar days after the date of notification of such acceptance, except if the 12th day falls on a holiday, a Saturday or Sunday, before 12 o'clock noon on the day following the holiday, or the Monday following the Saturday or Sunday, and as a guarantee thereof, herewith submits a certified or cashier's check or bid bond as required.

The undersigned agrees, if awarded the Contract, to substantially complete the work ready for occupancy in accordance with Section 011000.

This Proposal includes the cost of 100% Performance and Payment Bond.

Signed ____________________________

By ____________________________
Address ____________________________
____________________________
____________________________

NOTE: If bidder is a corporation, write State of Incorporation, and if a partnership, give full names of all partners.
Standard Form of Agreement Between Owner and Contractor where the basis of payment is a Stipulated Sum

AGREEMENT made as of the day of in the year
(In words, indicate day, month and year.)

BETWEEN the Owner:
(Name, legal status, address and other information)

Manchester Community College
1066 Front Street
Manchester, NH 03102

and the Contractor:
(Name, legal status, address and other information)

for the following Project:
(Name, location and detailed description)

Manchester Community College
Knox Building Window Wall and HVAC
Manchester, NH

The Architect:
(Name, legal status, address and other information)

Harriman
One Perimeter Road
Manchester, NH 03103

The Owner and Contractor agree as follows.
TABLE OF ARTICLES

1 THE CONTRACT DOCUMENTS
2 THE WORK OF THIS CONTRACT
3 DATE OF COMMENCEMENT AND SUBSTANTIAL COMPLETION
4 CONTRACT SUM
5 PAYMENTS
6 DISPUTE RESOLUTION
7 TERMINATION OR SUSPENSION
8 MISCELLANEOUS PROVISIONS
9 ENUMERATION OF CONTRACT DOCUMENTS
10 INSURANCE AND BONDS

ARTICLE 1 THE CONTRACT DOCUMENTS
The Contract Documents consist of this Agreement, Conditions of the Contract (General, Supplementary and other Conditions), Drawings, Specifications, Addenda issued prior to execution of this Agreement, other documents listed in this Agreement and Modifications issued after execution of this Agreement, all of which form the Contract, and are as fully a part of the Contract as if attached to this Agreement or repeated herein. The Contract represents the entire and integrated agreement between the parties hereto and supersedes prior negotiations, representations or agreements, either written or oral. An enumeration of the Contract Documents, other than a Modification, appears in Article 9. A list of Contract Documents is set forth in Exhibit A hereto.

ARTICLE 2 THE WORK OF THIS CONTRACT
§ 2.1 The Contractor shall fully execute the Work described in the Contract Documents or reasonably inferable from the Contract Documents as necessary to produce the intended results, except as specifically indicated in the Contract Documents to be the responsibility of others.

§ 2.2 The Contractor’s project team ("Project Team") will consist of a Project Executive, a Project Manager, and a Superintendent. The Project Team shall be initially as set forth below and the Contractor shall provide the Owner with written notice of the names and qualifications of the Project Manager and Superintendent at least 10 days prior to the Date of Commencement.

Project Executive:
Project Manager:
Superintendent:

2.2.1 The Contractor acknowledges that, in entering into this Agreement, the Owner is relying upon the fact that each of the members of the Project Team will continue to perform his or her services throughout the entirety of the performance of the Work. No change will be made in the membership of the Project Team without the Owner’s prior written approval, which approval shall not be withheld on an arbitrary basis; the Owner may require the replacement of any member of the Project Team for reasonable cause specified in writing, upon notice to the Contractor.

2.2.2 The Contractor will maintain a competent full-time staff (including, without limitation, the Superintendent, a Project Manager, and/or an Assistant Superintendent, if necessary) at the Project Site to coordinate and provide general direction of the Work and the progress of the Subcontractors on the Project. The Project...
Manager may, at the election of the Owner, be based at the Site or the Contractor’s home office, provided that the Project Manager spends all time necessary for the proper administration of the Project.

2.2.3 The Contractor shall submit to the Owner, for the Owner’s approval, prior to the start of Work on the Project, a job organization chart that includes all personnel to be employed on the Work.

2.2.4 The Contractor shall be represented by ________, the Owner shall be represented by ________, and the Architect shall be represented by David Rienstra at all Project meetings as called by the Architect or the Owner. Each such project representative shall have full authority to make all decisions and to bind the Contractor, the Owner and the Architect respectively, in all matters relating to this Agreement and the Project. The Owner, the Contractor and the Architect shall each have the right to designate an alternate representative upon written notice to the other parties, which alternate representative shall have the same authority as the representative named in this Section 3.2.4.

2.2.5 All labor employed by the Contractor to perform Work on the Site shall cooperate with all other separate contractors, subcontractors, and suppliers performing work on the Site, no matter by whom employed, in furtherance of the Owner’s interests.

ARTICLE 3 DATE OF COMMENCEMENT AND SUBSTANTIAL COMPLETION

§ 3.1 The date of commencement of the Work shall be the date of this Agreement unless a different date is stated below or provision is made for the date to be fixed in a notice to proceed issued by the Owner. If the Notice to Proceed is a Partial Notice to Proceed, it shall define the particular work to be commenced, the limitations upon the work to be done, and shall state the maximum amount (including allocable portion of the Contractor’s Fee) which the Contractor shall be entitled to be paid for such work. The Owner shall not be obligated to pay for any work done or to pay any amount in excess of the limitation stated in a partial Notice to Proceed.

(Insert the date of commencement if it differs from the date of this Agreement or, if applicable, state that the date will be fixed in a notice to proceed.)

If, prior to the commencement of the Work, the Owner requires time to file mortgages and other security interests, the Owner’s time requirement shall be as follows:

§ 3.2 The Contract Time shall be measured from the date of commencement.

§ 3.3 The Contractor shall perform in accordance with the Schedule attached hereto as Exhibit B and shall achieve Substantial Completion of the entire Work not later than August 30, 2013 (____) days from the date of commencement, or as follows:

(Insert number of calendar days. Alternatively, a calendar date may be used when coordinated with the date of commencement. If appropriate, insert requirements for earlier Substantial Completion of certain portions of the Work.)

<table>
<thead>
<tr>
<th>Portion of Work</th>
<th>Substantial Completion Date</th>
</tr>
</thead>
</table>

, subject to adjustments of this Contract Time as provided in the Contract Documents.

(Paragraph deleted)

§ 3.4 Liquidated Damages
If the Contractor fails to achieve Substantial Completion on the Substantial Completion Date, as that date may be modified in accordance with the Contract, the Design-Build shall pay to the Owner, or the Owner may withhold amounts otherwise due, liquidated damages in the amount of nine hundred thirty-three dollars ($933.00) per day for...
each day after the Substantial Completion Date the Contractor fails to achieve Substantial Completion of the Work. 
The Contractor acknowledges that the liquidated damages provided by this paragraph are reasonable and not a penalty. The Contractor shall achieve Final Completion within thirty (30) days after Substantial Completion. In the event that the Contractor, without excuse, fails to achieve Final Completion within thirty (30) days after Substantial Completion, the Contractor shall be liable to the Owner for actual damages, if any, incurred by the Owner.

ARTICLE 4 CONTRACT SUM
§ 4.1 The Owner shall pay the Contractor the Contract Sum in current funds for the Contractor’s performance of the Contract. The Contract Sum shall be ($ ), subject to additions and deductions as provided in the Contract Documents.

§ 4.2 The Contract Sum is based upon the following alternates, if any, which are described in the Contract Documents and are hereby accepted by the Owner:
(State the numbers or other identification of accepted alternates. If the bidding or proposal documents permit the Owner to accept other alternates subsequent to the execution of this Agreement, attach a schedule of such other alternates showing the amount for each and the date when that amount expires.)

§ 4.3 Unit prices, if any:
(Identify and state the unit price, state quantity limitations, if any, to which the unit price will be applicable.)

<table>
<thead>
<tr>
<th>Item</th>
<th>Units and Limitations</th>
<th>Price Per Unit ($0.00)</th>
</tr>
</thead>
</table>

§ 4.4 Allowances included in the Contract Sum, if any:
(Identify allowance and state exclusions, if any, from the allowance price.)

<table>
<thead>
<tr>
<th>Item</th>
<th>Price</th>
</tr>
</thead>
</table>

§ 4.5 The Contract Sum is based upon the Schedule of Values set forth as Exhibit C and the Qualifications and Assumptions set forth as Exhibit D.

ARTICLE 5 PAYMENTS
§ 5.1 PROGRESS PAYMENTS
§ 5.1.1 Based upon Applications for Payment submitted to the Architect by the Contractor and Certificates for Payment issued by the Architect, the Owner shall make progress payments on account of the Contract Sum to the Contractor as provided below and elsewhere in the Contract Documents.

§ 5.1.2 The period covered by each Application for Payment shall be one calendar month ending on the last day of the month. The Contractor shall, not less than five (5) business days prior to the end of each month, submit to the Owner and the Architect, a Pencil Application for Payment which projects work to be completed and paid for through the end of the month for review by Owner and Architect and the parties shall meet by the end of the month to review jointly. By the fifth day of the next month, the Contractor shall submit an Application for Payment,

§ 5.1.3 Provided that an Application for Payment is received by the Architect not later than the 5th day of a month, the Owner shall make payment of the certified amount to the Contractor not later than the 5th day of the next month. If an Application for Payment is received by the Architect after the application date fixed above, payment shall be made by the Owner not later than thirty (30) days after the Architect receives the Application for Payment.
(Federal, state or local laws may require payment within a certain period of time.)

§ 5.1.4 Each Application for Payment shall be based on the most recent schedule of values submitted by the Contractor in accordance with the Contract Documents. The schedule of values shall allocate the entire Contract Sum among the various portions of the Work. The schedule of values shall be prepared in such form and supported
by such data to substantiate its accuracy as the Architect may require. This schedule, unless objected to by the Architect, shall be used as a basis for reviewing the Contractor’s Applications for Payment.

§ 5.1.5 Applications for Payment shall show the percentage of completion of each portion of the Work as of the end of the period covered by the Application for Payment.

§ 5.1.6 Subject to other provisions of the Contract Documents, the amount of each progress payment shall be computed as follows:

.1 Take that portion of the Contract Sum properly allocable to completed Work as determined by multiplying the percentage completion of each portion of the Work by the share of the Contract Sum allocated to that portion of the Work in the schedule of values, less retainage of ten percent (10%). Pending final determination of cost to the Owner of changes in the Work, amounts not in dispute shall be included as provided in Section 7.3.9 of AIA Document A201™-2007, General Conditions of the Contract for Construction;

.2 Add that portion of the Contract Sum properly allocable to materials and equipment delivered and suitably stored at the site for subsequent incorporation in the completed construction (or, if approved in advance by the Owner, suitably stored off the site at a location agreed upon in writing), less retainage of ten percent (10%);

.3 Subtract the aggregate of previous payments made by the Owner; and

.4 Subtract amounts, if any, for which the Architect has withheld or nullified a Certificate for Payment as provided in Section 9.5 of AIA Document A201—2007.

§ 5.1.7 The progress payment amount determined in accordance with Section 5.1.6 shall be further modified under the following circumstances:

.1 Add, upon Substantial Completion of the Work, a sum sufficient to increase the total payments to the full amount of the Contract Sum, less such amounts as the Architect shall determine for incomplete Work, retainage applicable to such work and unsettled claims; and (Section 9.8.5 of AIA Document A201—2007 requires release of applicable retainage upon Substantial Completion of Work with consent of surety, if any.)

.2 Add, if final completion of the Work is thereafter materially delayed through no fault of the Contractor, any additional amounts payable in accordance with Section 9.10.3 of AIA Document A201—2007.

§ 5.1.8 Reduction or limitation of retainage, if any, shall be as follows:

(If it is intended, prior to Substantial Completion of the entire Work, to reduce or limit the retainage resulting from the percentages inserted in Sections 5.1.6.1 and 5.1.6.2 above, and this is not explained elsewhere in the Contract Documents, insert here provisions for such reduction or limitation.)

§ 5.1.9 Except with the Owner’s prior approval, the Contractor shall not make advance payments to suppliers for materials or equipment which have not been delivered and stored at the site.

§ 5.1.10 With each Application for Payment, the Contractor shall submit partial releases of lien and acknowledgments of payment executed by Contractor and Subcontractor and suppliers in the form reasonably acceptable to Owner. Each Application for Payment will also include a monthly status report of the progress of the Work. Such monthly status report shall be current through the date of the preceding Application for Payment. In no event shall the monthly status report with respect to an Application for Payment be submitted to the Owner later than the fifth (5th) day of the month next following the month to which such Application for Payment relates. The parties hereby agree that such report is of significant importance to the Owner in determining whether the Contractor is entitled to payment pursuant to such Application for Payment, and failure to deliver such report in its entirety on the date it is due shall be deemed to be just cause for withholding payment. The Owner’s waiver of the requirement of such report (or any portion thereof) in respect of any Application for Payment shall not be deemed to be a waiver of the Owner’s right to require the full status report in respect of any future Application for Payment. This report will include, in addition to the other documentation expressly required elsewhere in the Contract Documents, the following: a narrative description of the work performed; a progress bar chart indicating the precedence of the remaining portions of the Work; progress photographs; a report of all substantive matters (i.e. pending changes); the
number and amount of any Change Orders and a list of key action items which must be addressed by the Owner during the next following thirty (30) day period; a budget comparing: (i) the percentage complete accomplished to date and the balance to be billed per the Schedule of Values, and (ii) the actual time expended in the performance of the Work and the expected dated of completion of the Work; and, any other reports requested by the Owner. All reports shall be in forms reasonably satisfactory to the Owner.

§ 5.2 FINAL PAYMENT
§ 5.2.1 Final payment, constituting the entire unpaid balance of the Contract Sum, shall be made by the Owner to the Contractor when

1. the Contractor has fully performed the Contract except for the Contractor’s responsibility to correct Work as provided in Section 12.2.2 of AIA Document A201–2007, and to satisfy other requirements, if any, which extend beyond final payment; and

2. a final Certificate for Payment has been issued by the Architect.

§ 5.2.2 The Owner’s final payment to the Contractor shall be made no later than 30 days after the issuance of the Architect’s final Certificate for Payment, or as follows:

ARTICLE 6 DISPUTE RESOLUTION
§ 6.1 INITIAL DECISION MAKER
The Architect will serve as Initial Decision Maker pursuant to Section 15.2 of AIA Document A201–2007, unless the parties appoint below another individual, not a party to this Agreement, to serve as Initial Decision Maker.
(If the parties mutually agree, insert the name, address and other contact information of the Initial Decision Maker, if other than the Architect.)

§ 6.2 BINDING DISPUTE RESOLUTION
For any Claim subject to, but not resolved by, mediation pursuant to Section 15.3 of AIA Document A201–2007, the method of binding dispute resolution shall be as follows:
(Check the appropriate box. If the Owner and Contractor do not select a method of binding dispute resolution below, or do not subsequently agree in writing to a binding dispute resolution method other than litigation, Claims will be resolved by litigation in a court of competent jurisdiction.)

[ ] Arbitration pursuant to Section 15.4 of AIA Document A201–2007

[ X ] Litigation in a court of competent jurisdiction

[ ] Other (Specify)

ARTICLE 7 TERMINATION OR SUSPENSION
§ 7.1 The Contract may be terminated by the Owner or the Contractor as provided in Article 14 of AIA Document A201–2007.

§ 7.2 The Work may be suspended by the Owner as provided in Article 14 of AIA Document A201–2007.

ARTICLE 8 MISCELLANEOUS PROVISIONS
§ 8.1 Where reference is made in this Agreement to a provision of AIA Document A201–2007 or another Contract Document, the reference refers to that provision as amended or supplemented by other provisions of the Contract Documents.
§ 8.2 Payments due and unpaid under the Contract shall bear interest from the date payment is due at the rate stated below, or in the absence thereof, at the legal rate prevailing from time to time at the place where the Project is located.

(Insert rate of interest agreed upon, if any.)

Base Rate of the Bank of America or its successor plus one percent per annum

§ 8.3 The Owner’s representative:

(Name, address and other information)

§ 8.4 The Contractor’s representative:

(Name, address and other information)

§ 8.5 Neither the Owner’s nor the Contractor’s representative shall be changed without ten days written notice to the other party.

§ 8.6 Other provisions:

§ 8.6.1 Project Requirements. In addition to the Contractor’s obligations to comply with applicable laws, the Contractor specifically recognizes and agrees that the performance of the Work and the construction of the Project are subject to certain legal restrictions and agreements, as set forth in the agreements listed in Exhibit F attached hereto. The Contractor agrees that, in performing the Work, it shall comply with the agreements and restrictions set forth in the agreements listed on Exhibit F.

§ 8.6.2 Limitation of Owner’s Liability. No trustee, officer, director, beneficiary, trustee, employee, or other principals, agents, or representatives (whether disclosed or undisclosed) of the Owner shall be personally liable to the Contractor hereunder, for the Owner’s payment obligations or otherwise, the Contractor hereby agreeing to look solely to the interest of the Owner in the Project for the satisfaction of any liability of the Owner hereunder.

§ 8.6.3 Owner-furnished equipment. Owner may furnish equipment for installation by Contractor as part of the Work. To the extent the Contract Sum includes installation by Contractor of Owner-furnished equipment, and to the extent allowed by the manufactures of such equipment, Owner shall transfer all warranties on such equipment to Contractor, who shall assume any remaining warranties, provide installation in accordance with manufactures instructions as needed to maintain and protect such warranties, and facilitate warranty service as otherwise provided in the Contract Documents.

§ 8.6.4 Unclassified sitework: Contractor expressly understands and acknowledges that notwithstanding anything else stated in any Contract Document, the site is "unclassified," meaning that Contractor accepts responsibility for the site "as is" and without qualification as to concealed or subsurface conditions or the suitability of material on site for any purpose. Owner makes no representations or warranties with respect to such conditions or suitability. Any studies, tests, maps, boring results, and other geotechnical information or data provided to Contractor is for Contractor's information only and, should actual conditions differ from that stated therein, Contractor shall make no claim for extra compensation required to achieve the results intended by the Contract.
Documents. Contractor shall be responsible for achieving the results intended by the Contract Documents and accepts all risks with respect to actual conditions and quantities (subject to any provisions regarding unit prices stated herein). Contractor represents and warrants that it has investigated the site and performed sufficient due diligence to accept the risks inherent in this method of project delivery.

§ 8.8.5 If the Contractor commences the services prior to the Effective Date, all Services performed by the Contractor prior to the Effective Date shall be performed at the sole risk of the Contractor, and in the event that this Agreement does not become effective, the Owner shall have no liability to the Contractor.

§ 8.7 COMPLIANCE WITH LAWS
§ 8.7.1 In connection with the performance of the Services, the Contractor shall comply with all statutes, laws, regulations, and orders of federal, state, county or municipal authorities which impose any obligation or duty upon the Contractor, including, but not limited to, civil rights and equal opportunity laws. In addition, the Contractor shall comply with all applicable copyright laws.

§ 8.7.2 During the term of this Agreement, the Contractor shall not discriminate against employees or applicants for employment because of race, color, religion, creed, age, sex, handicap, sexual orientation, or national origin and will take affirmative action to prevent such discrimination.

§ 8.7.3 If this Agreement is funded in any part by monies of the United States, the Contractor shall comply with all the provisions of Executive Order No. 11246 ("Equal Employment Opportunity"), as supplemented by the regulations of the United States Department of Labor (41 C.F.R. Part 60), and with any rule, regulation, and guidelines as the State of New Hampshire or the United States issue to implement these regulations. The Contractor further agrees to permit the State or United States access to any of the Contractor's books, records, and accounts for the purpose of ascertaining compliance with all rules, regulations, and orders, and the covenant, terms, and conditions of this Agreement.

§ 8.8 BACKGROUND CHECKS
§ 8.8.1 The Owner reserves the right to require the Contractor to conduct background checks of any and all persons employed or controlled by the Contractor or any or its subcontractors or subconsultants, at any time, for any reason. If so request, the Contractor shall complete the requested background check to the Owner's satisfaction within a reasonable time period prescribed by the Owner.

§ 8.9 DATA/CONFIDENTIALITY
§ 8.9.1 Confidentiality of data shall be governed by NH RSA 91-A or other existing law. Disclosure of data requires prior written approval of the Owner.

§ 8.11 THIRD PARTIES
§ 8.11.1 The Parties hereto do not intend to benefit any third party and this Agreement shall not be construed to confer any such benefit.

ARTICLE 9 ENUMERATION OF CONTRACT DOCUMENTS
§ 9.1 The Contract Documents, except for Modifications issued after execution of this Agreement, are enumerated in the sections below.

§ 9.1.1 The Agreement is this executed AIA Document A101—2007, Standard Form of Agreement Between Owner and Contractor.

§ 9.1.2 The General Conditions are AIA Document A201—2007, General Conditions of the Contract for Construction.

§ 9.1.3 The Supplementary and other Conditions of the Contract:

<table>
<thead>
<tr>
<th>Document</th>
<th>Title</th>
<th>Date</th>
<th>Pages</th>
</tr>
</thead>
</table>

§ 9.1.4 The Specifications:

Init. / I

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User Notes: (1264930809)
(Either list the Specifications here or refer to an exhibit attached to this Agreement.)
See Exhibit A

<table>
<thead>
<tr>
<th>Section</th>
<th>Title</th>
<th>Date</th>
<th>Pages</th>
</tr>
</thead>
</table>

§ 9.1.5 The Drawings:
(Either list the Drawings here or refer to an exhibit attached to this Agreement.)
See Exhibit A

<table>
<thead>
<tr>
<th>Number</th>
<th>Title</th>
<th>Date</th>
<th>Pages</th>
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</table>

§ 9.1.6 The Addenda, if any:

<table>
<thead>
<tr>
<th>Number</th>
<th>Date</th>
<th>Pages</th>
</tr>
</thead>
</table>

 Portions of Addenda relating to bidding requirements are not part of the Contract Documents unless the bidding requirements are also enumerated in this Article 9.

§ 9.1.7 Additional documents, if any, forming part of the Contract Documents:

.1 AIA Document E201™–2007, Digital Data Protocol Exhibit, if completed by the parties, or the following:

.2 Other documents, if any, listed below:
(List here any additional documents that are intended to form part of the Contract Documents. AIA Document A201–2007 provides that bidding requirements such as advertisement or invitation to bid, instructions to Bidders, sample forms and the Contractor's bid are not part of the Contract Documents unless enumerated in this Agreement. They should be listed here only if intended to be part of the Contract Documents.)

The following exhibits are attached and incorporated by reference:

Exhibit A—List of Contract Documents dated __________
Exhibit B—Project Schedule dated __________
Exhibit C—Schedule of Values dated __________
Exhibit D—Contractor’s Qualifications and Assumptions dated __________
Exhibit E—List of Required Subcontract Provisions
Exhibit F—Project Requirements dated __________
Exhibit G—General Conditions AIA A201-2007

ARTICLE 10 INSURANCE AND BONDS
The Contractor shall purchase and maintain insurance and provide bonds as set forth in Article 11 of AIA Document A201–2007.
(State bonding requirements, if any, and limits of liability for insurance required in Article 11 of AIA Document A201–2007.)

<table>
<thead>
<tr>
<th>Type of insurance or bond</th>
<th>Limit of liability or bond amount ($0.00)</th>
</tr>
</thead>
</table>

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User Notes: 

(1264938808)
This Agreement entered into as of the day and year first written above.

<table>
<thead>
<tr>
<th>OWNER (Signature)</th>
<th>CONTRACTOR (Signature)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Printed name and title)</td>
<td>(Printed name and title)</td>
</tr>
</tbody>
</table>
Additions and Deletions Report for
AIA® Document A101™ – 2007

This Additions and Deletions Report, as defined on page 1 of the associated document, reproduces below all text the author has added to the standard form AIA document in order to complete it, as well as any text the author may have added to or deleted from the original AIA text. Added text is shown underlined. Deleted text is indicated with a horizontal line through the original AIA text.

Note: This Additions and Deletions Report is provided for information purposes only and is not incorporated into or constitute any part of the associated AIA document. This Additions and Deletions Report and its associated document were generated simultaneously by AIA software at 09:11:50 on 03/13/2013.

PAGE 1

Manchester Community College
1066 Front Street
Manchester, NH 03102

Manchester Community College
Knox Building Window Wall and HVAC
Manchester, NH

Harriman
One Perimeter Road
Manchester, NH 03103

PAGE 2

The Contract Documents consist of this Agreement, Conditions of the Contract (General, Supplementary and other Conditions), Drawings, Specifications, Addenda issued prior to execution of this Agreement, other documents listed in this Agreement and Modifications issued after execution of this Agreement, all of which form the Contract, and are as fully a part of the Contract as if attached to this Agreement or repeated herein. The Contract represents the entire and integrated agreement between the parties hereto and supersedes prior negotiations, representations or agreements, either written or oral. An enumeration of the Contract Documents, other than a Modification, appears in Article 9. A list of Contract Documents is set forth in Exhibit A hereeto.

The Contractor shall fully execute the Work described in the Contract Documents, except as specifically indicated in the Contract Documents to be the responsibility of others. § 2.1 The Contractor shall fully execute the Work described in the Contract Documents or reasonably inferable from the Contract Documents as necessary to produce the intended results, except as specifically indicated in the Contract Documents to be the responsibility of others.

§ 2.2 The Contractor’s project team ("Project Team") will consist of a Project Executive, a Project Manager, and a Superintendent. The Project Team shall be initially set forth below and the Contractor shall provide the Owner with written notice of the names and qualifications of the Project Manager and Superintendent at least 10 days prior to the Date of Commencement.

__________
Project Executive:

__________
Project Manager:

__________
Superintendent:
2.2.1 The Contractor acknowledges that, in entering into this Agreement, the Owner is relying upon the fact that each of the members of the Project Team will continue to perform his or her services throughout the entirety of the performance of the Work. No change will be made in the membership of the Project Team without the Owner’s prior written approval, which approval shall not be withheld on an arbitrary basis; the Owner may require the replacement of any member of the Project Team for reasonable cause specified in writing, upon notice to the Contractor.

2.2.2 The Contractor will maintain a competent full-time staff (including, without limitation, the Superintendent, a Project Manager, and/or an Assistant Superintendent, if necessary) at the Project Site to coordinate and provide general direction of the Work and the progress of the Subcontractors on the Project. The Project Manager may, at the election of the Owner, be based at the Site or the Contractor’s home office, provided that the Project Manager spends all time necessary for the proper administration of the Project.

2.2.3 The Contractor shall submit to the Owner, for the Owner’s approval, prior to the start of Work on the Project, a job organization chart that includes all personnel to be employed on the Work.

2.2.4 The Contractor shall be represented by and the Owner shall be represented by and the Architect shall be represented by David Rienstra at all Project meetings as called by the Architect or the Owner. Each such project representative shall have full authority to make all decisions and to bind the Contractor, the Owner and the Architect respectively, in all matters relating to this Agreement and the Project. The Owner, the Contractor and the Architect shall each have the right to designate an alternate representative upon written notice to the other parties, which alternate representative shall have the same authority as the representative named in this Section 3.2.4.

2.2.5 All labor employed by the Contractor to perform Work on the Site shall cooperate with all other separate contractors, subcontractors, and suppliers performing work on the Site, no matter by whom employed, in furtherance of the Owner’s interests.

PAGE 3

§ 3.1 The date of commencement of the Work shall be the date of this Agreement unless a different date is stated below or provision is made for the date to be fixed in a notice to proceed issued by the Owner. If the Notice to Proceed is a Partial Notice to Proceed, it shall define the particular work to be commenced, the limitations upon the work to be done, and shall state the maximum amount (including allocable portion of the Contractor’s Fee) which the Contractor shall be entitled to be paid for such work. The Owner shall not be obligated to pay for any work done or to pay any amount in excess of the limitation stated in a partial Notice to Proceed.

... 

§ 3.3 The Contractor shall perform in accordance with the Schedule attached hereto as Exhibit B and shall achieve Substantial Completion of the entire Work not later than August 30, 2013 ( ) days from the date of commencement, or as follows:

... 

(Amount provisions, if any, for liquidated damages relating to failure to achieve Substantial Completion on time or for bonus payments for early completion of the Work)

§ 3.4 Liquidated Damages

If the Contractor fails to achieve Substantial Completion on the Substantial Completion Date, as that date may be modified in accordance with the Contract, the Design-Builder shall pay to the Owner, or the Owner may withhold amounts otherwise due, liquidated damages in the amount of nine hundred thirty-three dollars ($933.00) per day for each day after the Substantial Completion Date the Contractor fails to achieve Substantial Completion of the Work. The Contractor acknowledges that the liquidated damages provided by this paragraph are reasonable and not a penalty. The Contractor shall achieve Final Completion within thirty (30) days after Substantial Completion. In the


User Notes:
event that the Contractor, without excuse, fails to achieve Final Completion within thirty (30) days after Substantial Completion, the Contractor shall be liable to the Owner for actual damages, if any, incurred by the Owner.

SECTION 4.5 The Contract Sum is based upon the Schedule of Values set forth as Exhibit C and the Qualifications and Assumptions set forth as Exhibit D.

...§ 5.1.2 The period covered by each Application for Payment shall be one calendar month ending on the last day of the month, or as follows:

month. The Contractor shall, not less than five (5) business days prior to the end of each month, submit to the Owner and the Architect, a Pencil Application for Payment which projects work to be completed and paid for through the end of the month for review by Owner and Architect and the parties shall meet by the end of the month to review jointly. By the fifth day of the next month, the Contractor shall submit an Application for Payment.

§ 5.1.3 Provided that an Application for Payment is received by the Architect not later than the 5th day of a month, the Owner shall make payment of the certified amount to the Contractor not later than the 5th day of the next month. If an Application for Payment is received by the Architect after the application date fixed above, payment shall be made by the Owner not later than thirty (30) days after the Architect receives the Application for Payment.

PAGE 5

.1. Take that portion of the Contract Sum properly allocable to completed Work as determined by multiplying the percentage completion of each portion of the Work by the share of the Contract Sum allocated to that portion of the Work in the schedule of values, less retainage of ten percent (10%). Pending final determination of cost to the Owner of changes in the Work, amounts not in dispute shall be included as provided in Section 7.3.9 of AIA Document A201™-2007, General Conditions of the Contract for Construction;

.2. Add that portion of the Contract Sum properly allocable to materials and equipment delivered and suitably stored at the site for subsequent incorporation in the completed construction (or, if approved in advance by the Owner, suitably stored off the site at a location agreed upon in writing), less retainage of ten percent (10%);

...§ 5.1.10 With each Application for Payment, the Contractor shall submit partial releases of lien and acknowledgements of payment executed by Contractor and Subcontractor and suppliers in the form reasonably acceptable to Owner. Each Application for Payment will also include a monthly status report of the progress of the Work. Such monthly status report shall be current through the date of the preceding Application for Payment. In no event shall the monthly status report with respect to an Application for Payment be submitted to the Owner later than the fifth (5th) day of the month next following the month to which such Application for Payment relates. The parties hereby agree that such report is of significant importance to the Owner in determining whether the Contractor is entitled to payment pursuant to such Application for Payment, and failure to deliver such report in its entirety on the date it is due shall be deemed to be just cause for withholding payment. The Owner’s waiver of the requirement of such report (or any portion thereof) in respect of any Application for Payment shall not be deemed to be a waiver of the Owner’s right to require the full status report in respect of any future Application for Payment. This report will include, in addition to the other documentation expressly required elsewhere in the Contract Documents, the following: a narrative description of the work performed; a progress bar chart indicating the precedence of the remaining portions of the Work; progress photographs; a report of all substantive matters (i.e., pending changes); the number and amount of any Change Orders and a list of key action items which must be addressed by the Owner during the next following thirty (30) day period; a budget comparing: (i) the percentage complete accomplished to date and the balance to be billed per the Schedule of Values, and (ii) the actual time expended in the performance of

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User Notes:
(1264936800)
the Work and the expected date of completion of the Work; and, any other reports requested by the Owner. All reports shall be in forms reasonably satisfactory to the Owner.

PAGE 6

[ ] Litigation in a court of competent jurisdiction

PAGE 7

%—Base Rate of the Bank of America or its successor plus one percent per annum

§8.6.1 Project Requirements. In addition to the Contractor's obligations to comply with applicable laws, the Contractor specifically recognizes and agrees that the performance of the Work and the construction of the Project are subject to certain legal restrictions and agreements, as set forth in the agreements listed in Exhibit F attached hereto. The Contractor agrees that, in performing the Work, it shall comply with the agreements and restrictions set forth in the agreements listed on Exhibit F.

§8.6.2 Limitation of Owner's Liability. No trustee, officer, director, beneficiary, trustee, employee, or other principals, agents, or representatives (whether disclosed or undisclosed) of the Owner shall be personally liable to the Contractor hereunder, for the Owner's payment obligations or otherwise, the Contractor hereby agreeing to look solely to the interest of the Owner in the Project for the satisfaction of any liability of the Owner hereunder.

§8.6.3 Owner-furnished equipment. Owner may furnish equipment for installation by Contractor as part of the Work. To the extent the Contract Sum includes installation by Contractor of Owner-furnished equipment, and to the extent allowed by the manufacturers of such equipment, Owner shall transfer all warranties on such equipment to Contractor, who shall assume any remaining warranties, provide installation in accordance with manufacturers' instructions as needed to maintain and protect such warranties, and facilitate warranty service as otherwise provided in the Contract Documents.

§8.6.4 Unclassified sitework: Contractor expressly understands and acknowledges that notwithstanding anything else stated in any Contract Document, the site is "unclassified," meaning that Contractor accepts responsibility for the site "as is" and without qualification as to concealed or subsurface conditions or the suitability of material on site for any purpose. Owner makes no representations or warranties with respect to such conditions or suitability. Any studies, tests, maps, boring results, and other geotechnical information or data provided to Contractor is for Contractor's information only and, should actual conditions differ from that stated therein, Contractor shall make no claims for extra compensation required to achieve the results intended by the Contract Documents. Contractor shall be responsible for achieving the results intended by the Contract Documents and accepts all risks with respect to actual conditions and quantities (subject to any provisions regarding unit prices stated herein). Contractor represents and warrants that it has investigated the site and performed sufficient due diligence to accept the risks inherent in this method of project delivery.

§8.6.5 If the Contractor commences the services prior to the Effective Date, all Services performed by the Contractor prior to the Effective Date shall be performed at the sole risk of the Contractor, and in the event that this Agreement does not become effective, the Owner shall have no liability to the Contractor.

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§8.7.1 In connection with the performance of the Services, the Contractor shall comply with all statutes, laws, regulations, and orders of federal, state, county or municipal authorities which impose any obligation or duty upon the Contractor, including, but not limited to, civil rights and equal opportunity laws. In addition, the Contractor shall comply with all applicable copyright laws.
§ 8.7.2 During the term of this Agreement, the Contractor shall not discriminate against employees or applicants for employment because of race, color, religion, creed, age, sex, handicap, sexual orientation, or national origin and will take affirmative action to prevent such discrimination.

§ 8.7.3 If this Agreement is funded in any part by monies of the United States, the Contractor shall comply with all the provisions of Executive Order No. 11246 ("Equal Employment Opportunity"), as supplemented by the regulation of the United States Department of Labor (41 C.F.R. Part 60), and with any rule, regulation, and guidelines as the State of New Hampshire or the United States issue to implement these regulations. The Contractor further agrees to permit the State or United States access to any of the Contractor’s books, records, and accounts for the purpose of ascertaining compliance with all rules, regulations, and orders, and the covenant, terms, and conditions of this Agreement.

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§ 8.8.1 The Owner reserves the right to require the Contractor to conduct background checks of any and all persons employed or controlled by the Contractor or any or its subcontractors or subconsultants, at any time, for any reason. If so request, the Contractor shall complete the requested background check to the Owner’s satisfaction within a reasonable time period prescribed by the Owner.

§ 8.9 DATA/CONFIDENTIALITY
§ 8.9.1 Confidentiality of data shall be governed by NH RSA 91-A or other existing law. Disclosure of data requires prior written approval of the Owner.

§ 8.11 THIRD PARTIES
§ 8.11.1 The Parties hereto do not intend to benefit any third part and this Agreement shall not be construed to confer any such benefit.

PAGE 9

See Exhibit A

...

See Exhibit A

...

The following exhibits are attached and incorporated by reference:

Exhibit A—List of Contract Documents dated
Exhibit B—Project Schedule dated
Exhibit C—Schedule of Values dated
Exhibit D—Contractor’s Qualifications and Assumptions dated
Exhibit E—List of Required Subcontract Provisions
Exhibit F—Project Requirements dated
Exhibit G - General Conditions AIA A201-2007
Certification of Document's Authenticity
AIA® Document D401™ – 2003

I, , hereby certify, to the best of my knowledge, information and belief, that I created the attached final document simultaneously with its associated Additions and Deletions Report and this certification at 09:11:50 on 03/13/2013 under Order No. 7130763645_1 from AIA Contract Documents software and that in preparing the attached final document I made no changes to the original text of AIA® Document A101™ – 2007, Standard Form of Agreement Between Owner and Contractor where the basis of payment is a Stipulated Sum, as published by the AIA in its software, other than those additions and deletions shown in the associated Additions and Deletions Report.

(Signed)

(Title)

(Dated)
COMMUNITY COLLEGE SYSTEM OF NEW HAMPSHIRE
INSURANCE REQUIRED OF CONTRACTORS

TYPES OF INSURANCE REQUIRED
For the purposes of this document the term Contractor shall include each and every contractor, subcontractor, and sub-subcontractor utilized by the General Contractor to complete the construction project.

General Liability Insurance
Commercial General Liability insurance covers claims for Bodily Injury and Property damage. CCSNH requires GL insurance when:

♦ A contractor will be working at a CCSNH location.
♦ The contractor has third parties on CCSNH’s premises who could be injured or cause injury to others.
♦ Their “completed work” (building; renovations; HVAC; etc.) may fail, causing bodily injury or property damage
♦ The contractor is likely to subcontract part of their work

Automobile Liability Insurance
A Business Auto Liability insurance is required when a Contractor and/or their employees and subcontractors will operate, maintain, load or unload vehicles as part of their contracted work on any campus. As such, any Contractor who drives onto CCSNH’s owned or leased property should be required to provide evidence of a Commercial Automobile Liability insurance.

Umbrella/Excess Liability Insurance
An Umbrella/Excess policy is required when CCSNH is requesting total per occurrence and aggregate limits of liability that are higher than those carried by the Contractor in their “primary” General Liability, Auto Liability or Employer’s Liability (WC) policies – which is always the case. Note: General Liability policies typically provide limits of $1,000,000 per occurrence and $2,000,000 aggregate. Automobile liability policies generally provide a $1,000,000 “combined single” (CSL) limit.

Workers’ Compensation Insurance
CCSNH should request evidence of Workers’ Compensation (including Employers Liability coverage) for EACH AND EVERY Contractor. Evidence of workers’ compensation insurance from subcontractors and sub-subcontractors is the responsibility of General Contractor.

Property Insurance
When a new building is being contracted or an existing building is being renovated, coverage for the building material and the structure itself is provided by CCSNH.
However, the Contractor, all Subcontractors, and Sub-subcontractors should be aware that this “Builder’s Risk” coverage does not provide coverage for the Contractor’s business personal property – tools, equipment, etc. As such, they need to provide coverage for this exposure themselves.

**Pollution Liability Insurance**
Pollution legal liability insurance may be required if there is a chance that the Contractor may cause a first party or third party liability or property damage claim arising out of the “pollution” of any land, water or buildings by any type of “hazardous waste” material through their own actions or actions of another acting on their behalf.

**Professional/Errors & Omissions Liability Insurance**
Professional or E&O insurance is required of all Architects and Engineers who provide the design and engineering for buildings and other structures.

**LIMITS OF INSURANCE REQUIRED**
The following insurance requirements are to be used as a guide for CCSNH’s contracts with Contractors/Sub-Contractors. The insurance requirements and indemnification language that are ultimately incorporated into the contracts should be tailored to the operations and exposures with respect to the construction being performed in order to protect the interests of CCSNH and its Affiliated Entities.

**Commercial General Liability:** Contractor agrees to maintain in full force during the term of this contract and until the completion of this project Commercial General Liability insurance with the following minimum limits of liability:

- $1,000,000. per occurrence Limit for bodily injury/property damage
- $1,000,000 per occurrence Personal and advertising injury
- $2,000,000 aggregate Products/completed operations
- $2,000,000 aggregate Policy aggregate
- $5,000 per person Medical expense

These limits shall be provided per project/per job.

**Automobile Liability Insurance:** Contractor agrees to maintain in full force during the term of this contract and until the completion of this project Commercial Automobile Liability insurance for all owned, non-owned, and hired vehicles/trucks. The minimum limit of liability shall be $1,000,000 each accident, combined single limit for Bodily Injury and Property Damage.

**Workers’ Compensation Insurance:** Contractor agrees to maintain in full force and effect Workers’ Compensation insurance which provides statutory coverage for Workers’ Compensation claims and Employers’ Liability insurance subject to minimum limits of:

- $500,000 each accident Bodily injury by accident
or the minimum limits required by Contractor’s Umbrella insurer.

**Umbrella Liability Insurance:** Contractor agrees to maintain in full force and affect Umbrella Liability insurance which provides excess following form coverage over the underlying Commercial General Liability, Automobile Liability, and Employers Liability policies previously described. The Umbrella/Excess policy will provide minimum limits of liability of $5,000,000 per occurrence and aggregate - and the aggregate limit should be provided on a “per project or job” or location basis.

**Professional Liability Insurance:** Architect/Engineer agrees to maintain in full force during the term of this contract and for a period of five years after the completion of this project, Architects and Engineers Professional Liability (Errors and Omissions) insurance subject to a minimum per occurrence and aggregate limit of $3,000,000. Note: The scope of coverage and limit provided by the policy shall encompass the Architect/Engineers obligations as defined in the project agreement.

**Personal Property Insurance:** Contractor is responsible for the purchase and maintenance of “property” insurance on a “replacement cost basis” to cover all of “property” (tools, equipment, materials, etc.) owned by the Contractor. Note: The contract should indicate that the property will “be the sole responsibility and risk of Contractor” and that “CCSNH shall not be liable for any loss, damage, or theft to such property.”

**Other Insurance:** CCSNH reserves the right to require the Contractor to maintain additional insurance coverage as deemed necessary by the nature of the contract and from time to time during the contract period.

**OTHER INSURANCE ISSUES AND REQUIREMENTS:**

**General Requirements**

Contractor is required to maintain, during the life of this contract with CCSNH, insurance that will adequately protect CCSNH and the Contractor against the exposures inherent to the contract and construction project. The insurance policies provided by Contractor must be underwritten by an insurance company that is financially sound and adequately rated (“A-” or higher) by one or more of the leading financial rating services including AM Best, Moody’s and/or Standard & Poors. The insurance companies utilized by the Contractor must be licensed to do business in the State of New Hampshire. If such insurance is provided by “self-insurance” or a Captive insurance company, adequate financial data should be provided to assure CCSNH of the Contractor’s ability to fund all deductibles, retentions and claims that occur.
**Additional Insureds:** The required Commercial General Liability Automobile Liability and Excess/Umbrella Liability coverage shall name CCSNH, its affiliates, subsidiaries, trustees, officers, employees and agents as additional insureds.

**Certificates of Insurance (COI)**
CCSNH requires the Contractor furnish Certificates of Insurance (COI) for the required coverage and limits to CCSNH before commencing work and 30 days prior to each renewal date of the required insurance policies. Such certificates shall state that, in the event of cancellation, material change in coverage or non-renewal, the Contractor will notify CCSNH at least thirty (30) days in advance via formal, written documentation.

**Cancellation/Non-Renewal**
In the event that any of the insurance policies purchased by the Contractor to satisfy the requirements in the contract are cancelled by the insurer, non-renewed by the Contractor or are changed materially (coverage, limits, etc.), CCSNH must be notified at least 60 days in advance of such an event. If the Contractor does not provide such notice, CCSNH has the right to procure the specified insurance coverage and charge the premiums back to the Contractor.

**Occurrence/Claims Made Forms**
CCSNH prefers that all Liability policies purchased by the Contractor to satisfy the requirements in the contract are written on an "occurrence" basis. However, if any liability policy must be written on a "claims made" basis, the Contractor must maintain such insurance for a minimum of three years after the termination of the contract or provide “tail coverage” if the policy is cancelled or non-renewed with a retroactive date that precedes the inception of the contract - or “prior acts” coverage without any time limitation.

#50576573
General Conditions of the Contract for Construction

the following PROJECT: MC 11-03  Manchester Community College – Knox Building Window Wall and HVAC Renovations.

Master Owner Document SOREV 1-5-12

THE OWNER:
Manchester Community College a Component of Community College System of New Hampshire
1066 Front Street
Manchester, NH 03102

THE ARCHITECT:
Harriman
One Perimeter Road
Manchester, NH 03103

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ARTICLE 1  GENERAL PROVISIONS
§ 1.1 BASIC DEFINITIONS
§ 1.1.1 THE CONTRACT DOCUMENTS
The Contract Documents are enumerated in the Agreement between the Owner and Contractor (hereinafter the Agreement) and consist of the Agreement, Conditions of the Contract (General, Supplementary and other Conditions), Drawings, Specifications, Addenda issued prior to execution of the Contract, other documents listed in the Agreement and Modifications issued after execution of the Contract. A Modification is (1) a written amendment to the Contract signed by both parties, (2) a Change Order, (3) a Construction Change Directive or (4) a written order for a minor change in the Work issued by the Architect. Unless specifically enumerated in the Agreement, the Contract Documents do not include the advertisement or invitation to bid, Instructions to Bidders, sample forms, other information furnished by the Owner in anticipation of receiving bids or proposals, the Contractor’s bid or proposal, or portions of Addenda relating to bidding requirements.

§ 1.1.2 THE CONTRACT
The Contract Documents form the Contract for Construction. The Contract represents the entire and integrated agreement between the parties hereto and supersedes prior negotiations, representations or agreements, either written or oral. The Contract may be amended or modified only by a Modification. Except as provided in section 3.18, nothing contained in the Contract Documents shall be construed to create a contractual relationship (1) between the Contractor and the Architect or the Architect’s consultants, (2) between the Owner and a Subcontractor or a Sub-subcontractor, (3) between the Owner and the Architect or the Architect’s consultants or (4) between any persons or entities other than the Owner and the Contractor. The Architect shall, however, be entitled to performance and enforcement of obligations under the Contract intended to facilitate performance of the Architect’s duties.

§ 1.1.3 THE WORK
The term “Work” means the construction and services required by the Contract Documents, whether completed or partially completed, and includes all other labor, materials, equipment and services provided or to be provided by the Contractor to fulfill the Contractor’s obligations. The Work may constitute the whole or a part of the Project.

§ 1.1.4 THE PROJECT
The Project is the total construction of which the Work performed under the Contract Documents may be the whole or a part and which may include construction by the Owner and by separate contractors.

§ 1.1.5 THE DRAWINGS
The Drawings are the graphic and pictorial portions of the Contract Documents showing the design, location and dimensions of the Work, generally including plans, elevations, sections, details, schedules and diagrams.

§ 1.1.6 THE SPECIFICATIONS
The Specifications are that portion of the Contract Documents consisting of the written requirements for materials, equipment, systems, standards and workmanship for the Work, and performance of related services.

§ 1.1.7 INSTRUMENTS OF SERVICE
Instruments of Service are representations, in any medium of expression now known or later developed, of the tangible and intangible creative work performed by the Architect and the Architect’s consultants under their respective professional services agreements. Instruments of Service may include, without limitation, studies, surveys, models, sketches, drawings, specifications, and other similar materials.

§ 1.1.8 INITIAL DECISION MAKER
The Initial Decision Maker is the person identified in the Agreement to render initial decisions on Claims in accordance with Section 15.2 and certify termination of the Agreement under Section 14.2.2.

§ 1.1.9 NUMBER AND GENDER
The pronouns "they," "them," and "their" are used with a singular antecedent that is indefinite or that does not specific gender, in lieu of the masculine singular and feminine singular pronouns "he," "she," "him," "her," "his," and "her," and accordingly "they," "them," and "their" may be singular or plural depending on their antecedents and the context.
§ 1.2 CORRELATION AND INTENT OF THE CONTRACT DOCUMENTS

§ 1.2.1 The intent of the Contract Documents is to include all items necessary for the proper execution and completion of the Work by the Contractor. The Contract Documents are complementary, and what is required by one shall be as binding as if required by all; performance by the Contractor shall be required only to the extent consistent with the Contract Documents and reasonably inferable from them as being necessary to produce the indicated results. All Work mentioned or indicated in the Contract Documents shall be performed by the Contractor as part of this Contract unless it is specifically indicated in the Contract Documents that such Work is to be done by others.

§ 1.2.2 Organization of the Specifications into divisions, sections and articles, and arrangement of Drawings shall not control the Contractor in dividing the Work among Subcontractors or in establishing the extent of Work to be performed by any trade.

§ 1.2.3 Unless otherwise stated in the Contract Documents, words that have well-known technical or construction industry meanings are used in the Contract Documents in accordance with such recognized meanings.

§ 1.2.4 In the event of conflicts or discrepancies among the Contract Documents, the documents shall be interpreted on the basis of the follow priorities: First, Modifications or Change Orders to the Contract Documents, those of later date having precedence over those of earlier date; Second, the Agreement between Owner and Contractor; Third, these General Conditions as modified; Fourth, Addenda to Specifications and Drawings, with later date having greater priority; Fifth, Specifications and Drawings.

Larger scale drawings shall take precedence over smaller scale drawings. Should Drawings or the Specifications disagree in themselves or with each other, the Contractor shall provide the better quality or greater quality of the Work unless otherwise directed by written addendum to the Contract.

§ 1.2.5 All indications or notations which apply to one of the number of similar situations, material or processes shall be deemed to apply to all such situations, materials or processes wherever they appear in the Work, except where a contrary result is clearly indicated by the Contract Documents.

§ 1.2.6 Where codes, standards, requirements and publications of public and private parties are referred to in the Contract Documents, references shall be understood to be to the latest revision prior to the date bids are received or negotiations are concluded, except otherwise indicated.

§ 1.2.7 All manufactured articles, materials and equipment shall be applied, installed, connected, erected, used, cleaned and conditioned in accordance with the manufacturer’s written or printed directions and instructions unless otherwise indicated.

§ 1.2.8 Where the Work is to fit with existing conditions or Work to be performed by others, the Contractor shall fully and completely join the Work with such conditions or Work, unless otherwise specified.

§ 1.2.9 Exact locations of fixtures and outlets shall be obtained from the Architect before the Work is roughed in. Work installed without such information from the Architect shall be relocated at the Contractor’s expense.

§ 1.2.10 Existing condition plans and information included with the Contract Documents or otherwise made available to the Contractor were obtained by the Owner for use by the Architect in the design of the Project. The Owner does not hold out such information to the Contractor as an accurate or approximate indication of subsurface conditions, and no claim for extra cost or extension of time resulting from a reliance by the Contractor on such information shall be except allowed as provided in Section 3.7.4.

§ 1.2.11 Where no explicit quality or standards for materials or workmanship are established for Work, such Work is to be consistent with the quality of the surrounding Work and of the construction of the Project generally.

§ 1.2.12 Certain drawings (including mechanical, electrical and fire protection drawings) are diagrammatic only, and are not intended to show the alignment, physical locations or configurations of such Work. Such Work shall be
installed without additional cost to the Owner to clear all obstructions, permit proper clearances for the Work of other trades, and present an orderly appearance where exposed. Prior to beginning such Work, the Contractor shall prepare coordination drawings showing the exact alignment, physical location and configuration of the components of the mechanical, electrical, and fire protection and other allied systems and demonstrating to the Architect’s satisfaction that the installation of such systems will comply with the preceding sentence. The Contractor shall be solely liable and responsible for any such costs and/or delays resulting from the Contractor’s failure to coordinate such installations.

§ 1.3 CAPITALIZATION
Terms capitalized in these General Conditions include those that are (1) specifically defined, (2) the titles of numbered articles, (3) the titles of other documents published by the American Institute of Architects, or (4) defined elsewhere in the Contract Documents.

§ 1.4 INTERPRETATION
In the interest of brevity the Contract Documents frequently omit modifying words such as “all” and “any” and articles such as “the” and “an,” but the fact that a modifier or an article is absent from one statement and appears in another is not intended to affect the interpretation of either statement.

§ 1.5 OWNERSHIP AND USE OF DRAWINGS, SPECIFICATIONS AND OTHER INSTRUMENTS OF SERVICE
§ 1.5.1 The Architect and the Architect’s consultants shall be deemed the authors and owners of their respective Instruments of Service, including the Drawings and Specifications, and will retain all common law, statutory and other reserved rights, including copyrights. The Contractor, Subcontractors, Sub-subcontractors, and material or equipment suppliers shall not own or claim a copyright in the Instruments of Service. Submittal or distribution to meet official regulatory requirements or for other purposes in connection with this Project is not to be construed as publication in derogation of the Architect’s or Architect’s consultants’ reserved rights.

§ 1.5.2 The Contractor, Subcontractors, Sub-subcontractors and material or equipment suppliers are authorized to use and reproduce the Instruments of Service provided to them solely and exclusively for execution of the Work. All copies made under this authorization shall bear the copyright notice, if any, shown on the Instruments of Service. The Contractor, Subcontractors, Sub-subcontractors, and material or equipment suppliers may not use the Instruments of Service on other projects or for additions to this Project outside the scope of the Work without the specific written consent of the Owner, Architect and the Architect’s consultants.

§ 1.6 TRANSMISSION OF DATA IN DIGITAL FORM
If the parties intend to transmit Instruments of Service or any other information or documentation in digital form, they shall endeavor to establish necessary protocols governing such transmissions, unless otherwise already provided in the Agreement or the Contract Documents.

ARTICLE 2  OWNER
§ 2.1 GENERAL
§ 2.1.1 The Owner is the person or entity identified as such in the Agreement and is referred to throughout the Contract Documents as if singular in number. The Owner shall designate in writing a representative who shall have express authority to bind the Owner with respect to all matters requiring the Owner’s approval or authorization. Except as otherwise provided in Section 4.2.1, the Architect does not have such authority. The term “Owner” means the Owner or the Owner’s authorized representative.

§ 2.1.2 Intentionally omitted.

§ 2.2 INFORMATION AND SERVICES REQUIRED OF THE OWNER
§ 2.2.1 Prior to commencement of the Work, the Contractor may request in writing that the Owner provide reasonable evidence that the Owner has made financial arrangements to fulfill the Owner’s obligations under the Contract. Thereafter, the Contractor may only request such evidence if (1) the Owner fails to make payments to the Contractor as the Contract Documents require; (2) a change in the Work materially changes the Contract Sum; or (3) the Contractor identifies in writing a reasonable concern regarding the Owner’s ability to make payment when due.
§ 2.2.2 Except for permits and fees that are the responsibility of the Contractor under the Contract Documents, including those required under Section 3.7.1, the Owner shall, with the Contractor’s cooperation when requested, secure and pay for necessary approvals, easements, assessments and charges required for construction, use or occupancy of permanent structures or for permanent changes in existing facilities.

§ 2.2.3 The Owner shall endeavor to furnish surveys describing physical characteristics, legal limitations and utility locations for the site of the Project, and a legal description of the site. The Contractor shall be entitled to rely on the accuracy of information furnished by the Owner but shall exercise proper precautions relating to the safe performance of the Work. The Owner does not hold out such information to the Contractor as accurate, and no claim for extra cost or extension of time resulting from a reliance by the Contractor on such information shall be allowed except as provided in section 3.7.4.

§ 2.2.4 The Owner shall furnish information or services required of the Owner by the Contract Documents with reasonable promptness after receipt from the Contractor of a written request for such information or services. The Owner shall also furnish any other information or services under the Owner’s control and relevant to the Contractor’s performance of the Work with reasonable promptness after receiving the Contractor’s written request for such information or services.

§ 2.2.5 Unless otherwise provided in the Contract Documents, the Owner shall furnish to the Contractor one copy of the Contract Documents for purposes of making reproductions pursuant to Section 1.5.2. The Contractor shall arrange for the reproduction of the additional Contract Documents as necessary, and the cost of such reproduction shall be included within the Contract Sum. The Owner shall cause the Architect to deliver electronic files with the Drawings to the Contractor which can be used by the Contractor to print additional sets (subject to any reasonable conditions imposed by the Architects).

§ 2.3 OWNER’S RIGHT TO STOP THE WORK
If the Contractor fails to correct Work that is not in accordance with the requirements of the Contract Documents as required by Section 12.2 or repeatedly fails to carry out Work in accordance with the Contract Documents, the Owner may issue a written order to the Contractor to stop the Work, or any portion thereof, until the cause for such order has been eliminated; however, the right of the Owner to stop the Work shall not give rise to a duty on the part of the Owner to exercise this right for the benefit of the Contractor or any other person or entity, except to the extent required by Section 6.1.3.

§ 2.4 OWNER’S RIGHT TO CARRY OUT THE WORK
If the Contractor defaults or neglects to carry out the Work in accordance with the Contract Documents and fails within a ten-day period after receipt of written notice from the Owner to commence and continue correction of such default or neglect with diligence and promptness, the Owner may, without prejudice to other remedies the Owner may have, correct such deficiencies. In such case an appropriate Change Order shall be issued deducting from payments then or thereafter due the Contractor the reasonable cost of correcting such deficiencies, including Owner’s expenses and compensation for the Architect’s additional services made necessary by such default, neglect or failure. Such action by the Owner and amounts charged to the Contractor are both subject to prior approval of the Architect. If payments then or thereafter due the Contractor are not sufficient to cover such amounts, the Contractor shall pay the difference to the Owner.

§ 2.5 Extent of Owner Approval or Consent
Owner is relying on the Architect to exercise the appropriate standard of care in connection with the design of the Work and the Contractor for execution of the Work, including all construction means, methods and techniques. Notwithstanding anything else set forth in the Contract Documents, any “approval” or “consent” by Owner in the context of the design of the Work means only approval of programmatic and/or aesthetic design intent. In the context of execution of the Work, “approval” by Owner of schedules and/or work plans means that the Owner acknowledges such activities or events for purposes of timing or coordination only.

§ 2.6 Owner-Furnished Materials, Equipment or Fixtures
If the Contract Documents require that, as part of the Work, that Contractor shall install or incorporate into the completed construction materials, equipment or fixtures furnished by Owner, Contractor’s obligations under this agreement extend to such materials, equipment and fixtures on the same basis as the rest of the Work. Contractor’s
obligations to correct defective or non-conforming Work extends to and includes any and all materials, equipment, and fixtures furnished by Owner and to the installation thereof by the Contractor and the Subcontractors as fully as if such products had been purchased directly by Contractor or a Subcontractor for incorporation into the Work. The Contractor acknowledges that it has received and approved all information and specifications for any such Owner-furnished products sufficient so as to permit the Contractor to make this agreement. Such specifications for Owner-furnished materials, equipment or fixtures shall be considered a part of the Contract Documents and such items, upon delivery to, and acceptance by, Contractor, shall become a part of the Work.

**ARTICLE 3 CONTRACTOR**

§ 3.1 GENERAL

§ 3.1.1 The Contractor is the person or entity identified as such in the Agreement and is referred to throughout the Contract Documents as if singular in number. The Contractor shall be lawfully licensed, if required in the jurisdiction where the Project is located. The Contractor shall designate in writing a representative who shall have express authority to bind the Contractor with respect to all matters under this Contract. The term “Contractor” means the Contractor or the Contractor’s authorized representative.

§ 3.1.2 The Contractor shall perform the Work in accordance with the Contract Documents.

§ 3.1.3 The Contractor shall not be relieved of obligations to perform the Work in accordance with the Contract Documents either by activities or duties of the Architect in the Architect’s administration of the Contract, or by tests, inspections or approvals required or performed by persons or entities other than the Contractor.

§ 3.2 REVIEW OF CONTRACT DOCUMENTS AND FIELD CONDITIONS BY CONTRACTOR

§ 3.2.1 Execution of the Contract by the Contractor is a representation that the Contractor has visited the site, become generally familiar with local conditions under which the Work is to be performed and correlated personal observations with requirements of the Contract Documents.

§ 3.2.2 Because the Contract Documents are complementary, the Contractor shall, before starting each portion of the Work, carefully study and compare the various Contract Documents relative to that portion of the Work, as well as the information furnished by the Owner pursuant to Section 2.2.3, shall take field measurements of any existing conditions related to that portion of the Work, and shall observe any conditions at the site affecting it. Before starting the Work, and at frequent intervals during the progress thereof, the Contractor shall carefully study and compare the Contract Documents with each other and with the information furnished by the Owner pursuant to section 2.2 and shall at once report to the Architect any error, inconsistency or omission the Contractor may discover. Any necessary change shall be ordered as provided in Article 7, subject to the requirements of section 1.2 and other provisions of the Contract Documents. If the Contractor proceeds with the Work without such notice to the Architect, having discovered such errors, inconsistencies or omissions, or if by reasonable study of the Contract Documents the Contractor should have discovered such, the Contract shall bear all costs arising therefrom.

§ 3.2.1.1 The Drawings are generally drawn to scale; however, the figured dimensions or notes thereon shall govern. Before ordering any materials or doing any Work, the Contractor and each Subcontractor shall verify all measurements at the building site, and shall be responsible for the correctness of same. No extra charge or compensation will be allowed on account of differences between the actual measurements and the dimensions indicated on the Drawings, except to the extent such differences are attributable to errors and omissions in the Contract Documents prepared by the Architect of which the Contractor is not aware (unless the Contractor should have been aware of such errors and omissions in connection with its exercise of the standard of care exercised by a reasonable contractor experienced in the type of work required) and for which correction would constitute a material change in the Work per the process set forth in Section 7.1.4 below. All differences which may be found shall be reported in writing to the Architect for consideration before proceeding with the Work. The Contractor shall give the Architect timely notice of any additional Drawings, Specifications, or instructions required to define the Work in greater detail, or to permit the proper progress of the Work.

§ 3.2.1.2 The Contractor shall not proceed with any Work not clearly and consistently defined in detail in the Contract Documents, but shall request additional Drawings or instructions from the Architect. If the Contractor proceeds with such Work without obtaining further Drawings, Specifications, or instructions, the Contractor shall correct Work performed incorrectly at the Contractor’s own cost and expense.
§ 3.2.3 Intentionally omitted.

§ 3.2.4 If the Contractor believes that additional cost or time is involved because of clarifications or instructions the Architect issues in response to the Contractor’s notices or requests for information pursuant to Section 3.2.2, the Contractor shall make Claims as provided in Article 15. If the Contractor fails to perform the obligations of Section 3.2.2, the Contractor shall pay such costs and damages to the Owner as would have been avoided if the Contractor had performed such obligations. If the Contractor performs those obligations, the Contractor shall not be liable to the Owner or Architect for damages resulting from errors, inconsistencies or omissions in the Contract Documents, for differences between field measurements or conditions and the Contract Documents, or for nonconformities of the Contract Documents to applicable laws, statutes, ordinances, codes, rules and regulations, and lawful orders of public authorities.

§ 3.3 SUPERVISION AND CONSTRUCTION PROCEDURES

§ 3.3.1 The Contractor shall supervise and direct the Work, using the Contractor’s best skill and attention. The Contractor shall be solely responsible for, and have control over, construction means, methods, techniques, sequences and procedures (including all safety precautions and programs) and for coordinating all portions of the Work under the Contract. If the Contract Documents give specific instructions concerning construction means, methods, techniques, sequences or procedures, the Contractor shall evaluate the jobsite safety thereof and, except as stated below, shall be fully and solely responsible for the jobsite safety of such means, methods, techniques, sequences or procedures. If the Contractor believes that such means, methods, techniques, sequences or procedures may not be safe, the Contractor shall (a) give timely written notice to the Owner and Architect of the specific means, methods, techniques or procedures referred to in the Contract Documents that the Contractor believes are not safe or suitable; (b) participate in discussions with the Owner and the Architect regarding the specific means, methods, techniques or procedures referred to in the Contract Documents that the Contractor believes are not safe or suitable and (c) shall not proceed with that portion of the Work until the Owner, the Architect and the Contractor have agreed upon specific means, methods, techniques or procedures that the Contractor agrees are safe and suitable for the Work. The Contractor shall remain solely responsible for and have control over the means, methods, techniques or procedures that are employed by the Contractor for the Work, notwithstanding that such construction means, methods, techniques, sequences or procedures are (i) referred to, indicated or implied by the Contract Documents or (ii) agreed to by the Architect or Owner. In no event shall the Contractor employ construction means, methods, procedures and techniques that violate (x) requirements of any warranties applicable to the Work or (y) laws, ordinances, regulations, rules and orders which bear upon the Contractor’s performance of the Work.

§ 3.3.2 The Contractor shall be responsible to the Owner for acts and omissions of the Contractor’s employees, Subcontractors and their agents and employees, and other persons or entities performing portions of the Work for, or on behalf of, the Contractor or any of its Subcontractors. Nothing contained in this section shall alter the relationship between the Contractor and each Subcontractor under the applicable subcontract with respect to each such Subcontractor’s obligation for safety for persons or property.

§ 3.3.3 The Contractor shall be responsible for inspection of portions of Work already performed to determine that such portions are in proper condition to receive subsequent Work.

§ 3.3.4 The Contractor shall coordinate and supervise the Work performed by Subcontractors to the end that the Work is carried out without conflict between trades and so that no trade, as a result of improper coordination or supervision, causes delay to the general progress of the Work. The Contractor and all Subcontractors shall at all times afford each trade, any separate contractor, or the Owner, every reasonable opportunity for the installation of Work and the storage of materials.

§ 3.3.5 The Contractor shall arrange for and attend job meetings with the Owner and the Architect and such other persons as the Architect or Owner may from time to time wish to have present. The Contractor shall be represented by a principal, project manager, general superintendent or other authorized main office representative, as well as by the Contractor’s own superintendent. An authorized representative of any Subcontractor or lower tier subcontractor shall attend such meetings if the representative’s presence is required by the Owner or the Architect. Such representatives of the Contractor and the Subcontractors shall be empowered to making binding commitments on all
matters to be discussed at such meetings, including costs, payments, change orders, time schedules and manpower. Any notices required under the Contract may be served on such representatives.

§ 3.4 LABOR AND MATERIALS
§ 3.4.1 Unless otherwise provided in the Contract Documents, the Contractor shall provide and pay for labor, materials, equipment, tools, construction equipment and machinery, water, heat, utilities, transportation, and other facilities and services necessary for proper execution and completion of the Work, whether temporary or permanent and whether or not incorporated or to be incorporated in the Work. The word "provide" shall mean furnish and install complete, including connections, unless otherwise specified.

§ 3.4.2 Except in the case of minor changes in the Work authorized by the Architect in accordance with Sections 3.12.8 or 7.4, the Contractor may make substitutions only with the consent of the Owner, after evaluation by the Architect and in accordance with a Change Order or Construction Change Directive. If the Contractor desires to substitute a product or method in lieu of what has been specified or shown in the Contract Documents, the Contractor may propose to do so in a written request to the Architect setting forth the following: (1) full explanation of the proposed substitution and submittal of all supporting data including technical information, catalog cuts, warranties, test results, installation instructions, operating procedures, and other like information for the original specified item and the proposed substitution as necessary for a complete evaluation of the substitution; (2) reasons why the substitution is advantageous or necessary, including the benefits to the Owner and the Work in the event the substitution is acceptable; (3) the adjustment, if any, in the Contract Sum in the event that substitution is acceptable; and (4) the adjustment, if any, in the Contract Time in the event that substitution is acceptable. Proposals for substitutions shall be submitted to the Architect, with a copy to the Owner, not later than 30 days prior to the time of such substitute product or method would be incorporated in the Work or, if to be used or incorporated within 30 days of the commencement of the Work, immediately upon execution of the Agreement. No substitutions will be considered or allowed without the Contractor’s submittal of complete substantiating data and information as stated herein. Approval of a proposed substitution shall be at the sole discretion of the Owner (after consulting with the Architect).

§ 3.4.2.1 By making a request for substitution, the Contractor: (1) represents that the Contractor has investigated the proposed substitute product and determined that it is equal or superior in all respects to that specified; (2) represents that the Contractor will provide the same warranty for the substitution that the Contractor would for that specified; (3) certifies that the cost data presented is complete and includes all related costs under this Contract except the Architect’s redesign costs, and waives all claims for additional costs related to the substitution which subsequently become apparent; and (4) will coordinate the installation of the accepted substitute, making such changes as may be required for the work to be complete in all respects.

§ 3.4.2.2 The Contract Documents are intended to produce a build-out of consistent character and quality of design. All components of the building, including visible items of mechanical and electrical equipment, have been selected to have a coordinated design in relation to the overall appearance of the building. The Architect shall judge the design and appearance of proposed substitutes on the basis of their suitability in relation to the overall design of the Project, as well as for their intrinsic merits. The Architect will not approve as equal to materials specified proposed substitutes which, in the Architect’s opinion, would be out of character, obtrusive, or otherwise inconsistent with the character and quality of design of the Project. In order to permit coordinated design of color and finishes, the Contractor shall, if required by the Architect, furnish the substituted material in any color, finish, texture, or pattern which would have been available from the manufacturer originally specified, at no additional cost to the Owner.

§ 3.4.3 The Contractor shall enforce strict discipline and good order among the Contractor’s employees and other persons carrying out the Work. The Contractor shall not permit employment of unfit persons or persons not properly skilled in tasks assigned to them. The Owner may require removal of any workers from the Project that it deems unfit or not beneficial to the Project. The Owner reserves the right to require the Contractor to perform a background check of any worker employed by the Contractor or any of its subcontractors. If so request, the Contractor shall perform the background check to the Owner’s satisfaction and shall provide the results to the Owner within a reasonable time period established by the Owner.
§ 3.4.4 All manufactured materials shall be ordered to be delivered in the manufacturer’s original, unbroken packages, containers or bundles, bearing the name of the manufacturer and brand name of other designation, and all materials shall be handled, stored, installed, cleaned and protected in accordance with the manufacturer’s directions, unless otherwise indicated in the Contract Documents.

§ 3.4.5 Any product, material or equipment specified in the Contract Documents by reference to the number, symbol or title of a specified standard, such as a commercial standard, federal specification, trade association standard, or other similar or related construction industry standard, shall comply with requirements in the latest revision thereof as of the date the Owner and the Contractor execute the Agreement.

§ 3.4.6 In all cases in which a manufacturer’s name, trade name or other property designation is used in the Contract Documents in connection with a material, equipment or product to be furnished thereunder, the Contractor shall furnish the material, equipment or product of the named manufacturer(s) unless a written request for substitution is made in accordance with section 3.4.2 and the substitution is approved in writing by the Owner.

§ 3.4.7 The Contractor and all Subcontractors shall make all provisions necessary to avoid any disputes with labor unions and shall be responsible for any delays, damages or extra costs incurred as a result of such disputes. The Contractor shall be responsible for the maintenance of harmonious labor relations among its employees and the employees of its Subcontractors in such manner as will provide for harmony as far as practical among workers at the Project site. Prior to contracting with any Subcontractor, the Contractor will require such Subcontractor to certify its willingness to cooperate with not only the other Subcontractors hired by the Contractor, but also with the Owner, Architect, any other contractors hired by the Owner, and their subcontractors. Any Subcontractor not cooperating shall, at the Owner’s reasonable discretion, be dismissed by the Contractor and a qualified replacement subcontractor shall be hired at the Contractor’s expense.

§ 3.5 WARRANTY
The Contractor warrants to the Owner and Architect that materials and equipment furnished under the Contract will be of good quality and new unless the Contract Documents require or permit otherwise. The Contractor further warrants that the Work will conform to the requirements of the Contract Documents and will be free from defects, except for those inherent in the quality of the Work the Contract Documents require or permit. Work, materials, or equipment not conforming to these requirements may be considered defective. The Contractor’s warranty excludes remedy for damage or defect caused by abuse, alterations to the Work not executed by the Contractor, improper or insufficient maintenance, improper operation, or normal wear and tear and normal usage. If required by the Architect, the Contractor shall furnish satisfactory evidence as to the kind and quality of materials and equipment.

§ 3.5.2 The Contractor shall be responsible for determining that all materials furnished for the Work meet all requirements of the Contract Documents. The Architect may require the Contractor to produce reasonable evidence that materials used meet such requirements, such as certified reports or past tests by qualified testing laboratories, reports of studies by qualified experts, or other evidence which, in the opinion of the Architect, would lead to a reasonable certainty that any material used, or proposed to be used, in the Work meets the requirements of the Contract Documents. All such data shall be furnished at the Contractor’s expense.

§ 3.5.3 The warranty provided in this section 3.5 shall be in addition to and not in limitation of any other warranty required by the Contract Documents or otherwise provided by law.

§ 3.5.4 The Contractor hereby assigns to the Owner, effective at the time of Substantial Completion of the Work, any and all manufacturer’s warranties required by the Contract Documents relating to materials and labor used in the Work and further agrees to perform the Work in such manner so as to preserve all such manufacturer’s warranties.

§ 3.5.5 The Contractor shall procure and deliver to the Architect, prior to final payment, all special warranties required by the Contract Documents. Delivery by the Contractor shall constitute the Contractor’s guarantee to the Owner that the warranty will be performed in accordance with its terms and conditions.
§ 3.6 TAXES
The Contractor shall pay sales, consumer, use and similar taxes for the Work provided by the Contractor that are legally enacted when bids are received or negotiations concluded, whether or not yet effective or merely scheduled to go into effect.

§ 3.7 PERMITS, FEES, NOTICES, AND COMPLIANCE WITH LAWS
§ 3.7.1 Unless otherwise provided in the Contract Documents, the Contractor shall secure and pay for the building permit as well as for other permits, fees, licenses, and inspections by government agencies necessary for proper execution and completion of the Work that are customarily secured after execution of the Contract and legally required at the time bids are received or negotiations concluded. The Contractor shall apply for required licenses, permits, inspections and/or approvals sufficiently in advance of the time required to allow the Contractor and/or the Architect to respond to any municipal comments, conditions or requests (including, without limitation, changes to the Work) without delaying the progress of the Work.

§ 3.7.2 The Contractor shall comply with and give notices required by applicable laws, statutes, ordinances, codes, rules and regulations, and lawful orders of public authorities applicable to performance of the Work.

§ 3.7.3 If the Contractor performs Work knowing it to be contrary to applicable laws, statutes, ordinances, codes, rules and regulations, or lawful orders of public authorities, the Contractor shall assume appropriate responsibility for such Work and shall bear the costs attributable to correction.

§ 3.7.4 Concealed or Unknown Conditions. If the Contractor encounters conditions at the site that are (1) subsurface or otherwise concealed physical conditions that differ materially from those indicated in the Contract Documents or (2) unknown physical conditions of an unusual nature, that differ materially from those ordinarily found to exist and generally recognized as inherent in construction activities of the character provided for in the Contract Documents, the Contractor shall promptly provide notice to the Owner and the Architect before conditions are disturbed and in no event later than 21 days after first observance of the conditions. The Architect will promptly investigate such conditions and, if the Architect determines that they differ materially and cause an increase or decrease in the Contractor’s cost of, or time required for, performance of any part of the Work, will recommend an equitable adjustment in the Contract Sum or Contract Time, or both. If the Architect determines that the conditions at the site are not materially different from those indicated in the Contract Documents and that no change in the terms of the Contract is justified, the Architect shall promptly notify the Owner and Contractor in writing, stating the reasons. If either party disputes the Architect’s determination or recommendation, that party may proceed as provided in Article 15.

§ 3.7.5 If, in the course of the Work, the Contractor encounters human remains or recognizes the existence of burial markers, archaeological sites or wetlands not indicated in the Contract Documents, the Contractor shall immediately suspend any operations that would affect them and shall notify the Owner and Architect. Upon receipt of such notice, the Owner shall promptly take any action necessary to obtain governmental authorization required to resume the operations. The Contractor shall continue to suspend such operations until otherwise instructed by the Owner but shall continue with all other operations that do not affect those remains or features. Requests for adjustments in the Contract Sum and Contract Time arising from the existence of such remains or features may be made as provided in Article 15.

§ 3.7.6 The Contractor shall be responsible for familiarizing itself with the regulatory requirements governing the disposal of material, including material containing pollutants, from the site. The Owner will not recognize claims for additional disposal costs that could reasonably have been anticipated at the time of bidding.

§ 3.8 ALLOWANCES
§ 3.8.1 The Contractor shall include in the Contract Sum all allowances stated in the Contract Documents. Items covered by allowances shall be supplied for such amounts and by such persons or entities as the Owner may direct, but the Contractor shall not be required to employ persons or entities to whom the Contractor has reasonable objection.

§ 3.8.2 Unless otherwise provided in the Contract Documents,
.1 allowances shall cover the cost to the Contractor of materials and equipment delivered at the site and all required taxes, less applicable trade discounts;

.2 Contractor’s costs for unloading and handling at the site, labor, installation costs, overhead, profit and other expenses contemplated for stated allowance amounts shall be included in the Contract Sum but not in the allowances; and

.3 whenever costs are more than or less than allowances, the Contract Sum shall be adjusted accordingly by Change Order. The amount of the Change Order shall reflect (1) the difference between actual costs and the allowances under Section 3.8.2.1 and (2) changes in Contractor’s costs under Section 3.8.2.2.

§ 3.8.3 Materials and equipment under an allowance shall be selected by the Owner with reasonable promptness.

§ 3.9 SUPERINTENDENT
§ 3.9.1 The Contractor shall employ a competent superintendent and necessary assistants who shall be in attendance at the Project site during performance of the Work. The superintendent shall represent the Contractor, and communications given to the superintendent shall be as binding as if given to the Contractor.

§ 3.9.2 The Contractor, as soon as practicable after award of the Contract, shall furnish in writing to the Owner through the Architect the name and qualifications of a proposed superintendent. The Architect may reply within 14 days to the Contractor in writing stating (1) whether the Owner or the Architect has reasonable objection to the proposed superintendent or (2) that the Architect requires additional time to review. Failure of the Architect to reply within the 14 day period shall constitute notice of no reasonable objection. The Owner may require the Contractor to provide additional supervision to assist the superintendent when Owner determines the workload requires it.

§ 3.9.3 The Contractor shall not employ a proposed superintendent to whom the Owner or Architect has made reasonable and timely objection. The Contractor shall not change the superintendent without the Owner’s consent, which shall not unreasonably be withheld or delayed. The Contractor shall remove the superintendent if requested to do so in writing by the Owner, and shall promptly replace him with a competent person reasonably acceptable to the Owner.

§ 3.9.4 The superintendent shall keep a daily log of the progress of the Work and make it available to the Owner at all times. A copy of the log shall be submitted to the Owner upon completion of the Project. Additionally, daily field reports recording work activities, labor force and other information as required by the Owner shall be prepared daily by the Contractor and each subcontractor and submitted to the Owner.

§ 3.9.5 The Contractor shall furnish to both the Owner and the Architect the names, addresses and telephone numbers of the project manager, the superintendent, the superintendent’s immediate supervisor, the superintendents of all subcontractors, and at least two other of their and their subcontractor’s authorized representatives, indicating where they can be contacted at times other than normal working hours in case of emergency.

§ 3.9.6 The Contractor’s superintendent shall not be assigned to, or become involved in, any project other than that of this Contract. He/she shall remain in attendance at the site, and, except for illness or other reason excusable to the Owner, shall be present at all times when Work of any kind is being done, including Work done during overtime. If absent for illness or other reason excusable to the Owner, a replacement having full authority and responsibility of the full-time superintendent shall be provided.

§ 3.9.7 The Contractor shall coordinate and supervise the Work performed by Subcontractors to the end that the Work is carried out without conflict between trades and so that no trade, at any time, causes delay to the general progress of the Work. The Contractor and all Subcontractors shall at all times afford each trade, any separate contractor, or the Owner, every reasonable opportunity for the installation of Work and the storage of materials.

§ 3.10 CONTRACTOR'S CONSTRUCTION SCHEDULES
§ 3.10.1 The Contractor, promptly after being awarded the Contract, or in the case of a GMP as part of the GMP Proposal, shall prepare and submit for the Owner’s and Architect’s information a Contractor’s construction schedule for the Work (the “Schedule”). The Schedule shall not exceed time limits current under the Contract Documents, shall be revised at appropriate intervals as required by the conditions of the Work and Project, shall be related to the
entire Project to the extent required by the Contract Documents, and shall provide for expeditious and practicable execution of the Work.

§ 3.10.1.1 The Schedule shall utilize the Critical Path Method of scheduling within a format acceptable to the Owner and shall be submitted in digital and hardcopy (paper or vellum) formats. The Schedule shall be developed with and shall be subject to approval by the Owner and shall: (i) comply with and include any the Milestone Dates required by the Contract Documents, including but not limited to Substantial Completion and Final Completion for each phase of Work, along with any other Milestone Dates as required by the Owner; (ii) show the Contractor’s overall approach to the planning, scheduling and execution of the Work, including schedule activities for all Work components ("Activities"), Notice to Proceed, procurement of permits, shop drawing submittals, review and approval, anticipated design submittals, material and equipment procurement and delivery, third party interfaces (e.g., utility work), and closeout and commissioning; (iii) include only Activities with durations equal to or less than ten (10) calendar days; (iv) include logic relationships between Activities reflecting the Contractor’s as-planned sequencing of Work; and (v) identify any planned overtime.

§ 3.10.1.2 The Contractor shall monitor the progress of the Work for conformation with the requirements of the Schedule and shall promptly advise the Owner of any actual delays or potential delays. The Contractor shall deliver a written report to the Owner each month (or more frequently if requested by the Owner or the Architect) setting forth the actual progress of the Work and highlighting discrepancies between the actual progress of the Work and the Schedule (such updates are sometimes referred to in these General Conditions as "Progress Reports"). In the event any progress report indicates delays in achievements of any Milestone Date, the Contractor shall propose in written form an affirmative plan (the "Corrective Plan") to correct the delay, including overtime, re-sequencing of Work and/or additional labor, if necessary, which Corrective Plan shall indicate the date by which the progress of the work will comply with the Schedule, and shall be subject to the approval of the Owner. In no event shall any progress report or Corrective Plan constitute an adjustment in the Schedule, Contract Time or any Milestone Date unless any such adjustment is agreed to by the Owner and authorized pursuant to a Change Order.

§ 3.10.1.3 In the event (i) that the performance of the Work as of a Milestone Date has not progressed or reached the level of completion required by the Schedule, and (ii) the Contractor fails to submit a Corrective Plan that is approved by the Owner or the progress of the Work is not brought back into compliance with the Schedule on the date proposed by an approved Corrective Plan, the Owner shall have the right to order the Contractor to take corrective measures to expedite the progress of the work, including, without limitation, (1) supplying additional shifts or overtime, (2) supplying the additional manpower, equipment, and facilities, (3) re-sequencing of Work, and (4) other similar measures (hereinafter referred to collectively as "Extraordinary Measures"). Such Extraordinary Measures shall continue until the progress of the Work complies with the stage of completion required by the Contract Documents. The Owner’s right to require Extraordinary Measures is solely for the purpose of ensuring the Contractor’s compliance with the Schedule. The Contractor shall not be entitled to an adjustment in the Contract Sum in connection with Extraordinary Measures required by the Owner under or pursuant to this Section 3.10.1. The Owner may exercise the rights furnished the Owner under or pursuant to this Section 3.10.1 as frequently as reasonably necessary to ensure that the Contractor’s performance of the work complies with the Schedule.

§ 3.10.1.4 In conjunction with the monthly Schedule submission, the Contractor shall draft and submit to the Owner a narrative explaining in detail all changes to the previous Schedule, lack of progress, delays, slippage or accelerations. The Owner at any time may require the Contractor to develop and submit an additional written mitigation plan based on feasible field actions that shall address and correct such delays, progress impediments, schedule slippage or missed Milestone Dates.

§ 3.10.1.5 Float or slack time associated with any one chain of activities is defined as the amount of time between the earliest start date and the latest start date or between the earliest finish date and the latest finish date for such activities, as set forth in the Schedule required under this Agreement, including any revisions or updates thereto. The Owner shall retain all beneficial rights to all schedule float including that resulting from any scheduled or actual completion in less than the Contract Time. The Contractor shall in no way be entitled to any compensation for any Claims for interference with or denial of an “early finish” or “early completion” of the Work. Extensions of time for performance will be granted only to the extent that the equitable time adjustments for the activity or activities affected exceed the total float along the activity chain involved at the time the change was ordered or the delay
occurred. Notwithstanding the above, the Contractor shall only be entitled to an extension of time for an excusable delay to the critical path of the Work.

§ 3.10.2 The Contractor shall prepare a submittal schedule, promptly after being awarded the Contract and thereafter as necessary to maintain a current submittal schedule, and shall submit the schedule(s) for the Architect’s approval. The Architect’s approval shall not unreasonably be delayed or withheld. The submittal schedule shall (1) be coordinated with the Contractor’s construction schedule, and (2) allow the Architect reasonable time to review submittals. If the Contractor fails to submit a submittal schedule, the Contractor shall not be entitled to any increase in Contract Sum or extension of Contract Time based on the time required for review of submittals.

§ 3.10.3 The Contractor shall perform the Work in general accordance with the most recent schedules submitted to the Owner and Architect.

§ 3.11 DOCUMENTS AND SAMPLES AT THE SITE
The Contractor shall maintain at the site one record copy of the Drawings, Specifications, Addenda, Change Orders and other Modifications, in good order and marked currently to record field changes and selections made during construction (the "As-built Documents"), and one record copy of approved Shop Drawings, Product Data, Samples and similar required submittals. The markups to the As-Built Documents shall consist of record information including: (i) deviations from the Drawings made during construction; (ii) details in the Work not previously shown; (iii) changes to existing conditions or existing conditions found to differ from those shown on the Drawings; (iv) the actual installed position of equipment, piping conduits, light switches, electric fixtures, circuiting, ducts, dampers, access panels, control values, drains, openings, and stub-outs; and (v) such other information as the Owner may reasonably request. The Architect and/or the Owner’s Representative (a) make routine edits and updates to the Drawings prepared by or on behalf of the Architect that are normal in the course of construction administration at mutually acceptable times during construction of the Project and (b) deliver such updated Drawings to the Contractor (in printed and electronic form) for use by the Contractor in preparing the Record Documents (subject to any reasonable conditions imposed by the Architect or Owner’s Representative). Upon completion of the Work, the Contractor shall deliver to the Architect the marked As-Built Documents and reproducible transparencies thereof. Approval by the Architect, Owner’s Representative, and the Owner of As-Built Documents prepared by the Contractor and its Subcontractors and suppliers shall be a condition precedent to the Owner’s obligation to make final payment to the Contractor. The Contractor shall also deliver to the Architect all operations manuals for equipment as a condition precedent to final payment by Owner.

§ 3.12 SHOP DRAWINGS, PRODUCT DATA AND SAMPLES
§ 3.12.1 Shop Drawings are drawings, diagrams, schedules and other data specially prepared for the Work by the Contractor or a Subcontractor, Sub-subcontractor, manufacturer, supplier or distributor to illustrate some portion of the Work.

§ 3.12.2 Product Data are illustrations, standard schedules, performance charts, instructions, brochures, diagrams and other information furnished by the Contractor to illustrate materials or equipment for some portion of the Work.

§ 3.12.3 Samples are physical examples that illustrate materials, equipment or workmanship and establish standards by which the Work will be judged.

§ 3.12.4 Shop Drawings, Product Data, Samples and similar submittals are not Contract Documents. Their purpose is to demonstrate the way by which the Contractor proposes to conform to the information given and the design concept expressed in the Contract Documents for those portions of the Work for which the Contract Documents require submittals. Review by the Architect is subject to the limitations of Section 4.2.7. Informational submittals upon which the Architect is not expected to take responsive action may be so identified in the Contract Documents. Submittals that are not required by the Contract Documents may be returned by the Architect without action.

§ 3.12.5 The Contractor shall review for compliance with the Contract Documents, approve and submit to the Architect Shop Drawings, Product Data, Samples and similar submittals required by the Contract Documents in accordance with the submittal schedule approved by the Architect or, in the absence of an approved submittal schedule, with reasonable promptness and in such sequence as to cause no delay in the Work or in the activities of the Owner or of separate contractors.
§ 3.12.6 By submitting Shop Drawings, Product Data, Samples and similar submittals, the Contractor represents to the Owner and Architect that the Contractor has (1) reviewed and approved them, (2) determined and verified materials, field measurements and field construction criteria related thereto, or will do so and (3) checked and coordinated the information contained within such submittals with the requirements of the Work and of the Contract Documents. The accuracy of all such information is the responsibility of the Contractor. In reviewing Shop Drawings, Product Data, Samples, and similar submittals, the Architect shall be entitled to rely upon the Contractor’s presentation that such information is correct and accurate.

§ 3.12.7 The Contractor shall perform no portion of the Work for which the Contract Documents require submittal and review of Shop Drawings, Product Data, Samples or similar submittals until the respective submittal has been approved by the Architect. The portions of the Work that are the subject of the approved submittal shall be completed in accordance with such approved submittal.

§ 3.12.8 The Work shall be in accordance with approved submittals except that the Contractor shall not be relieved of responsibility for deviations from requirements of the Contract Documents by the Architect’s approval of Shop Drawings, Product Data, Samples or similar submittals unless the Contractor has specifically informed the Architect in writing of such deviation at the time of submittal and (1) the Architect has given written approval to the specific deviation as a minor change in the Work, or (2) a Change Order or Construction Change Directive has been issued authorizing the deviation. The Contractor shall not be relieved of responsibility for errors or omissions in Shop Drawings, Product Data, Samples or similar submittals by the Architect’s approval thereof.

§ 3.12.9 The Contractor shall direct specific attention, in writing or on resubmitted Shop Drawings, Product Data, Samples or similar submittals, to revisions other than those requested by the Architect on previous submittals. Unless such written notice has been given, the Architect’s approval of resubmitted Shop Drawing, Product Data, Sample, or similar submittal shall not constitute approval of any changes not requested on the prior submittal.

§ 3.12.10 The Contractor shall not be required to provide professional services that constitute the practice of architecture or engineering unless such services are specifically required by the Contract Documents for a portion of the Work or unless the Contractor needs to provide such services in order to carry out the Contractor’s responsibilities for construction means, methods, techniques, sequences and procedures. The Contractor shall not be required to provide professional services in violation of applicable law. If professional design services or certifications by a design professional related to systems, materials or equipment are specifically required of the Contractor by the Contract Documents, the Owner and the Architect will specify all performance and design criteria that such services must satisfy. The Contractor shall cause such services or certifications to be provided by a properly licensed design professional, whose signature and seal shall appear on all drawings, calculations, specifications, certifications, Shop Drawings and other submittals prepared by such professional. Shop Drawings and other submittals related to the Work designed or certified by such professional, if prepared by others, shall bear such professional’s written approval when submitted to the Architect. The Owner and the Architect shall be entitled to rely upon the adequacy, accuracy and completeness of the services, certifications and approvals performed or provided by such design professionals, provided the Owner and Architect have specified to the Contractor all performance and design criteria that such services must satisfy. Pursuant to this Section 3.12.10, the Architect will review, approve or take other appropriate action on submittals only for the limited purpose of checking for conformance with information given and the design concept expressed in the Contract Documents. The Contractor shall not be responsible for the adequacy of the performance and design criteria specified in the Contract Documents.

§ 3.13 USE OF SITE
The right of possession of the premises and the improvements made thereon by the Contractor shall remain at all times in the Owner. The Contractor’s right to entry and use thereof arises solely from the permission granted by the Owner under the Contract Documents. The Contractor shall confine the Contractor’s apparatus, the storage of materials, and the operations of the Contractor’s workers to limits indicated by law, ordinances, the Contract Documents and permits and/or directions of the Architect and/or the Owner and shall not unreasonably encumber the premises with the Contractor’s materials. The Owner shall not be liable to the Contractor, Subcontractors, their employees or anyone else with respect to the condition of the premises. The Owner shall have the right to refuse admittance to the site to any agent or employee of the Contractor or Subcontractors whose presence the Owner deems hostile to the Owner’s interest.
§ 3.14 CUTTING AND PATCHING
§ 3.14.1 The Contractor shall be responsible for cutting, fitting or patching required to complete the Work or to make its parts fit together properly. All areas requiring cutting, fitting and patching shall be restored to the condition existing prior to the cutting, fitting and patching, unless otherwise required by the Contract Documents.

§ 3.14.2 The Contractor shall not damage or endanger a portion of the Work or fully or partially completed construction of the Owner or separate contractors by cutting, patching or otherwise altering such construction, or by excavation. The Contractor shall not cut or otherwise alter such construction by the Owner or a separate contractor except with written consent of the Owner and of such separate contractor; such consent shall not be unreasonably withheld. The Contractor shall not unreasonably withhold from the Owner or a separate contractor the Contractor’s consent to cutting or otherwise altering the Work. Existing work that is cut, damaged, disturbed or otherwise interfered with by the Contractor, a Subcontractor, or anyone for whom they are responsible shall be fully, properly and carefully repaired by the responsible Contractor or Subcontractor. All such repairs shall be completed in a first-class manner to the satisfaction of the Architect, and shall match similar existing adjoining work.

§ 3.15 CLEANING UP
§ 3.15.1 The Contractor shall keep the premises and surrounding area free from accumulation of waste materials or rubbish caused by operations under the Contract. At completion of the Work, the Contractor shall remove waste materials, rubbish, the Contractor’s tools, construction equipment, machinery and surplus materials from and about the Project. Immediately prior to the Architect’s inspection for Substantial Completion, the Contractor shall completely clean the premises. Concrete and ceramic surfaces shall be cleaned and washed. Resilient coverings shall be cleaned, waxed and buffed. Woodwork shall be dusted and cleaned. Sash, fixtures and equipment shall be thoroughly cleaned. Stains, spots, dust, marks and smears shall be removed from all surfaces. Hardware and all metal surfaces shall be cleaned and polished. Glass and plastic surfaces shall be thoroughly cleaned by professional window cleaners. All damaged, broken or scratched glass or plastic shall be replaced by the Contractor at the Contractor’s expense.

§ 3.15.2 If the Contractor fails to clean up as provided in the Contract Documents, the Owner may do so and Owner shall be entitled to reimbursement from the Contractor.

§ 3.16 ACCESS TO WORK
The Contractor shall provide the Owner and Architect safe access to the Work in preparation and progress wherever located.

§ 3.17 ROYALTIES, PATENTS AND COPYRIGHTS
The Contractor shall pay all royalties and license fees. The Contractor shall defend suits or claims for infringement of copyrights and patent rights and shall hold the Owner and Architect harmless from loss on account thereof, but shall not be responsible for such defense or loss when a particular design, process or product of a particular manufacturer or manufacturers is required by the Contract Documents, or where the copyright violations are contained in Drawings, Specifications or other documents prepared by the Owner or Architect. However, if the Contractor has reason to believe that the required design, process or product is an infringement of a copyright or a patent, the Contractor shall be responsible for such loss unless such information is promptly furnished to the Architect.

§ 3.18 INDEMNIFICATION
§ 3.18.1 To the fullest extent permitted by law the Contractor shall defend (with counsel reasonably satisfactory to Owner), indemnify and hold harmless the Owner, Architect, Architect’s consultants, its lenders and affiliates, and agents and employees of any of them from and against claims, damages, losses and expenses, including but not limited to attorneys’ fees, arising out of or resulting from performance of the Work, provided that such claim, damage, loss or expense is attributable to bodily injury, sickness, disease or death, or to injury to or destruction of tangible property (other than the Work itself), caused in whole or in part by the negligent acts or omissions of the Contractor, a Subcontractor, anyone directly or indirectly employed by them or anyone for whose acts they may be liable, regardless of whether or not such claim, damage, loss or expense is caused in part by a party indemnified hereunder. Such obligation shall not be construed to negate, abridge, or reduce other rights or obligations of indemnity which would otherwise exist as to a party or person described in this Section 3.18.
§ 3.18.2 In claims against any person or entity indemnified under this Section 3.18 by an employee of the Contractor, a Subcontractor, anyone directly or indirectly employed by them or anyone for whose acts they may be liable, the indemnification obligation under Section 3.18.1 shall not be limited by a limitation on amount or type of damages, compensation or benefits payable by or for the Contractor or a Subcontractor under workers’ compensation acts, disability benefit acts or other employee benefit acts.

§ 3.19 LIENS
§ 3.19.1 In the event that any Subcontractor, supplier or any other party for whom the Contractor is responsible establishes a lien against the Work and/or the Project site, the Contractor shall, within five days of receipt of notice from the Owner regarding such lien, cause the lien to be discharged (either by obtaining and recording a lien discharge bond from a surety and in a form acceptable to the Owner or otherwise) at no cost to the Owner, except to the extent that the lien is directly and solely attributable to a failure by the Owner to pay undisputed amounts to the Contractor as and when due under the Contract Documents. If the Contractor fails to cause the lien to be discharged within such five day period, the Owner shall have the right to withhold all further payments to the Contractor until the lien is discharged. The Owner may either (a) apply amount so withheld to discharging such lien or (b) retain such amounts until such lien is discharged or released by the Contractor or the lienor, and shall thereafter credit to the Contractor any amounts remaining after payment of the fees and expenses the Owner incurs in connection with such lien. The Contractor agrees to indemnify and hold harmless the Owner from all costs and expenses incurred by the Owner in connection with such liens. For purposes of this Section 3.19.1, the term "lien" shall mean any instrument filed with the applicable land title records which creates or perfects a lien under any lien law.

§ 3.20 PROTECTION FROM WATER DAMAGE
§ 3.20.1 In performing the Work, the Contractor shall exercise diligent efforts to protect the building and to cause all materials, supplies, systems and equipment which are delivered to the Project site from exposure to, and damage from, water. Without limiting the generality of the foregoing, the Contractor shall (a) install temporary barriers adequate to prevent water entry to the building from openings in the roof, exterior walls or other applicable building elements to the extent related to the Work, (b) cause all materials, supplies, systems and equipment which are delivered to the Project site to be stored in a safe and secure location, packaged in a watertight manner where possible, and stored in a manner which protects such items from inclement weather, the elements (including, without limitation, rain, snow and water damage) and other damage until such items are incorporated into the work, and (c) ensure that all plumbing components and exterior elements included within the Work are constructed and installed in accordance with the Contract Documents so as not to allow water leaks or penetration.

§ 3.20.2 In addition to (and not in limitation of) the indemnification obligations of Contractor set forth in Section 3.18 above, Contractor shall defend, indemnify and hold harmless the parties indemnified under Section 3.18.1 above to the fullest extent permitted by law from all Claims arising out of or resulting from the failure of Contractor (or any subcontractor of any tier) to comply with the provisions of this Section 3.20. The foregoing indemnification shall include, without limitation, any Claim attributable to (i) bodily injury, sickness, disease or death arising out of or relating to, and (ii) the costs of any abatement, clean-up, removal and disposal (to the satisfaction of Owner) of, any mold, fungal growth, spores or the like which occurs at the Project site as a result of any failure by Contractor (or any subcontractor of any tier) to comply with the provisions of this Section 3.20.

ARTICLE 4  ARCHITECT
§ 4.1 GENERAL
§ 4.1.1 The Owner shall retain an architect lawfully licensed to practice architecture or an entity lawfully practicing architecture in the jurisdiction where the Project is located. That person or entity is identified as the Architect in the Agreement and is referred to throughout the Contract Documents as if singular in number.

§ 4.1.2 Duties, responsibilities and limitations of authority of the Architect as set forth in the Contract Documents shall not be restricted, modified or extended without written consent of the Owner, Contractor and Architect. Consent shall not be unreasonably withheld.

§ 4.1.3 If the employment of the Architect is terminated, the Owner shall employ a successor architect as to whom the Contractor has no reasonable objection and whose status under the Contract Documents shall be that of the Architect.
§ 4.2 ADMINISTRATION OF THE CONTRACT

§ 4.2.1 The Architect will provide administration of the Contract as described in the Contract Documents until the date the Architect issues the final Certificate For Payment. The Architect will have authority to act on behalf of the Owner only to the extent provided in the Contract Documents.

§ 4.2.2 The Architect will visit the site at intervals appropriate to the stage of construction, or as otherwise agreed with the Owner, to become generally familiar with the progress and quality of the portion of the Work completed, and to determine in general if the Work observed is being performed in a manner indicating that the Work, when fully completed, will be in accordance with the Contract Documents. However, the Architect will not be required to make exhaustive or continuous on-site inspections to check the quality or quantity of the Work. The Architect will not have control over, charge of, or responsibility for, the construction means, methods, techniques, sequences or procedures, or for the safety precautions and programs in connection with the Work, since these are solely the Contractor’s rights and responsibilities under the Contract Documents, except as provided in Section 3.3.1.

§ 4.2.3 On the basis of the site visits, the Architect will keep the Owner reasonably informed about the progress and quality of the portion of the Work completed, and report to the Owner (1) known deviations from the Contract Documents and from the most recent construction schedule submitted by the Contractor, and (2) defects and deficiencies observed in the Work. The Architect will not be responsible for the Contractor’s failure to perform the Work in accordance with the requirements of the Contract Documents. The Architect will not have control over or charge of and will not be responsible for acts or omissions of the Contractor, Subcontractors, or their agents or employees, or any other persons or entities performing portions of the Work.

§ 4.2.4 COMMUNICATIONS FACILITATING CONTRACT ADMINISTRATION

Except as otherwise provided in the Contract Documents or when direct communications have been specially authorized, the Owner and Contractor shall endeavor to communicate with each other through the Architect about matters arising out of or relating to the Contract. Communications by and with the Architect’s consultants shall be through the Architect. Communications by and with Subcontractors and material suppliers shall be through the Contractor. Communications by and with separate contractors shall be through the Owner.

§ 4.2.5 Based on the Architect’s evaluations of the Contractor’s Applications for Payment, the Architect will review and certify the amounts due the Contractor and will issue Certificates for Payment in such amounts.

§ 4.2.6 The Architect has authority to reject Work that does not conform to the Contract Documents. Whenever the Architect considers it necessary or advisable, the Architect will have authority to require inspection or testing of the Work in accordance with Sections 13.5.2 and 13.5.3, whether or not such Work is fabricated, installed or completed. However, neither this authority of the Architect nor a decision made in good faith either to exercise or not to exercise such authority shall give rise to a duty or responsibility of the Architect to the Contractor, Subcontractors, material and equipment suppliers, their agents or employees, or other persons or entities performing portions of the Work.

§ 4.2.7 The Architect will review and approve, or take other appropriate action upon, the Contractor’s submittals such as Shop Drawings, Product Data and Samples, but only for the limited purpose of checking for conformance with information given and the design concept expressed in the Contract Documents. The Architect’s action will be taken in accordance with the submittal schedule approved by the Architect or, in the absence of an approved submittal schedule, with reasonable promptness while allowing sufficient time in the Architect’s professional judgment to permit adequate review. Review of such submittals is not conducted for the purpose of determining the accuracy and completeness of other details such as dimensions and quantities, or for substantiating instructions for installation or performance of equipment or systems, all of which remain the responsibility of the Contractor as required by the Contract Documents. The Architect’s review of the Contractor’s submittals shall not relieve the Contractor of the obligations under Sections 3.3, 3.5 and 3.12. The Architect’s review shall not constitute approval of safety precautions or, unless otherwise specifically stated by the Architect, of any construction means, methods, techniques, sequences or procedures. The Architect’s approval of a specific item shall not indicate approval of an assembly of which the item is a component.
§ 4.2.8 The Architect will prepare Change Orders and Construction Change Directives, and may authorize minor changes in the Work as provided in Section 7.4 not involving an adjustment in the Contract Sum or an extension of the Contract Time. The Architect will investigate and make determinations and recommendations regarding concealed and unknown conditions as provided in Section 3.7.4.

§ 4.2.9 The Architect will conduct inspections to determine the date or dates of Substantial Completion and the date of final completion; issue Certificates of Substantial Completion pursuant to Section 9.8; receive and forward to the Owner, for the Owner’s review and records, written warranties and related documents required by the Contract and assembled by the Contractor pursuant to Section 9.10; and issue a final Certificate for Payment pursuant to Section 9.10.

§ 4.2.10 If the Owner and Architect agree, the Architect will provide one or more project representatives to assist in carrying out the Architect’s responsibilities at the site. The duties, responsibilities and limitations of authority of such project representatives shall be as set forth in an exhibit to be incorporated in the Contract Documents.

§ 4.2.11 The Architect will interpret and decide matters concerning performance under, and requirements of, the Contract Documents on written request of either the Owner or Contractor. The Architect’s response to such requests will be made in writing within any time limits agreed upon or otherwise with reasonable promptness.

§ 4.2.12 Interpretations and decisions of the Architect will be consistent with the intent of, and reasonably inferable from, the Contract Documents and will be in writing or in the form of drawings. When making such interpretations and decisions, the Architect will endeavor to secure faithful performance by both Owner and Contractor, will not show partiality to either and will not be liable for results of interpretations or decisions rendered in good faith.

§ 4.2.12.1 The Architect may, as the Architect judges desirable, issue additional drawings or instructions indicating in greater detail the construction or design of the various parts of the Work; such drawings or instructions may be effected by field order or other notice to the Contractor, and provided such drawings or instructions are reasonably consistent with the previously existing Contract Documents, the Work shall be executed in accordance with such additional drawings or instructions without additional cost or extension of the Contract Time. If the Contractor claims additional cost or time on account of such additional drawings or instructions, the Contractor shall give the notice provided in Article 15.

§ 4.2.13 The Architect’s decisions on matters relating to aesthetic effect will be final if consistent with the intent expressed in the Contract Documents and the agreement of the owner.

§ 4.2.14 The Architect will review and respond to requests for information about the Contract Documents. The Architect’s response to such requests will be made in writing within any time limits agreed upon or otherwise with reasonable promptness. If appropriate, the Architect will prepare and issue supplemental Drawings and Specifications in response to the requests for information.

ARTICLE 5 SUBCONTRACTORS
§ 5.1 DEFINITIONS
§ 5.1.1 A Subcontractor is a person or entity who has a direct contract with the Contractor to perform a portion of the Work at the site. The term “Subcontractor” is referred to throughout the Contract Documents as if singular in number and means a Subcontractor or an authorized representative of the Subcontractor. The term “Subcontractor” does not include a separate contractor or subcontractors of a separate contractor.

§ 5.1.2 A Sub-subcontractor is a person or entity who has a direct or indirect contract with a Subcontractor to perform a portion of the Work at the site. The term “Sub-subcontractor” is referred to throughout the Contract Documents as if singular in number and means a Sub-subcontractor or an authorized representative of the Sub-subcontractor.

§ 5.2 AWARD OF SUBCONTRACTS AND OTHER CONTRACTS FOR PORTIONS OF THE WORK
§ 5.2.1 Unless otherwise stated in the Contract Documents or the bidding requirements, the Contractor, as soon as practicable after award of the Contract, shall furnish in writing to the Owner through the Architect the names of persons or entities (including those who are to furnish materials or equipment fabricated to a special design)
proposed for each principal portion of the Work. The Architect may reply within 14 days to the Contractor in writing stating (1) whether the Owner or the Architect has reasonable objection to any such proposed person or entity or (2) that the Architect requires additional time for review. Failure of the Owner or Architect to reply within the 14 day period shall constitute notice of no reasonable objection.

§ 5.2.2 The Contractor shall not contract with a proposed person or entity to whom the Owner or Architect has made reasonable and timely objection. The Contractor shall not be required to contract with anyone to whom the Contractor has made reasonable objection.

§ 5.2.3 If the Owner or Architect has reasonable objection to a person or entity proposed by the Contractor, the Contractor shall propose another to whom the Owner or Architect has no reasonable objection. If the proposed but rejected Subcontractor was reasonably capable of performing the Work and of complying with bonding, insurance and other applicable requirements under the Contract Documents, the Contract Sum and Contract Time shall be increased or decreased by the difference, if any, occasioned by such change, and an appropriate Change Order shall be issued before commencement of the substitute Subcontractor’s Work. However, no increase in the Contract Sum or Contract Time shall be allowed for such change unless the Contractor has acted promptly and responsively in submitting names as required.

§ 5.2.4 The Contractor shall not substitute a Subcontractor, person or entity previously selected if the Owner or Architect makes reasonable objection to such substitution.

§ 5.2.5 The form and content of each subcontract shall be submitted to the Owner for its approval, which shall not be unreasonably withheld or delayed. Each subcontract shall expressly provide for the contingent assignment referred to in Section 5.4.1.

§ 5.3 SUBCONTRACTUAL RELATIONS
By appropriate agreement, written where legally required for validity, the Contractor shall require each Subcontractor, to the extent of the Work to be performed by the Subcontractor, to be bound to the Contractor by terms of the Contract Documents, and to assume toward the Contractor all the obligations and responsibilities, including without limitation the responsibility for safety of the Subcontractor’s Work and the obligations set forth in Section 3.18, which the Contractor, by these Documents, assumes toward the Owner and Architect. Each subcontract agreement shall preserve and protect the rights of the Owner and Architect under the Contract Documents with respect to the Work to be performed by the Subcontractor so that subcontracting thereof will not prejudice such rights, and shall allow to the Subcontractor, unless specifically provided otherwise in the subcontract agreement, the benefit of all rights, remedies and redress against the Contractor that the Contractor, by the Contract Documents, has against the Owner. Where appropriate, the Contractor shall require each Subcontractor to enter into similar agreements with Sub-subcontractors. The Contractor shall make available to each proposed Subcontractor, prior to the execution of the subcontract agreement, copies of the Contract Documents to which the Subcontractor will be bound, and, upon written request of the Subcontractor, identify to the Subcontractor terms and conditions of the proposed subcontract agreement that may be at variance with the Contract Documents. Subcontractors will similarly make copies of applicable portions of such documents available to their respective proposed Sub-subcontractors. Each subcontract agreement shall state that (1) the Subcontractor agrees that the Contractor’s rights under the subcontract agreement may (a) be assigned to the Owner, subject to the conditions of Section 5.4.1 of these General Conditions, (b) include agreements to mediate consistent with those in the Contract Documents and (c) be terminated without penalty or premium if the Contractor’s services are terminated. By entering into a subcontract for any portion of the Work, a Subcontractor shall be deemed to have agreed to the terms of the preceding sentence as if such terms were included in its subcontract agreement, and (2) the Subcontractor shall be required to perform its Work in accordance with all applicable laws, statutes, ordinances, building codes, rules and regulations without any adjustment to the subcontract amount or time for performance.

§ 5.4 CONTINGENT ASSIGNMENT OF SUBCONTRACTS
§ 5.4.1 Each subcontract agreement for a portion of the Work is assigned by the Contractor to the Owner, provided that assignment is effective only after termination of the Contract by the Owner for cause pursuant to Section 14.2 and only for those subcontract agreements that the Owner accepts by notifying the Subcontractor and Contractor in writing; and
When the Owner accepts the assignment of a subcontract agreement, the Owner assumes the Contractor’s rights and obligations under the subcontract.

§ 5.4.2 Upon such assignment, if the Work has been suspended for more than 30 days, the Subcontractor’s compensation shall be equitably adjusted for increases in cost resulting from the suspension.

§ 5.4.3 Upon such assignment to the Owner under this Section 5.4, the Owner may further assign the subcontract to a successor contractor or other entity. If the Owner assigns the subcontract to a successor contractor or other entity, the Owner shall nevertheless remain legally responsible for all of the successor contractor’s obligations under the subcontract.

§ 5.5 Contractor will require each Subcontractor to employ a competent superintendent or trade foreman who shall be in attendance at the Project site during the progress of Subcontractor’s Work.

ARTICLE 6 CONSTRUCTION BY OWNER OR BY SEPARATE CONTRACTORS

§ 6.1 OWNER’S RIGHT TO PERFORM CONSTRUCTION AND TO AWARD SEPARATE CONTRACTS

§ 6.1.1 The Owner reserves the right to perform construction or operations related to the Project with the Owner’s own forces, and to award separate contracts in connection with other portions of the Project or other construction or operations on the site under Conditions of the Contract identical or substantially similar to these including those portions related to insurance and waiver of subrogation. If the Contractor claims that delay or additional cost is involved because of such action by the Owner, the Contractor shall make such Claim as provided in Article 15.

§ 6.1.1.1 Notwithstanding anything to the contrary, the Owner shall have the right to install fixed and loose furniture, furnishings, fixtures, data communications lines, equipment and other items during the Contractor’s performance of the Work or portion(s) thereof. The Owner and the Contractor shall cooperate in scheduling and coordinating any such activities by or on behalf of the Owner. Any such installation or activities by or on behalf of the Owner shall not be deemed as acceptance of any part of any Work not completed in accordance with the Contract Documents.

§ 6.1.2 When separate contracts are awarded for different portions of the Project or other construction or operations on the site, the term “Contractor” in the Contract Documents in each case shall mean the Contractor who executes each separate Owner-Contractor Agreement.

§ 6.1.3 The Owner shall provide for coordination of the activities of the Owner’s own forces and of each separate contractor with the Work of the Contractor, who shall cooperate with them. The Contractor shall participate with other separate contractors and the Owner in reviewing their construction schedules. The Contractor shall make any revisions to the construction schedule deemed necessary after a joint review and mutual agreement. The construction schedules shall then constitute the schedules to be used by the Contractor, separate contractors and the Owner until subsequently revised.

§ 6.1.4 Intentionally omitted.

§ 6.2 MUTUAL RESPONSIBILITY

§ 6.2.1 The Contractor shall afford the Owner and separate contractors reasonable opportunity for introduction and storage of their materials and equipment and performance of their activities, and shall connect and coordinate the Contractor’s construction and operations with theirs as required by the Contract Documents.

§ 6.2.2 If part of the Contractor’s Work depends for proper execution or results upon construction or operations by the Owner or a separate contractor, the Contractor shall, prior to proceeding with that portion of the Work, promptly report to the Architect apparent discrepancies or defects in such other construction that would render it unsuitable for such proper execution and results. Failure of the Contractor so to report shall constitute an acknowledgment that the Owner’s or separate contractor’s completed or partially completed construction is fit and proper to receive the Contractor’s Work, except as to defects not then reasonably discoverable.
§ 6.2.3 The Contractor shall reimburse the Owner for costs the Owner incurs that are payable to a separate contractor because of the Contractor’s delays, improperly timed activities or defective construction. The Owner shall be responsible to the Contractor for costs the Contractor incurs because of a separate contractor’s delays, improperly timed activities, damage to the Work or defective construction.

§ 6.2.4 The Contractor shall promptly remedy damage the Contractor wrongfully causes to completed or partially completed construction or to property of the Owner or separate contractors as provided in Section 10.2.5.

§ 6.2.5 The Owner and each separate contractor shall have the same responsibilities for cutting and patching as are described for the Contractor in Section 3.14.

§ 6.3 OWNER’S RIGHT TO CLEAN UP
If a dispute arises among the Contractor, separate contractors and the Owner as to the responsibility under their respective contracts for maintaining the premises and surrounding area free from waste materials and rubbish, the Owner may clean up and the Architect will allocate the cost among those responsible.

ARTICLE 7  CHANGES IN THE WORK
§ 7.1 GENERAL
§ 7.1.1 Changes in the Work may be accomplished after execution of the Contract, and without invalidating the Contract, by Change Order, Construction Change Directive or order for a minor change in the Work, subject to the limitations stated in this Article 7 and elsewhere in the Contract Documents.

§ 7.1.2 A Change Order shall be based upon agreement among the Owner, Contractor and Architect; a Construction Change Directive requires agreement by the Owner and Architect and may or may not be agreed to by the Contractor; an order for a minor change in the Work may be issued by the Architect alone.

§ 7.1.3 Changes in the Work shall be performed under applicable provisions of the Contract Documents, and the Contractor shall proceed promptly, unless otherwise provided in the Change Order, Construction Change Directive or order for a minor change in the Work.

§ 7.1.4 If, subsequent to execution of the Agreement, the Architect issues any proposal requests, supplemental instructions, sketches and other materials intended to further define, clarify or modify the Contract Documents (collectively, the “Supplemental Material”) Contractor shall, within ten (10) days of receiving any Supplemental Material, notify the Architect and Owner’s Representative in writing of any error, inconsistency or discrepancy that the Contractor discovers between the Supplemental Materials and the Contract Documents and indicate whether the Supplemental Material have any impact upon the Contract Sum and/or the Contract Time. Failure of the Contractor to provide such notice is hereby deemed to mean: (1) such Supplemental Materials are consistent with the Contract Documents; (2) do not require a change in the Contract Sum and/or Contract Time; and (3) Contractor is willing and able to perform all of the Work for the Contract Sum, and in accordance with all the requirements of the Contract Documents. If the Contractor notifies the Owner’s Representative and Architect that it believes the Supplemental Materials are either inconsistent with the Contract Documents and/or represent added Work or will delay performance in accordance with the Project schedule, the Owner’s Representative and Architect will review the Contractor’s response and provide the Owner with recommendations for approval or disapproval, and the Owner shall have one or more of the following options:

(a) The Owner may direct the Architect to modify that aspect of the Supplemental Materials to which the Contractor objects. The Contractor shall cooperate with the Owner, Owner’s Representative and the Architect during the modification effort and shall make recommendations appropriate to correct such portions of the Supplemental Materials. The Architect shall submit to the Contractor the revised Supplemental Materials as approved by the Owner. The Contractor shall promptly reexamine such revised Supplemental Materials as described in Section 7.1.4;

(b) If, upon review of the Contractor’s notice, the Owner (after consultation with the Architect and Owner’s Representative) believes that the portion of the Work described therein does not constitute a material change in the Work, or disagrees as to the impact claimed by the Contractor to the Contract Sum or Contract Time,
as applicable, the Owner may so advise the Contractor through the Owner’s Representative or Architect. If such disagreement is not promptly resolved, the Work subject to disagreement shall be identified in a schedule (the “Disputed Work Schedule”). Whenever possible, the Owner and the Contractor shall resolve items set forth in the Disputed Work Schedule confirming such resolution in Change Orders. Items in the Disputed Work Schedule that are not resolved by the Owner and the Contractor shall be subject to the dispute resolution procedures set forth in Article 15. During the pendency of such dispute resolution procedures, all items remaining in the Disputed Work Schedule shall be performed by the Contractor as required by the Contract Documents and a tentative adjustment shall be made to the Contract Sum to the extent of any undisputed aspect of the item. No adjustment shall be made to the Contract Sum for any disputed item or portion of an item. For each remaining item in the Disputed Work Schedule, the Contractor shall keep a specific, detailed accounting of the time and materials required to complete such item. Adjustments to the Schedule shall not be permitted on a tentative basis; or

(c) If, upon review of such notice from Contractor, the Owner agrees that all or a portion of the Work therein entitles the Contractor to Change Order and the Owner elects not to direct the Architect to modify the Supplement Materials, the Owner and the Contractor shall enter into a written Change Order providing for such agreed changes to the Contract Sum and/or Contract Time, as applicable.

§ 7.1.5 Unless otherwise agreed to by the Owner, the aggregate limitation on the amount of profit and overhead that the Contractor, each Subcontractor and all lower lien subcontractors and suppliers can charge for Work performed pursuant to Change Orders and Construction Change Directives shall be as follows: (a) for the Contractor for Work performed by the Contractor’s own forces, _ten_ percent (_10_%) of the cost of the Work; (b) for the Contractor for Work performed by Subcontractors, _five_ percent (_5_%) of the cost of such Work; (c) for each Subcontractor for Work performed by such Subcontractor’s own forces, _ten_ percent (_10_%) of the cost of such Work for overhead and for profit; and (d) for each Subcontractor for Work performed by lower tier subcontractors, _five_ percent (_5_%) of the cost of such Work for overhead and for profit. This aggregate combined profit and overhead amount shall include all other markups and non-direct costs.

§ 7.2 CHANGE ORDERS
§ 7.2.1 A Change Order is a written instrument prepared by the Architect and signed by the Owner, Contractor and Architect stating their agreement upon all of the following:

.1 The change in the Work;
.2 The amount of the adjustment, if any, in the Contract Sum; and
.3 The extent of the adjustment, if any, in the Contract Time.

§ 7.2.2 Unless expressly reserved therein, an executed Change Order shall constitute a final settlement of all matters relating to the change in the Work which is the subject of the Change Order, including, but not limited to, all direct and indirect costs associated with such change, any adjustments to the Contract Sum or GMP and any adjustments to the Schedule, Contract Time and/or Milestone Dates.

§ 7.3 CONSTRUCTION CHANGE DIRECTIVES
§ 7.3.1 A Construction Change Directive is a written order prepared by the Architect and signed by the Owner and Architect, directing a change in the Work prior to agreement on adjustment, if any, in the Contract Sum or Contract Time, or both. The Owner may by Construction Change Directive, without invalidating the Contract, order changes in the Work within the general scope of the Contract consisting of additions, deletions or other revisions, the Contract Sum and Contract Time being adjusted accordingly.

§ 7.3.2 A Construction Change Directive shall be used in the absence of total agreement on the terms of a Change Order.

§ 7.3.3 If the Construction Change Directive provides for an adjustment to the Contract Sum, the adjustment shall be based on one of the following methods:

.1 Mutual acceptance of a lump sum properly itemized and supported by sufficient substantiating data to permit evaluation;
.2 Unit prices stated in the Contract Documents or subsequently agreed upon;
Cost to be determined in a manner agreed upon by the parties and a mutually acceptable fixed or percentage fee; or

As provided in Section 7.3.7.

§ 7.3.4 If unit prices are stated in the Contract Documents or subsequently agreed upon, and if quantities originally contemplated are materially changed in a proposed Change Order or Construction Change Directive so that application of such unit prices to quantities of Work proposed will cause substantial inequity to the Owner or Contractor, the applicable unit prices shall be equitably adjusted.

§ 7.3.5 Upon receipt of a Construction Change Directive, the Contractor shall promptly proceed with the change in the Work involved and advise the Architect of the Contractor’s agreement or disagreement with the method, if any, provided in the Construction Change Directive for determining the proposed adjustment in the Contract Sum or Contract Time.

§ 7.3.6 A Construction Change Directive signed by the Contractor indicates the Contractor’s agreement therewith, including adjustment in Contract Sum and Contract Time or the method for determining them. Such agreement shall be effective immediately and shall be recorded as a Change Order.

§ 7.3.7 Failure of the Contractor to notify the Owner of any disagreement with any proposed adjustment to the Contract Sum or Contract Time, as applicable, or method for determining them set forth in a Construction Change Directive within ten days after the date of receipt by the Contractor of such Construction Change Directive shall be deemed to be an agreement by the Contractor to the proposed adjustment to the Contract Sum or Contract Time or method for determining them set forth in such Construction Change Directive. If the Contractor disagrees in writing on a timely basis with the method for adjustment in the Contract Sum, the Architect shall determine the method and the adjustment on the basis of reasonable expenditures and savings of those performing the Work attributable to the change, including, in case of an increase in the Contract Sum, an amount for overhead and profit in accordance with Section 7.1.5 above.. In such case, and also under Section 7.3.3.3, the Contractor shall keep and present, in such form as the Architect may prescribe, an itemized accounting together with appropriate supporting data. If the Owner and the Contractor fail to agree on the adjustment to the Contract Sum or Contract Time, as applicable, or method for determining them arising from any Construction Change Directive, (a) the adjustment to the Contract Sum shall be the net increase or decrease in the Cost of the Work attributable to the Construction Change Directive plus mark-up per Section 7.1.5 and (b) the adjustment to the Contract Time shall be equal to the net increase or decrease (if any) in the time required to perform the entire Work attributable to the Construction Change Directive. As used in this Section, the term "Cost of the Work" for Contractor shall mean the Cost of the Work as defined in the Agreement and for Subcontractors as defined in Section 7.6 below. Any disagreement as to the determination of such items that are not resolved by the Owner and the Contractor shall be subject to the dispute resolution procedures set forth in Article 15 of these General Conditions of the Contract.

§ 7.3.8 The amount of credit to be allowed by the Contractor to the Owner for a deletion or change that results in a net decrease in the Contract Sum shall be actual net cost as confirmed by the Architect. When both additions and credits covering related Work or substitutions are involved in a change, the allowance for overhead and profit shall be figured on the basis of net increase, if any, with respect to that change.

§ 7.3.9 Pending final determination of the total cost of a Construction Change Directive to the Owner, the Contractor may request payment for Work completed under the Construction Change Directive in Applications for Payment. The Architect will make an interim determination for purposes of monthly certification for payment for those costs and certify for payment the amount that the Architect determines, in the Architect’s professional judgment, to be reasonably justified. The Architect’s interim determination of cost shall adjust the Contract Sum on the same basis as a Change Order, subject to the right of either party to disagree and assert a Claim in accordance with Article 15.

§ 7.3.10 When the Owner and Contractor agree with a determination made by the Architect concerning the adjustments in the Contract Sum and Contract Time, or otherwise reach agreement upon the adjustments, such agreement shall be effective immediately and the Architect will prepare a Change Order. Change Orders may be issued for all or any part of a Construction Change Directive.
§ 7.4 MINOR CHANGES IN THE WORK
The Architect has authority to order minor changes in the Work not involving adjustment in the Contract Sum or extension of the Contract Time and not inconsistent with the intent of the Contract Documents. Such changes will be effected by written order signed by the Architect and shall be binding on the Owner and Contractor.

§ 7.5 BACK–UP FOR CHANGE ORDERS
§ 7.5.1 Lump Sum Proposal: The Contractor, Subcontractor or lower tier subcontractor’s proposal covering the extra Work or change will be itemized for the various components or Work and segregated by labor, material and equipment in a detailed format satisfactory to the Owner. Such format will include a material and labor quantity take-off and related pricing information and extensions (by drawing, if applicable). The Contractor will furnish his itemized lump sum proposal and the similarly detailed proposals of any Subcontractors, lower tier subcontractors or material suppliers.

§ 7.5.2 Time and Material: Should the Owner elect to have the extra Work or change performed on a time and material basis, and so notify the Contractor in writing, the Contractor, Subcontractor or lower tier subcontractor shall perform the Work in such manner. Records supporting the actual cost of the Work (as defined in the Section 7.6) performed must be kept and forwarded to the Owner’s representative. Such records include, but are not limited to, material tickets for all actual material used, daily time sheets itemizing workmen’s names and hours worked for all actual labor costs, and such other evidence as the Owner’s representative may reasonably request. Owner may require authentication of all time sheets and material tickets. If so requested, the failure to provide such authentication may constitute a waiver of any rights to payment of the Contractor, Subcontractor or any lower tier subcontractor for the extra Work or change performed.

§ 7.5.3 Unit Prices: The Contractor, Subcontractor or lower tier subcontractor’s proposal shall itemize the quantities of each item of Work for which there is an applicable unit price. The quantities must be itemized in relation to each specific Contract Drawing.

§ 7.6 ACTUAL COST OF THE WORK FOR SUBCONTRACTORS
§ 7.6.1 If performed on a time and material basis, the Actual Cost of the Work for a Subcontractor shall comprise the following elements:

§ 7.6.1.1 Direct Job Costs for Labor: The number of hours, hourly payroll cost, labor burden (as defined in 7.6.1.2) and extended totals for each item of Work to arrive at the cost for direct jobsite labor including working foremen. All other administration, clerical expense and supervision above the level of working foremen (such as general foremen, superintendent, project manager, etc.) shall be considered covered by the Subcontractor’s mark-up per Section 7.1.5.

§ 7.6.1.2 Labor Burden: The employer’s net actual cost of payroll taxes (FICA, SUTA, FUTA), net actual cost of union benefits, and net actual cost for workers’ compensation insurance, taking into consideration adjustments for experience modifiers, premium discounts, dividends, rebates, etc. Labor burden shall not be considered to include costs of Commercial General Liability Insurance, auto insurance or umbrella insurance which shall be considered covered by the Subcontractor’s mark-up per Section 7.1.5.

§ 7.6.1.3 Direct Job Costs for Materials & Equipment: The quantity, price and extended totals for each item of Work to arrive at the costs of direct material and equipment. Appropriate amounts may be included for the rental of major equipment (defined as tools and equipment with individual purchase costs of more than $1,000) specifically needed to perform the extra Work or change. Use of small tools (defined as tools and equipment with individual purchase costs of less than $1,000) is considered covered by the mark-up percentage to be added to the direct cost of the extra work or change. Cost, for construction equipment, shall be the lower of the total expected rental cost or ownership cost equivalent including transportation charges and all applicable taxes.

§ 7.6.2 If performed on a unit price basis, the Actual Cost of Work shall comprise the following elements:

§ 7.6.2.1 Unit prices are for Work complete, measured in place (i.e., actual quantity installed) and cover profit and all other costs and expenses of the Contractor, Subcontractor or lower tier subcontractor. Unit prices include, without limit, all conditions of the Contract and all general requirements such as layout, reproduction of Drawings
and Specifications, testing and inspection, shop drawing and sample coordination, supervision (field and home office), small tools and expendable items, insurance, taxes, temporary facilities and services, including access and safety provisions, "as-built" drawings, and general and administrative overhead and profit.

§ 7.6.2.2 Unit Price Application: For unit price items, additions and deletions of like items shall be algebraically summed and then multiplied by the applicable unit prices.

§ 7.6.3 Any changes undertaken without the Architect’s or the Owner’s authorization will not be recognized as a basis for a Claim for extra cost at a later date. If the Contractor claims that any instructions or orders, whether oral, written, by drawings, or otherwise, involve extra cost or time, and such instructions or orders are not accompanied by a written acknowledgement by the Owner or the Architect that extra payment will be made or time extended, they shall promptly so notify the Architect in writing and should not proceed with the Work until they have received a further written order to proceed, except in cases of emergency affecting life or property. No claim for extra cost or time on account of such instructions shall be valid unless the Contractor has so notified the Architect, before proceeding, that they claim extra cost and time and has received the further written order form the Owner’s representative to proceed.

ARTICLE 8 TIME
§ 8.1 DEFINITIONS
§ 8.1.1 Unless otherwise provided, Contract Time is the period of time, including authorized adjustments, allotted in the Contract Documents for Substantial Completion of the Work.

§ 8.1.2 The date of commencement of the Work is the date established in the Agreement.

§ 8.1.3 The date of Substantial Completion is the date certified by the Architect in accordance with Section 9.8.

§ 8.1.4 The term “day” as used in the Contract Documents shall mean calendar day unless otherwise specifically defined.

§ 8.2 PROGRESS AND COMPLETION
§ 8.2.1 Time limits stated in the Contract Documents are of the essence of the Contract. By executing the Agreement the Contractor confirms that the Contract Time is a reasonable period for performing the Work.

§ 8.2.2 The Contractor shall not knowingly, except by agreement or instruction of the Owner in writing, prematurely commence operations on the site or elsewhere prior to the effective date of insurance required by Article 11 to be furnished by the Contractor and Owner. The date of commencement of the Work shall not be changed by the effective date of such insurance.

§ 8.2.3 The Contractor shall proceed expeditiously with adequate forces and shall achieve Substantial Completion within the Contract Time.

§ 8.3 DELAYS AND EXTENSIONS OF TIME
§ 8.3.1 If the Contractor is delayed at any time in the progress of the Work by an act or neglect of the Owner or Architect, or of an employee of either, or of a separate contractor employed by the Owner; or by changes ordered in the Work; or by area-wide labor disputes not directed expressly at Contractor or any Subcontractor, fire, unusual delay in deliveries, unavoidable casualties or other causes beyond the Contractor’s control; or by delay authorized by the Owner; or by other causes that the Architect determines may justify delay, then the Contract Time shall be extended by Construction Change Directive for such reasonable time as the Architect may determine. The Contractor acknowledges and agrees that (a) no adjustments to the Contract Time shall be made unless the events described above shall have the effect of actually delaying completion of components of the Work on the critical path indicated in the Schedule and (b) adjustments to Milestone Dates and/or the Contract Time will be permitted in connection with any such delay only to the extent such delay (i) is not caused, or could not have been avoided, by the Contractor, (ii) could not be limited or avoided by the Contractor’s timely notice to the Owner of the delay, (iii) has an impact of at least one (1) day and (iv) has no concurrent or contributing cause for which the Contractor would not be entitled to an extension of the Contract Time. Notwithstanding anything to the contrary, the Contractor shall
not be entitled to any extension in the Contract Time for delays in receiving required licenses, permits, inspections or approvals unless the Owner is required to provide or obtain such licenses, permits, inspections or approvals.

§ 8.3.2 Claims relating to time shall be made in accordance with applicable provisions of Article 15 and this section 8.3.2 through section 8.3.8 below. Contractor’s written Claim for extension of Contract Time shall be accompanied by detailed dates, correspondence, notices, and any other data which provides proof of the events which are the basis for the Claim, including a network analysis justifying the time extension. Said network analysis shall specifically detail the extension of the critical path of the Project caused by the events which underlie the time extension request.

§ 8.3.3 Should the Contractor be delayed in the performance of the Work, the Contractor shall (a) notify the Owner and the Architect in writing within three (3) days following the event or occurrence causing such delay and (b) notify the Owner and the Architect of the estimated extent of the delay and the cost, if any, which may be incurred as result of the delay within twenty-one (21) days following the event or occurrence causing such delay. If the Contractor fails to so notify the Owner and the Architect, the Contractor shall be barred from asserting any claim for compensation, expense or damages with respect to such delay.

§ 8.3.4 No claim for delay shall be allowed on account of failure of the Architect to furnish Drawings, Specifications or instructions, or to return Shop Drawings or Samples until a reasonable period of time (but in any event not less than fifteen days or such longer period as may be agreed to among the Architect, the Contractor and the Owner) after receipt by the Architect of written demand for such instructions, Drawings, or Samples, and not then unless the Contractor shows that the Architect’s delay has materially interfered with the progress of the Work.

§ 8.3.5 Notwithstanding anything to the contrary in any of the Contract Documents, the Contractor acknowledges and agrees that no extension of time shall be granted on account of weather conditions except as provided for in this Section 8.3.5. A Claim by the Contractor for an increase in the Contract Time on account of weather shall only be granted if all the following conditions are met: (1) the weather during any calendar month (or pro rata portions of partial months at the beginning and end of the Contract Time) is "abnormal," as defined below; (2) the Contractor demonstrates that such abnormal weather had the effect of delaying completion of components of Work on the critical path indicated in the Construction Schedule; and (3) such Claim is made by written notice. "Abnormal weather" shall, for purposes of this Section, be limited to circumstances in which adverse weather conditions significantly exceed those which have historically been encountered, or may reasonably be expected to be encountered, at the Project site.

§ 8.3.6 If any of events described in this Section 8.3 of the General Conditions of the Contract entitle the Contractor to an extension of the Contract Time, the sole remedy of the Contractor shall be such extension of the Contract Time and the Contractor shall not be entitled to any adjustment of the Contract Sum, except as otherwise provided in the following sentence. If and to the extent that the Contract Time is extended by more than ten (10) business days solely on account of fault or neglect of the Owner or Architect, the Contract Sum shall be increased by the Contractor’s reasonable and verified additional direct out of pocket costs of performing the Work to the extent directly and solely attributable to extensions of the Contract Time on account of the fault or neglect of the Owner or Architect in excess of ten (10) business days.

§ 8.3.7 The Owner and Contractor agree that it is the intent of the Contract Documents that the Contractor shall have responsibility to achieve Substantial Completion of the Work within the Contract Time with an adequate work force, irrespective of any labor dispute (other than those of general applicability not directed at the Project, the Contractor or anyone for whom the Contractor is responsible), including picketing at or near the Project site, whether or not the Contractor is the primary employer involved in the labor dispute or a neutral employer, and whether or not the Contractor has a collective bargaining relationship with the union(s) involved in the labor dispute. Notwithstanding anything to the contrary in any of the Contract Documents, the Contractor acknowledges and agrees that no extension of time shall be granted on account of a labor dispute (other than those of general applicability not directed at the Project, the Contractor, or anyone for whom the contractor is responsible).

§ 8.3.8 If the Contractor submits a progress report indicating, or otherwise expresses an intention to achieve, completion of the Work prior to any completion date required by the Contract Documents or expiration of the Contract Time, no liability of the Owner to the Contractor for any failure of the Contractor to so complete the Work shall be created or implied.
ARTICLE 9  PAYMENTS AND COMPLETION

§ 9.1 CONTRACT SUM
The Contract Sum is stated in the Agreement and, including authorized adjustments, is the maximum amount payable by the Owner to the Contractor for performance of the Work under the Contract Documents. The Contractor shall provide to the Owner, throughout the course of the Work, reports projecting the cash flow needs of the Contractor. This report shall be prepared and delivered monthly, projecting the anticipated needs for the balance of the Project.

§ 9.2 SCHEDULE OF VALUES
Where the Contract is based on a stipulated sum or Guaranteed Maximum Price, the Contractor shall submit to the Owner and Architect, before the first Application for Payment, a schedule of values allocating the entire Contract Sum to the various portions of the Work and prepared in such form and supported by such data to substantiate its accuracy as the Architect may require and shall be revised if later found by the Architect to be inaccurate. This schedule, unless objected to by the Architect, shall be used as a basis for reviewing the Contractor’s Applications for Payment. Each item in the schedule of values shall be exclusive of the Contractor’s Fee. The proper share of the Contractor’s Fee for each item shall be listed in a separate line or column.

§ 9.3 APPLICATIONS FOR PAYMENT
§ 9.3.1 At the time or times established in the Agreement for each progress payment, the Contractor shall submit to the Architect an itemized Application for Payment prepared in accordance with the schedule of values, if required under Section 9.2., for completed portions of the Work. The format and number of copies of such Applications for Payment shall be as directed by the Owner. Such application shall be notarized, if required, and supported by such data substantiating the Contractor’s right to payment as the Owner or Architect may require, such as copies of requisitions from Subcontractors and material suppliers, and shall reflect retainage if provided for in the Contract Documents. Each Application for Payment shall be accompanied by the following, all in form and substance satisfactory to the Owner: (i) a current Contractor’s lien waiver and duly executed and acknowledged sworn statement showing all Subcontractors and material suppliers with whom the Contractor has entered into subcontracts, the amount of each such subcontract, the amount requested for any Subcontractor and material supplier in the requested progress payment, together with similar sworn statements from all such Subcontractors and material suppliers: (ii) duly executed waivers of mechanics’ and material suppliers’ liens from all Subcontractors and, when appropriate, from material suppliers and lower tier Subcontractors establishing payment or satisfaction of payment of all amounts requested by the Contractor on behalf of such entities or persons in any previous Application for Payment; (iii) proof of compliance with insurance and surety provisions as outlined in this Agreement: (iv) an updated Schedule that accurately reflects the current status of the Project: and (v) all information and materials required to comply with the requirements of the Contract Documents or reasonably requested by the Owner or the Architect.

§ 9.3.1.1 As provided in Section 7.3.9, such applications may include requests for payment on account of changes in the Work that have been properly authorized by Construction Change Directives, or by interim determinations of the Architect, but not yet included in Change Orders when such Construction Change Directives have set forth an adjustment to the Contract Sum.

§ 9.3.2 Applications for Payment shall not include requests for payment for portions of the Work for which the Contractor does not intend to pay a Subcontractor or material supplier, unless such Work has been performed by others whom the Contractor intends to pay.

§ 9.3.2 Unless otherwise provided in the Contract Documents, payments shall be made on account of materials and equipment delivered and suitably stored at the site for subsequent incorporation in the Work. If approved in advance by the Owner, payment may similarly be made for materials and equipment suitably stored off the site at a location agreed upon in writing. Payment for materials and equipment stored on or off the site shall be conditioned upon compliance by the Contractor with procedures satisfactory to the Owner to establish the Owner’s title to such materials and equipment or otherwise protect the Owner’s interest, and shall include the costs of applicable insurance, storage and transportation to the site for such materials and equipment stored off the site.
§ 9.3.3 The Contractor warrants that title to all Work covered by an Application for Payment will pass to the Owner no later than the time of payment. The Contractor further warrants that upon submittal of an Application for Payment all Work for which Certificates for Payment have been previously issued and payments received from the Owner shall, to the best of the Contractor’s knowledge, information and belief, be free and clear of liens, claims, security interests or encumbrances in favor of the Contractor, Subcontractors, material suppliers, or other persons or entities making a claim by reason of having provided labor, materials and equipment relating to the Work.

§ 9.3.4 Contractor shall maintain record drawings as required by the Contract Documents, including for the mechanical and electrical trades, and shall review and inspect such drawings on a monthly basis. Contractor shall, on a monthly basis provide to Owner written confirmation that the record drawings are current.

§ 9.4 CERTIFICATES FOR PAYMENT
§ 9.4.1 The Architect will, within seven days after receipt of the Contractor’s Application for Payment, either issue to the Owner a Certificate for Payment, with a copy to the Contractor, for such amount as the Architect determines is properly due, or notify the Contractor and Owner in writing of the Architect’s reasons for withholding certification in whole or in part as provided in Section 9.5.1.

§ 9.4.2 The issuance of a Certificate for Payment will constitute a representation by the Architect to the Owner, based on the Architect’s evaluation of the Work and the data comprising the Application for Payment, that, to the best of the Architect’s knowledge, information and belief, the Work has progressed to the point indicated and that the quality of the Work is in accordance with the Contract Documents. The foregoing representations are subject to an evaluation of the Work for conformance with the Contract Documents upon Substantial Completion, to results of subsequent tests and inspections, to correction of minor deviations from the Contract Documents prior to completion and to specific qualifications expressed by the Architect. The issuance of a Certificate for Payment will further constitute a representation that the Contractor is entitled to payment in the amount certified. However, the issuance of a Certificate for Payment will not be a representation that the Architect has (1) made exhaustive or continuous on-site inspections to check the quality or quantity of the Work, (2) reviewed construction means, methods, techniques, sequences or procedures, (3) reviewed copies of requisitions received from Subcontractors and material suppliers and other data requested by the Owner to substantiate the Contractor’s right to payment, or (4) made examination to ascertain how or for what purpose the Contractor has used money previously paid on account of the Contract Sum.

§ 9.5 DECISIONS TO WITHHOLD CERTIFICATION
§ 9.5.1 The Architect may withhold a Certificate for Payment in whole or in part, to the extent reasonably necessary to protect the Owner, if in the Architect’s opinion the representations to the Owner required by Section 9.4.2 cannot be made. If the Architect is unable to certify payment in the amount of the Application, the Architect will notify the Contractor and Owner as provided in Section 9.4.1. If the Contractor and Architect cannot agree on a revised amount, the Architect will promptly issue a Certificate for Payment for the amount for which the Architect is able to make such representations to the Owner. The Architect may also withhold a Certificate for Payment or, because of subsequently discovered evidence, may nullify the whole or a part of a Certificate for Payment previously issued, to such extent as may be necessary in the Architect’s opinion to protect the Owner from loss for which the Contractor is responsible, including loss resulting from acts and omissions described in Section 3.3.2, because of

1. defective Work not remedied;
2. third party claims filed or reasonable evidence indicating probable filing of such claims unless security acceptable to the Owner is provided by Contractor, including subcontractor and/or supplier lien claims which have not been dissolved by bond by operation of law by the Contractor;
3. failure of the Contractor to make payments properly to Subcontractors or for labor, materials or equipment;
4. reasonable evidence that the Work cannot be completed for the unpaid balance of the Contract Sum;
5. damage to the Owner or a separate contractor;
6. reasonable evidence that the Work will not be completed within the Contract Time, and that the unpaid balance would not be adequate to cover actual or liquidated damages for the anticipated delay; or
7. repeated failure to carry out the Work in accordance with the Contract Documents.
8. failure to maintain current record drawings
§ 9.5.2 When the above reasons for withholding certification are removed, certification will be made for amounts previously withheld.

§ 9.5.3 If the Architect withholds certification for payment under Section 9.5.1.3, the Owner may, at its sole option, issue joint checks to the Contractor and to any Subcontractor or material or equipment suppliers to whom the Contractor failed to make payment for Work properly performed or material or equipment suitably delivered. If the Owner makes payments by joint check, the Owner shall notify the Architect and the Architect will reflect such payment on the next Certificate for Payment.

§ 9.6 PROGRESS PAYMENTS
§ 9.6.1 After the Architect has issued a Certificate for Payment, the Owner shall make payment in the manner and within the time provided in the Contract Documents, and shall so notify the Architect.

§ 9.6.2 The Contractor shall pay each Subcontractor no later than seven days after receipt of payment from the Owner the amount to which the Subcontractor is entitled, reflecting percentages actually retained from payments to the Contractor on account of the Subcontractor’s portion of the Work. The Contractor shall, by appropriate agreement with each Subcontractor, require each Subcontractor to make payments to Sub-subcontractors in a similar manner.

§ 9.6.3 Intentionally omitted.

§ 9.6.4 The Owner has the right to request written evidence from the Contractor that the Contractor has properly paid Subcontractors and material and equipment suppliers amounts paid by the Owner to the Contractor for subcontracted Work. If the Contractor fails to furnish such evidence within seven days, the Owner shall have the right to contact Subcontractors to ascertain whether they have been properly paid. Neither the Owner nor Architect shall have an obligation to pay or to see to the payment of money to a Subcontractor, sub-subcontractor, or vendor.

§ 9.6.5 Contractor payments to material and equipment suppliers shall be treated in a manner similar to that provided in Sections 9.6.2 and 9.6.4.

§ 9.6.6 A Certificate for Payment, a progress payment, or partial or entire use or occupancy of the Project by the Owner shall not constitute acceptance of Work not in accordance with the Contract Documents.

§ 9.6.7 Unless the Contractor provides the Owner with a payment bond in the full penal sum of the Contract Sum, payments received by the Contractor for Work properly performed by Subcontractors and suppliers shall be held by the Contractor for those Subcontractors or suppliers who performed Work or furnished materials, or both, under contract with the Contractor for which payment was made by the Owner. Nothing contained herein shall require money to be placed in a separate account and not commingled with money of the Contractor, shall create any fiduciary liability or tort liability on the part of the Contractor for breach of trust or shall entitle any person or entity to an award of punitive damages against the Contractor for breach of the requirements of this provision.

§ 9.7 FAILURE OF PAYMENT
If the Architect does not issue a Certificate for Payment, through no fault of the Contractor, within fourteen (14) days after receipt of the Contractor’s Application for Payment, or if the Owner does not pay the Contractor within fourteen (14) days after the date established in the Contract Documents the amount certified by the Architect, then the Contractor may, upon fourteen (14) additional days’ written notice to the Owner and Architect, stop the Work until payment of the amount owing has been received. The Contract Time shall be extended appropriately and the Contract Sum shall be increased by the amount of the Contractor’s reasonable costs of shut-down, delay and start-up, plus interest as provided for in the Contract Documents.

§ 9.8 SUBSTANTIAL COMPLETION
§ 9.8.1 Substantial Completion is the stage in the progress of the Work when the Work or designated portion thereof is sufficiently complete in accordance with the Contract Documents so that the Owner can occupy or utilize the Work for its intended use and only minor items which can be corrected or completed without any material interference with the Owner’s use of the Work which remains to be corrected or completed. Further, the following items are required from the Contractor prior to the Owner’s issuing of the Certificate of Substantial Completion: (i)
the Owner and Architect agree that the Project is ready for the use intended without any concurrent Work that will disrupt the Owner’s activities; (ii) the Owner and the Architect agree that the Work has been completed in accordance with the Contract Documents, specifications, plans, drawings and all Change Orders; (iii) all HVAC systems included in the Work are functioning in accordance with the Contract Documents and a satisfactory test and balance report for said systems has been received by the Architect; (iv) all life safety systems included in the Work are functioning in accordance with the Contract Documents; (v) receipt by the Architect of the list of all outstanding Work that shall become the Punch List; and (vi) receipt by the Owner of all required final certifications and/or approvals from the governmental authorities having jurisdiction over the Work.

§ 9.8.2 Intentionally omitted.

§ 9.8.3 Upon receipt of the Contractor’s list, the Architect will make an inspection to determine whether the Work or designated portion thereof is substantially complete. If the Architect’s inspection discloses any item, whether or not included on the Contractor’s list, which is not sufficiently complete in accordance with the Contract Documents so that the Owner can occupy or utilize the Work or designated portion thereof for its intended use, the Contractor shall, before issuance of the Certificate of Substantial Completion, complete or correct such item upon notification by the Architect. In such case, the Contractor shall then submit a request for another inspection by the Architect to determine Substantial Completion.

§ 9.8.4 When the Work or designated portion thereof is substantially complete, the Architect will prepare a Certificate of Substantial Completion that shall establish the date of Substantial Completion, shall establish responsibilities of the Owner and Contractor for security, maintenance, heat, utilities, damage to the Work and insurance, and shall fix the time within which the Contractor shall finish all items on the list accompanying the Certificate. Warranties required by the Contract Documents shall commence on the date of Substantial Completion of the Work or designated portion thereof unless otherwise provided in the Certificate of Substantial Completion.

§ 9.8.5 The Certificate of Substantial Completion shall be submitted to the Owner and Contractor for their written acceptance of responsibilities assigned to them in such Certificate. Upon such acceptance and consent of surety, if any, the Owner shall make payment of retainage applying to such Work or designated portion thereof. Such payment shall be adjusted for Work that is incomplete or not in accordance with the requirements of the Contract Documents.

§ 9.9 PARTIAL OCCUPANCY OR USE

§ 9.9.1 The Owner may occupy or use any completed or partially completed portion of the Work at any stage. Such partial occupancy or use may begin whether or not the portion is substantially complete, provided the respective responsibilities of Owner and Contractor for payments, retainage, if any, security, maintenance, heat, utilities, damage to the Work and insurance, and have been established in writing. When the Contractor considers a portion substantially complete, the Contractor shall prepare and submit a list to the Architect as provided under Section 9.8.2. Consent of the Contractor to partial occupancy or use shall not be unreasonably withheld. The stage of the progress of the Work shall be determined by written agreement between the Owner and Contractor or, if no agreement is reached, by decision of the Architect.

§ 9.9.2 Immediately prior to such partial occupancy or use, the Owner, Contractor and Architect shall jointly inspect the area to be occupied or portion of the Work to be used in order to determine and record the condition of the Work.

§ 9.9.3 Unless otherwise agreed upon, partial occupancy or use of a portion or portions of the Work shall not constitute acceptance of Work not complying with the requirements of the Contract Documents.

§ 9.10 FINAL COMPLETION AND FINAL PAYMENT

§ 9.10.1 Upon receipt of the Contractor’s written notice that the Work is ready for final inspection and acceptance and upon receipt of a final Application for Payment, the Architect will promptly make such inspection and, when the Architect finds the Work acceptable under the Contract Documents and the Contract fully performed, the Architect will promptly issue a final Certificate for Payment stating that to the best of the Architect’s knowledge, information and belief, and on the basis of the Architect’s on-site visits and inspections, the Work has been completed in accordance with terms and conditions of the Contract Documents and that the entire balance found to be due the Contractor and noted in the final Certificate is due and payable. The Architect’s final Certificate for Payment will
constitute a further representation that conditions listed in Section 9.10.2 as precedent to the Contractor’s being entitled to final payment have been fulfilled.

§ 9.10.2 Neither final payment nor any remaining retained percentage shall become due until the Contractor submits to the Architect (1) an affidavit that payrolls, bills for materials and equipment, and other indebtedness connected with the Work for which the Owner or the Owner’s property might be responsible or encumbered (less amounts withheld by Owner) have been paid or otherwise satisfied, (2) a certificate evidencing that insurance required by the Contract Documents to remain in force after final payment is currently in effect and will not be canceled or allowed to expire until at least 30 days’ prior written notice has been given to the Owner, (3) a written statement that the Contractor knows of no substantial reason that the insurance will not be renewable to cover the period required by the Contract Documents, (4) consent of surety, if any, to final payment, (5) waivers of liens, in the form provided by the Owner, from the Contractor and all Subcontractors and suppliers who performed portions of the Work or supplied materials or equipment in connection with the Work, (6) the expiration of time within which any Contractor, Subcontractor or supplier could file a lien under law, (7) if required by the Owner, other data establishing payment or satisfaction of obligations, such as receipts, releases and waivers of liens, claims, security interests or encumbrances arising out of the Contract, to the extent and in such form as may be designated by the Owner, (8) to the extent that final certificates(s) of occupancy for the Project and the certificates of inspection and operating permits described in Section 13.5.4 are required by governmental authorities to use and occupy the Project as intended, and to the extent that such items were not delivered to the Owner as a condition to Substantial completion of the Work, the final certificate(s) of occupancy for the Project and the certificates of inspection and operating permits described in Section 13.5.4, (9) the As-Built Documents and reproducible transparencies thereof, in accordance with Section 3.11, (10) all special warranties required by the Contract Documents, endorsed by the Contractor and in a form reasonably acceptable to the Architect and the Owner, and (11) all manufacturers’ catalogs, instructions, and other similar data, including the necessary graphic cuts, diagrams, value charts, and the like, covering all mechanical and manually operated devices furnished and/or installed in any permanent structure. All of the foregoing items shall be submitted to the Owner in a single binder (the "Project Binder"), and the Contractor shall submit to the Owner four (4) copies of the Project Binder. As an additional condition to be satisfied prior to final payment, the Contractor’s personnel or Subcontractors’ or suppliers’ personnel, as appropriate, shall provide the property management and operations personnel at the Property with training in the operation and maintenance of building systems and controls installed as part of the Work. If a Subcontractor refuses to furnish a release or waiver required by the Owner, the Contractor may furnish a bond satisfactory to the Owner to indemnify the Owner against such lien. If such lien remains unsatisfied after payments are made, the Contractor shall refund to the Owner all money that the Owner may be compelled to pay in discharging such lien, including all costs and reasonable attorneys’ fees.

§ 9.10.3 If, after Substantial Completion of the Work, final completion thereof is materially delayed through no fault of the Contractor or by issuance of Change Orders affecting final completion, and the Architect so confirms, the Owner shall, upon application by the Contractor and certification by the Architect, and without terminating the Contract, make payment of the balance due for that portion of the Work fully completed and accepted. If the remaining balance for Work not fully completed or corrected is less than retainage stipulated in the Contract Documents, and if bonds have been furnished, the written consent of surety to payment of the balance due for that portion of the Work fully completed and accepted shall be submitted by the Contractor to the Architect prior to certification of such payment. Such payment shall be made under terms and conditions governing final payment, except that it shall not constitute a waiver of claims.

§ 9.10.4 The making of final payment shall constitute a waiver of Claims by the Owner except those arising from

1. liens, Claims, security interests or encumbrances arising out of the Contract and unsettled;
2. failure of the Work to comply with the requirements of the Contract Documents; or
3. terms of special warranties required by the Contract Documents.
4. any Claim which has not been waived in accordance with this Agreement shall be deemed to have accrued upon discovery by the Owner of the condition or breach upon which such Claim is based, for the purpose of any applicable statute of limitation.

§ 9.10.5 Acceptance of final payment by the Contractor, a Subcontractor or material supplier shall constitute a waiver of claims by that payee except those previously made in writing and identified by that payee as unsettled at the time of final Application for Payment.
ARTICLE 10  PROTECTION OF PERSONS AND PROPERTY

§ 10.1 SAFETY PRECAUTIONS AND PROGRAMS
The Contractor shall be responsible for initiating, maintaining and supervising all safety precautions and programs in connection with the performance of the Contract.

§ 10.2 SAFETY OF PERSONS AND PROPERTY

§ 10.2.1 The Contractor shall take reasonable precautions for safety of, and shall provide reasonable protection to prevent damage, injury or loss to:
   .1 employees on the Work and other persons who may be affected thereby;
   .2 the Work and materials and equipment to be incorporated therein, whether in storage on or off the site, under care, custody or control of the Contractor or the Contractor’s Subcontractors or Sub-subcontractors; and
   .3 other property at the site or adjacent thereto, such as trees, shrubs, lawns, walks, pavements, roadways, structures and utilities not designated for removal, relocation or replacement in the course of construction.

§ 10.2.2 The Contractor shall comply with and give notices required by applicable laws, statutes, ordinances, codes, rules and regulations, and lawful orders of public authorities bearing on safety of persons or property or their protection from damage, injury or loss.

§ 10.2.3 The Contractor shall erect and maintain, as required by existing conditions and performance of the Contract, reasonable safeguards for safety and protection, including posting danger signs and other warnings against hazards, promulgating safety regulations and notifying owners and users of adjacent sites and utilities.

§ 10.2.4 When use or storage of explosives or other hazardous materials or equipment or unusual methods are necessary for execution of the Work, the Contractor shall exercise utmost care and carry on such activities under supervision of properly qualified personnel.

§ 10.2.5 The Contractor shall promptly remedy damage and loss (other than damage or loss insured under property insurance required by the Contract Documents) to property referred to in Sections 10.2.1.2 and 10.2.1.3 caused in whole or in part by the Contractor, a Subcontractor, a Sub-subcontractor, or anyone directly or indirectly employed by any of them, or by anyone for whose acts they may be liable and for which the Contractor is responsible under Sections 10.2.1.2 and 10.2.1.3, except damage or loss attributable to acts or omissions of the Owner or Architect or anyone directly or indirectly employed by either of them, or by anyone for whose acts either of them may be liable, and not attributable to the fault or negligence of the Contractor. The foregoing obligations of the Contractor are in addition to the Contractor’s obligations under Section 3.18.

§ 10.2.6 The Contractor shall designate a responsible member of the Contractor’s organization at the site whose duty shall be the prevention of accidents. This person shall be the Contractor’s superintendent unless otherwise designated by the Contractor in writing to the Owner and Architect.

§ 10.2.7 The Contractor shall not permit any part of the construction or site to be loaded so as to cause damage or create an unsafe condition.

§ 10.2.8 The Contractor shall provide and maintain in good operating condition suitable and adequate fire protection equipment and services, and shall comply with all reasonable recommendations regarding fire protection made by the representatives of the fire insurance company carrying insurance on the Work or by the local fire chief or fire marshal. The area within the site limits, including all storage areas, shall be kept orderly and clean, and all combustible rubbish shall be promptly removed from the site.

§ 10.2.9 The Contractor is responsible for maintaining the area within the site limits free of all debris and food-related trash that may harbor and/or attract rodents. The Contractor shall provide secure refuse containers for all food-related trash. The containers shall be heavy-duty refuse containers with tight-fitting domed lids, with a spring loaded flap, and no opening that allow access by rodents. The Contractor shall notify the Owner immediately whenever rodents or signs of rodents (e.g., burrows, droppings) are observed.
§ 10.2.10 The Contractor shall at all times protect excavations, trenches, buildings and materials, from rain water, ground water, backup or leakage of sewers, drains and other piping, and from water of any other origin and shall remove promptly any accumulation of water. The Contractor shall provide and operate all pumps, piping and other equipment necessary to this end.

§ 10.2.11 The Contractor shall take reasonable precautions to prevent loss or damage caused by vandalism, theft, burglary, pilferage or unexplained disappearance of property of the Owner, whether or not forming part of the Work, located within those areas of the Project to which the Contractor has control.

§ 10.2.8 INJURY OR DAMAGE TO PERSON OR PROPERTY
If either party suffers injury or damage to person or property because of an act or omission of the other party, or of others for whose acts such party is legally responsible, written notice of such injury or damage, whether or not insured, shall be given to the other party within a reasonable time not exceeding 21 days after discovery. The notice shall provide sufficient detail to enable the other party to investigate the matter.

§ 10.3 HAZARDOUS MATERIALS
§ 10.3.1 The Contractor is responsible for compliance with any requirements included in the Contract Documents regarding hazardous materials. If the Contractor encounters a hazardous material or substance not addressed in the Contract Documents and if reasonable precautions and normal and/or customary construction practices will be inadequate to prevent foreseeable bodily injury or death to persons resulting from a material or substance, including but not limited to asbestos or polychlorinated biphenyl (PCB), encountered on the site by the Contractor, the Contractor shall, upon recognizing the condition, immediately stop Work in the affected area and report the condition to the Owner and Architect in writing.

§ 10.3.2 Upon receipt of the Contractor’s written notice, the Owner shall obtain the services of a licensed laboratory to verify the presence or absence of the material or substance reported by the Contractor and, in the event such material or substance is found to be present, to cause it to be rendered harmless. Unless otherwise required by the Contract Documents, the Owner shall furnish in writing to the Contractor and Architect the names and qualifications of persons or entities who are to perform tests verifying the presence or absence of such material or substance or who are to perform the task of removal or safe containment of such material or substance. The Contractor and the Architect will promptly reply to the Owner in writing stating whether or not either has reasonable objection to the persons or entities proposed by the Owner. If either the Contractor or Architect has an objection to a person or entity proposed by the Owner, the Owner shall propose another to whom the Contractor and the Architect have no reasonable objection. When the material or substance has been rendered harmless, Work in the affected area shall resume upon written agreement of the Owner and Contractor. By Change Order, the Contract Time shall be extended appropriately and the Contract Sum shall be increased in the amount of the Contractor’s reasonable additional costs of shut-down, delay and start-up.

§ 10.3.3 Intentionally omitted.
§ 10.3.4 The Owner shall not be responsible under this Section 10.3 for materials or substances the Contractor brings to the site.

§ 10.3.4.1 Hazardous waste that is generated by the Contractor as part of the Work shall be stored and disposed of in accordance with all applicable Federal, State and local regulations. Hazardous waste storage requirements include, but are not limited to, secondary containment, proper labeling, segregation of incompatible materials and routing inspection of storage areas. In addition, all hazardous waste containers shall be constructed of a material that is compatible with the waste, shall be in sound condition, and shall be kept securely closed at all times.

§ 10.3.4.2 The Contractor is responsible for the proper removal and disposition of all surplus chemicals (e.g., paints, lubricants, cleaning products) that they bring on-site as part of the Work. The Contractor shall not use any drain, pipe or plumbing fixture for the disposal of any waste materials. No chemicals that the Contractor brings on-site shall remain on the Project site at the completion of the Work.

§ 10.3.4.3 To ensure that construction activities and the use of heavy equipment does not increase the risk of release of oil or hazardous materials to the environment, the Contractor shall have and implement a Spill Plan that reflects
all regulatory standards. The Contractor shall immediately report all spills/releases to the Owner. The Contractor shall coordinate with the Owner regarding reporting and follow-up documentation to outside regulatory agencies.

§ 10.3.5 The Contractor shall indemnify the Owner for the cost and expense the Owner incurs (1) for remediation of a material or substance the Contractor brings to the site and negligently handles, or (2) where the Contractor fails to perform its obligations under Section 10.3.1, except to the extent that the cost and expense are due to the Owner’s fault or negligence.

§ 10.3.6 If, without negligence on the part of the Contractor, the Contractor is held liable by a government agency for the cost of remediation of a hazardous material or substance outside the scope of its Work solely by reason of performing Work as required by the Contract Documents, the Owner shall indemnify the Contractor for all cost and expense thereby incurred.

§ 10.3.7 Notwithstanding anything to the contrary, the Contractor acknowledges and agrees that the Work will likely require the removal and/or remediation of soil, debris and other items containing hazardous materials or contaminants to the extent disclosed in reports or materials previously delivered to the Contractor. All such Work shall be performed, and all such materials shall be removed and disposed of, by qualified and licensed (where required) parties engaged by the Contractor in compliance with all applicable legal requirements.

§ 10.4 EMERGENCIES
In an emergency affecting safety of persons or property, the Contractor shall act, at the Contractor’s discretion, to prevent threatened damage, injury or loss. Additional compensation or extension of time claimed by the Contractor on account of an emergency shall be determined as provided in Article 15 and Article 7.

ARTICLE 11  INSURANCE AND BONDS
§ 11.1 CONTRACTOR’S LIABILITY INSURANCE
§ 11.1.1 The Contractor shall purchase from and maintain in a company or companies acceptable to Owner and lawfully authorized to do business in the jurisdiction in which the Project is located such insurance as will protect the Contractor from claims which may arise out of or result from the Contractor’s operations and completed operations under the Contract and for which the Contractor may be legally liable, whether such operations be by the Contractor or by a Subcontractor or by anyone directly or indirectly employed by any of them, or by anyone for whose acts any of them may be liable. Such insurance shall include, at a minimum, the following:

§ 11.1.1.1 The Contractor shall maintain the insurance coverages set out in this Section, insuring the Contractor and its employees, agents, and designees, which insurance shall be by policies that are subject to the Owner’s approval:

a. Workers’ Compensation Insurance to cover full liability under the Workers’ Compensation laws of the state or jurisdiction in which the Project is located at the statutory limits required in said jurisdiction, including coverage for the benefits provided under United States Longshoremen’s & Harbor Workers’ Act, if applicable.

b. Employers’ Liability Insurance (with limits of not less than $500,000 per accident for Bodily Injury by accident, $500,000 each employee - by disease and $500,000 policy limit - by disease), covering operations of the Contractor.

c. Commercial General Liability (“CGL”) Insurance for operations of the Contractor with coverage written at least as broad as that of the standard Commercial General Liability Insurance policy (Occurrence Form) including hazards of operations (including explosions, collapse, and underground operations), with contractual liability coverage and personal injury liability coverage for claims arising out of this Agreement. The insurance required by this subsection (c) shall be written for not less than limits of liability as follows: $1,000,000 each occurrence for bodily injury and property damage; $2,000,000 general aggregate; and $2,000,000 aggregate products/completed operations. CGL coverage shall be written on ISO Occurrence Form CG 00 01 (10 01) or a substitute form providing equivalent coverage and shall cover liability arising from premises, operations, independent contractors, products, completed operations, and personal and advertising injury.
d. Automobile Liability Insurance covering all owned non-owned and hired automobiles, trucks, and trailers of the Contractor. Such insurance coverage shall be written at least as broad as that of the Standard Commercial Automobile Liability policy and shall be written for not less than a $1,000,000 limit of liability per occurrence for bodily injury and property damage.

e. Should aircraft or watercraft of any kind be used by Contractor, any tier of Subcontractor or by anyone else on their behalf, Contractor or Subcontractor shall maintain or cause the operator of the aircraft/watercraft to maintain Aircraft/Watercraft Public Liability Insurance including bodily injury, property damage, and passenger liability, with respect to any aircraft/watercraft owner, used, operated or hired in connection with the Work the Contractor, Subcontractor or anyone else written for not less than a $5,000,000 limit of liability per occurrence for bodily injury and property damage.

f. Should the performance of this Agreement require the Contractor, any tier of subcontractor or anyone else on their behalf to conduct any activities in the vicinity of a railroad, the Contractor or Subcontractor shall maintain such Railroad Protective Insurance as may be required by the affected railroad written for not less than the limits required by such railroad. The Contractor's Railroad Protective Insurance shall be written on the policy form required by the affected railroad.

g. Excess or Umbrella Liability Insurance with coverage written at least as broad as those of the primary policies required by this Subsections I (b), (c), (d) and (e) above and written for not less than a $10,000,000 limit of liability per occurrence.

§ 11.1.1.2 Each insurance policy to be maintained under the prior Section, subparts 1 (b), (c), (d), (e), (f), and (g), shall be endorsed to name as Additional Insureds: the Owner, Owner’s Representative, Architect and the trustees, directors, officers, agents, consultants, servants and employees of each of them and all other interests as may be reasonably required by the Owner. Such parties shall be included as Additional Insureds on the CGL and Umbrella using ISO Additional Insured Endorsement CG 20 10 (11 85) or CG 20 33 (10 01) AND CG 20 37 (10 01) or an endorsement providing equivalent coverage to the additional insureds. This insurance for the Additional Insureds shall be as broad as the coverage provided for the named insured. Such insurance shall apply as primary and non-contributing insurance before any other insurance or self insurance, including any deductible, maintained by, or provided to, the Additional Insured. If the Additional Insureds have other insurance which is applicable to the loss, such other insurance shall be on an excess or contingent basis and apply to the Additional Insureds only. The amount of Contractor’s insurance shall not be reduced by the existence of such other insurance. All Subcontractors shall provide endorsements naming the Contractor, the Owner, Owner’s Representative, Architect, and any lenders of Owner and all other parties required by this Agreement as “Additional Insureds” on their CGL and Umbrella policies using the same ISO forms or combinations of forms, Contractor and all Subcontractors shall maintain CGL and Umbrella coverage for themselves and all additional insureds for the duration of the Work and maintain Completed Operations coverage for themselves and the Additional Insureds for at least six (6) years after Substantial Completion of the Work.

§ 11.1.1.3 Prior to the date on which Contractor commences the performance of the Work, the Contractor shall cause to be furnished to the Owner the Certificate of Insurance for the coverages required by this Agreement to be maintained by Contractor with insurance carriers acceptable to the Owner. As and when the Owner may direct, copies of the actual insurance policies or renewals or replacements thereof shall be submitted to the Owner. All copies of policies, if any, and Certificates of Insurance submitted to the Owner shall be in form and content acceptable to the Owner. In the event Contractor maintains insurance with limits exceeding the limits required hereunder, the Certificate of Insurance shall state the full extent of the coverage available to the above Additional Insureds. Such excess liability coverage will inure to the benefit of the Additional Insureds in the event of loss in excess of the minimum insurance required herein. Contractor will obtain and maintain copies of Certificates of Insurance from all Subcontractors.

§ 11.1.1.4 Contractor shall require all policies of insurance that are secured and maintained by Contractor to include clauses providing that each carrier shall waive all of its rights of recovery, under subrogation or otherwise, against the Owner, Owner’s Representative, Architect and their affiliates. In addition, Contractor waives all rights of recovery against the Owner, Owner’s Representative and/or Architect it may have or acquire because of deductible clauses in or inadequacy of limits of any policies of insurance that are in any way related to the Work or activities of
Contractor. Nothing contained herein shall relieve contractor from its obligations to exercise due care in the performance of its duties under this Contract. If the Contractor fails to furnish and maintain the required insurance, the Owner may, at its option, purchase such insurance on behalf of the Contractor, and Contractor shall pay the cost thereof to the Owner upon demand and shall furnish to the Owner any information needed to obtain such insurance.

§ 11.1.2 Intentionally omitted.

§ 11.1.3 Certificates of insurance acceptable to the Owner shall be filed with the Owner prior to commencement of the Work and thereafter upon renewal or replacement of each required policy of insurance. These certificates and the insurance policies required by this Section 11.1 shall contain a provision that coverages afforded under the policies will not be canceled or allowed to expire until at least 30 days’ prior written notice has been given to the Owner. An additional certificate evidencing continuation of liability coverage, including coverage for completed operations, shall be submitted with the final Application for Payment as required by Section 9.10.2 and thereafter upon renewal or replacement of such coverage until the expiration of the time required by Section 11.1.2. Information concerning reduction of coverage on account of revised limits or claims paid under the General Aggregate, or both, shall be furnished by the Contractor with reasonable promptness. These certificates shall forthwith evidence of all coverage required by Section 11.1.1. The form of certificates shall be the ACORD form. Contractor shall furnish to the Owner copies of any endorsements that are subsequently issued amending limits of coverage.

§ 11.1.4 Intentionally omitted.

§ 11.2 OWNER’S LIABILITY INSURANCE
The Owner shall be responsible for purchasing and maintaining the Owner’s usual liability insurance.

§ 11.3 PROPERTY INSURANCE
§ 11.3.1 Unless otherwise provided, the Owner shall purchase and maintain, in a company or companies lawfully authorized to do business in the jurisdiction in which the Project is located, property insurance written on a builder’s risk “all-risk” or equivalent policy form in the amount of the initial Contract Sum, plus value of subsequent Contract Modifications and cost of materials supplied or installed by others, comprising total value for the entire Project at the site on a replacement cost basis without optional deductibles. Such property insurance shall be maintained, unless otherwise provided in the Contract Documents or otherwise agreed in writing by all persons and entities who are beneficiaries of such insurance, until final payment has been made as provided in Section 9.10 or until no person or entity other than the Owner has an insurable interest in the property required by this Section 11.3 to be covered, whichever is later. This insurance shall include interests of the Owner, the Contractor, Subcontractors and Sub-subcontractors in the Project.

§ 11.3.1.1 Property insurance shall be on an “all-risk” or equivalent policy form and shall include, without limitation, insurance against the perils of fire (with extended coverage) and physical loss or damage including, without duplication of coverage, theft, vandalism, malicious mischief, collapse, earthquake, flood, windstorm, falsework, testing and startup, temporary buildings and debris removal including demolition occasioned by enforcement of any applicable legal requirements, and shall cover reasonable compensation for Architect’s and Contractor’s services and expenses required as a result of such insured loss. The Owner’s property insurance will not cover hoists, tools, or other equipment belonging to the Contractor or any Subcontractor.

§ 11.3.1.2 If the Owner does not intend to purchase such property insurance required by the Contract and with all of the coverages in the amount described above, the Owner shall so inform the Contractor in writing prior to commencement of the Work. The Contractor may then effect insurance that will protect the interests of the Contractor, Subcontractors and Sub-subcontractors in the Work, and by appropriate Change Order the cost thereof shall be charged to the Owner. If the Contractor is damaged by the failure or neglect of the Owner to purchase or maintain insurance as described above, without so notifying the Contractor in writing, then the Owner shall bear all reasonable costs properly attributable thereto.

§ 11.3.1.3 If the property insurance requires deductibles, the Owner shall pay costs not covered because of such deductibles unless such loss is due to the fault or neglect of Contractor or a party for whom Contractor is responsible.
§ 11.3.1.4 This property insurance shall cover portions of the Work stored off the site, and also portions of the Work in transit.

§ 11.3.1.5 Partial occupancy or use in accordance with Section 9.9 shall not commence until the insurance company or companies providing property insurance have consented to such partial occupancy or use by endorsement or otherwise. The Owner and the Contractor shall take reasonable steps to obtain consent of the insurance company or companies and shall, without mutual written consent, take no action with respect to partial occupancy or use that would cause cancellation, lapse or reduction of insurance.

§ 11.3.2 BOILER AND MACHINERY INSURANCE
The Owner shall purchase and maintain boiler and machinery insurance required by the Contract Documents or by law, which shall specifically cover such insured objects during installation and until final acceptance by the Owner; this insurance shall include interests of the Owner, Contractor, Subcontractors and Sub-subcontractors in the Work, and the Owner and Contractor shall be named insureds.

§ 11.3.3 LOSS OF USE INSURANCE
The Owner, at the Owner’s option, may purchase and maintain such insurance as will insure the Owner against loss of use of the Owner’s property due to fire or other hazards, however caused. The Owner waives all rights of action against the Contractor for loss of use of the Owner’s property, including consequential losses due to fire or other hazards however caused to the extent covered by insurance.

§ 11.3.4 If the Contractor requests in writing that insurance for risks other than those described herein or other special causes of loss be included in the property insurance policy, the Owner shall, if possible, include such insurance, and the cost thereof shall be charged to the Contractor by appropriate Change Order.

§ 11.3.5 Intentionally omitted.

§ 11.3.6 Before an exposure to loss may occur, the Owner shall file with the Contractor a copy of each policy that includes insurance coverages required by this Section 11.3. Each policy shall contain all generally applicable conditions, definitions, exclusions and endorsements related to this Project. Each policy shall contain a provision that the policy will not be canceled or allowed to expire, and that its limits will not be reduced, until at least 30 days’ prior written notice has been given to the Contractor.

§ 11.3.7 WAIVERS OF SUBROGATION
The Owner and Contractor waive all rights against (1) each other and any of their subcontractors, sub-subcontractors, agents and employees, each of the other, and (2) the Architect, Architect’s consultants, separate contractors described in Article 6, if any, and any of their subcontractors, sub-subcontractors, agents and employees, for damages caused by fire or other causes of loss to the extent covered by property insurance obtained pursuant to this Section 11.3 or other property insurance applicable to the Work, except such rights as they have to proceeds of such insurance held by the Owner as fiduciary. The Owner or Contractor, as appropriate, shall require of the Architect, Architect’s consultants, separate contractors described in Article 6, if any, and the subcontractors, sub-subcontractors, agents and employees of any of them, by appropriate agreements, written where legally required for validity, similar waivers each in favor of other parties enumerated herein. The policies shall provide such waivers of subrogation by endorsement or otherwise. A waiver of subrogation shall be effective as to a person or entity even though that person or entity would otherwise have a duty of indemnification, contractual or otherwise, did not pay the insurance premium directly or indirectly, and whether or not the person or entity had an insurable interest in the property damaged.

§ 11.3.8 A loss insured under the Owner’s property insurance shall be adjusted by the Owner in good faith and made payable to the Owner for the insureds, as their interests may appear, subject to requirements of any applicable mortgagee clause and of Section 11.3.10. The Contractor shall pay Subcontractors their just shares of insurance proceeds received by the Contractor, and by appropriate agreements, written where legally required for validity, shall require Subcontractors to make payments to their Sub-subcontractors in similar manner.

§ 11.3.9 Intentionally omitted.
§ 11.3.10 The Owner shall have power to adjust and settle a loss with insurers unless one of the parties in interest shall object in writing within five days after occurrence of loss to the Owner's exercise of this power; if such objection is made, the dispute shall be resolved in the manner selected by the Owner and Contractor as the method of binding dispute resolution in the Agreement.

§ 11.4 PERFORMANCE BOND AND PAYMENT BOND
§ 11.4.1 The Owner shall have the right to require the Contractor to furnish bonds covering faithful performance of the Contract and payment of obligations arising thereunder as stipulated in bidding requirements or specifically required in the Contract Documents on the date of execution of the Contract. The cost of all bonds shall be included in the Construction Managers Fee. If the construction manager requires bonding of subcontractors, this cost shall be noted as a separate cost item on the subcontractors bid and contract. The owner shall have the right to reject the bond cost for subcontractors as a cost of the work and require the construction manager to carry the cost as part of the base fee.

§ 11.4.2 Upon the request of any person or entity appearing to be a potential beneficiary of bonds covering payment of obligations arising under the Contract, the Contractor shall promptly furnish a copy of the bonds or shall authorize a copy to be furnished.

§ 11.5.1.1 In addition, should anyone claiming by, through or under Contractor assert a mechanic’s lien on the Project alleging non-payment for work, labor and materials or other similar claims regarding the Project, Contractor shall be obligated to obtain a bond pursuant to applicable law, or if acceptable to Owner, other lawful and satisfactory security, to discharge said lien and to clear the title of the Project.

ARTICLE 12 UNCOVERING AND CORRECTION OF WORK
§ 12.1 UNCOVERING OF WORK
§ 12.1.1 If a portion of the Work is covered contrary to the Architect’s request or to requirements specifically expressed in the Contract Documents, it must, if requested in writing by the Architect, be uncovered for the Architect’s examination and be replaced at the Contractor’s expense without change in the Contract Time.

§ 12.1.2 If a portion of the Work has been covered that the Architect has not specifically requested to examine prior to its being covered, the Architect may request to see such Work and it shall be uncovered by the Contractor. If such Work is in accordance with the Contract Documents, costs of uncovering and replacement shall, by appropriate Change Order, be at the Owner’s expense. If such Work is not in accordance with the Contract Documents, such costs and the cost of correction shall be at the Contractor’s expense unless the condition was caused by the Owner or a separate contractor in which event the Owner shall be responsible for payment of such costs.

§ 12.2 CORRECTION OF WORK
§ 12.2.1 BEFORE OR AFTER SUBSTANTIAL COMPLETION
The Contractor shall promptly correct Work rejected by the Architect or failing to conform to the requirements of the Contract Documents, whether discovered before or after Substantial Completion and whether or not fabricated, installed or completed. Costs of correcting such rejected Work, including additional testing and inspections, the cost of uncovering and replacement, and compensation for the Architect’s services and expenses made necessary thereby, and any cost, expenses, loss or damages to the Owner resulting from such failure or defect, shall be at the Contractor’s expense.

§ 12.2.2 AFTER SUBSTANTIAL COMPLETION
§ 12.2.2.1 In addition to the Contractor’s obligations under Section 3.5, if, within one year after the date of Substantial Completion of the Work or designated portion thereof or after the date for commencement of warranties established under Section 9.9.1, or by terms of an applicable special warranty required by the Contract Documents, any of the Work is found to be not in accordance with the requirements of the Contract Documents, the Contractor shall correct it promptly after receipt of written notice from the Owner to do so unless the Owner has previously given the Contractor a written acceptance of such condition. The Owner shall give such notice promptly after discovery of the condition. If the Contractor fails to correct nonconforming Work within a reasonable time during that period after receipt of notice from the Owner or Architect, the Owner may correct it in accordance with Section
2.4. This obligation under the Section 12.2.2 shall survive acceptance of the Work under the Contract and termination of the Contract.

§ 12.2.2.2 The one-year period for correction of Work shall be extended with respect to portions of Work first performed after Substantial Completion by the period of time between Substantial Completion and the actual completion of that portion of the Work. This obligation under this Section 12.2.2 shall survive acceptance of the Work under the Contract and termination of the Contract.

§ 12.2.2.3 Intentionally omitted.

§ 12.2.3 The Contractor shall remove from the site portions of the Work that are not in accordance with the requirements of the Contract Documents and are neither corrected by the Contractor nor accepted by the Owner.

§ 12.2.4 The Contractor shall bear the cost of correcting destroyed or damaged construction, whether completed or partially completed, of the Owner or separate contractors caused by the Contractor’s correction or removal of Work that is not in accordance with the requirements of the Contract Documents.

§ 12.2.5 Nothing contained in this Section 12.2 shall be construed to establish a period of limitation with respect to other obligations the Contractor has under the Contract Documents. Establishment of the one-year period for correction of Work as described in Section 12.2.2 relates only to the specific obligation of the Contractor to correct the Work, and has no relationship to the time within which the obligation to comply with the Contract Documents may be sought to be enforced, nor to the time within which proceedings may be commenced to establish the Contractor’s liability with respect to the Contractor’s obligations other than specifically to correct the Work.

§ 12.3 ACCEPTANCE OF NONCONFORMING WORK
If the Owner prefers to accept Work that is not in accordance with the requirements of the Contract Documents, the Owner may do so instead of requiring its removal and correction, in which case the Contract Sum will be reduced as appropriate and equitable, but in such event, the Owner’s acceptance shall not be deemed a waiver of any other rights the Owner has hereunder. Such adjustment shall be effected whether or not final payment has been made.

ARTICLE 13  MISCELLANEOUS PROVISIONS
§ 13.1 GOVERNING LAW
The Contract shall be governed by the law of the place where the Project is located.

§ 13.2 SUCCESSORS AND ASSIGNS
§ 13.2.1 The Owner and Contractor respectively bind themselves, their partners, successors, assigns and legal representatives to covenants, agreements and obligations contained in the Contract Documents. Except as provided in Section 13.2.2, neither party to the Contract shall assign the Contract as a whole without written consent of the other; provided, however, that either party may assign this Agreement or any rights acquired hereunder without the other party’s consent if such assignment is to any corporation or entity which may hereafter become the party’s successor-in-interest or which purchases all or substantially all of the party’s assets. In the event an assignment is approved, the assignee must expressly assume all obligations and liabilities of the assignor hereunder, and such assignment will not relieve the assignor of its obligations hereunder. Any attempt at assignment without the consent of the other party as provided herein shall be deemed null and void and a material breach of this Agreement. If either party attempts to make such an assignment without such consent, that party shall nevertheless remain legally responsible for all obligations under the Contract.

§ 13.2.2 Notwithstanding the foregoing, the Owner may, without consent of the Contractor, assign the Contract to a lender providing construction financing for the Project, if the lender assumes the Owner’s rights and obligations under the Contract Documents. The Contractor shall execute all consents reasonably required to facilitate such assignment.

§ 13.3 WRITTEN NOTICE
Written notice shall be deemed to have been duly served if delivered in person to the individual, to a member of the firm or entity, or to an officer of the corporation for which it was intended; or if delivered at, or sent by registered or certified mail or by courier service providing proof of delivery to, the last business address known to the party giving notice.
§ 13.4 RIGHTS AND REMEDIES
§ 13.4.1 Duties and obligations imposed by the Contract Documents and rights and remedies available thereunder shall be in addition to and not a limitation of duties, obligations, rights and remedies otherwise imposed or available by law.

§ 13.4.2 No action or failure to act by the Owner, Architect or Contractor shall constitute a waiver of a right or duty afforded them under the Contract, nor shall such action or failure to act constitute approval of or acquiescence in a breach there under, except as may be specifically agreed in writing.

§ 13.5 TESTS AND INSPECTIONS
§ 13.5.1 Tests, inspections and approvals of portions of the Work shall be made as required by the Contract Documents and by applicable laws, statutes, ordinances, codes, rules and regulations or lawful orders of public authorities. Unless otherwise provided, the Contractor shall make arrangements for such tests, inspections and approvals with an independent testing laboratory or entity acceptable to the Owner, or with the appropriate public authority, and shall bear all related costs of tests, inspections and approvals. The Contractor shall give the Architect timely notice of when and where tests and inspections are to be made so that the Architect may be present for such procedures. The Owner shall bear costs of (1) tests, inspections or approvals that do not become requirements until after bids are received or negotiations concluded, and (2) tests, inspections or approvals where building codes or applicable laws or regulations prohibit the Owner from delegating their cost to the Contractor.

§ 13.5.2 If the Architect, Owner or public authorities having jurisdiction determine that portions of the Work require additional testing, inspection or approval not included under Section 13.5.1, the Architect will, upon written authorization from the Owner, instruct the Contractor to make arrangements for such additional testing, inspection or approval by an entity acceptable to the Owner, and the Contractor shall give timely notice to the Architect of when and where tests and inspections are to be made so that the Architect may be present for such procedures. Such costs, except as provided in Section 13.5.3, shall be at the Owner’s expense.

§ 13.5.3 If such procedures for testing, inspection or approval under Sections 13.5.1 and 13.5.2 reveal failure of the portions of the Work to comply with requirements established by the Contract Documents, all costs made necessary by such failure including those of repeated procedures and compensation for the Architect’s services and expenses shall be at the Contractor’s expense.

§ 13.5.4 Required certificates of testing, inspection or approval shall, unless otherwise required by the Contract Documents, be secured by the Contractor and promptly delivered to the Architect.

§ 13.5.5 If the Architect is to observe tests, inspections or approvals required by the Contract Documents, the Architect will do so promptly and, where practicable, at the normal place of testing.

§ 13.5.6 Tests or inspections conducted pursuant to the Contract Documents shall be made promptly to avoid unreasonable delay in the Work.

§ 13.6 INTEREST
Payments due and unpaid under the Contract Documents shall bear interest from the date payment is due at such rate as the parties may agree upon in writing or, in the absence thereof, at the legal rate prevailing from time to time at the place where the Project is located.

§ 13.7 TIME LIMITS ON CLAIMS
The Owner and Contractor shall commence all claims and causes of action, whether in contract, tort, breach of warranty or otherwise, against the other arising out of or related to the Contract in accordance with the requirements of the final dispute resolution method selected in the Agreement within the time period specified by applicable law. The Owner and Contractor waive all claims and causes of action not commenced in accordance with this Section 13.7.
ARTICLE 14  TERMINATION OR SUSPENSION OF THE CONTRACT

§ 14.1 TERMINATION BY THE CONTRACTOR

§ 14.1.1 The Contractor may terminate the Contract if the Work is stopped for a period of 30 consecutive days through no act or fault of the Contractor or a Subcontractor, Sub-subcontractor or their agents or employees or any other persons or entities performing portions of the Work under direct or indirect contract with the Contractor, for any of the following reasons:

.1 Issuance of an order of a court or other public authority having jurisdiction that requires all Work to be stopped;
.2 An act of government, such as a declaration of national emergency that requires all Work to be stopped;
.3 Because the Architect has not issued a Certificate for Payment and has not notified the Contractor of the reason for withholding certification as provided in Section 9.4.1, or because the Owner has not made payment on a Certificate for Payment within the time stated in the Contract Documents; or
.4 The Owner has failed to furnish to the Contractor promptly, upon the Contractor’s request, reasonable evidence as required by Section 2.2.1.

§ 14.1.2 The Contractor may terminate the Contract if, through no act or fault of the Contractor or a Subcontractor, Sub-subcontractor or their agents or employees or any other persons or entities performing portions of the Work under direct or indirect contract with the Contractor, repeated suspensions, delays or interruptions of the entire Work by the Owner as described in Section 14.3 constitute in the aggregate more than 100 percent of the total number of days scheduled for completion, or 120 days in any 365-day period, whichever is less.

§ 14.1.3 If one of the reasons described in Section 14.1.1 or 14.1.2 exists, the Contractor may, upon seven days’ written notice to the Owner and Architect, terminate the Contract and recover from the Owner payment for Work executed, including reasonable overhead and profit, costs incurred by reason of such termination, and damages.

§ 14.1.4 If the Work is stopped for a period of 60 consecutive days through no act or fault of the Contractor or a Subcontractor or their agents or employees or any other persons performing portions of the Work under contract with the Contractor because the Owner has repeatedly failed to fulfill the Owner’s obligations under the Contract Documents with respect to matters important to the progress of the Work, the Contractor may, upon seven additional days’ written notice to the Owner and the Architect, terminate the Contract and recover from the Owner as provided in Section 14.1.3.

§ 14.2 TERMINATION BY THE OWNER FOR CAUSE

§ 14.2.1 The Owner may terminate the Contract if the Contractor

.1 repeatedly refuses or fails to supply enough properly skilled workers or proper materials;
.2 fails to make payment to Subcontractors for materials or labor in accordance with the respective agreements between the Contractor and the Subcontractors;
.3 repeatedly disregards applicable laws, statutes, ordinances, codes, rules and regulations, or lawful orders of a public authority; or
.4 otherwise is guilty of substantial breach of a provision of the Contract Documents.

§ 14.2.2 When any of the above reasons exist, the Owner may without prejudice to any other rights or remedies of the Owner and after giving the Contractor and the Contractor’s surety, if any, seven days’ written notice, terminate employment of the Contractor and may, subject to any prior rights of the surety:

.1 Exclude the Contractor from the site and take possession of all materials, equipment, tools, and construction equipment and machinery thereon owned by the Contractor;
.2 Accept assignment of subcontracts pursuant to Section 5.4; and
.3 Finish the Work by whatever reasonable method the Owner may deem expedient. Upon written request of the Contractor, the Owner shall furnish to the Contractor a detailed accounting of the costs incurred by the Owner in finishing the Work.

§ 14.2.3 When the Owner terminates the Contract for one of the reasons stated in Section 14.2.1, the Contractor shall not be entitled to receive further payment until the Work is finished.
§ 14.2.4 If the unpaid balance of the Contract Sum exceeds costs of finishing the Work, including compensation for the Architect’s services and expenses made necessary thereby, and other damages incurred by the Owner and not expressly waived, such excess shall be paid to the Contractor. If such costs and damages exceed the unpaid balance, the Contractor shall pay the difference to the Owner. The amount to be paid to the Contractor or Owner, as the case may be, shall be certified by the Initial Decision Maker, upon application, and this obligation for payment shall survive termination of the Contract.

§ 14.3 SUSPENSION BY THE OWNER FOR CONVENIENCE
§ 14.3.1 The Owner may, without cause, order the Contractor in writing to suspend, delay or interrupt the Work in whole or in part for such period of time as the Owner may determine.

§ 14.3.2 The Contract Sum and Contract Time shall be adjusted for increases in the cost and time caused by suspension, delay or interruption as described in Section 14.3.1. Adjustment of the Contract Sum shall include profit. No adjustment shall be made to the extent
  .1 that performance is, was or would have been so suspended, delayed or interrupted by another cause for which the Contractor is responsible; or
  .2 that an equitable adjustment is made or denied under another provision of the Contract.

§ 14.4 TERMINATION BY THE OWNER FOR CONVENIENCE
§ 14.4.1 The Owner may, at any time, terminate the Contract for the Owner’s convenience and without cause.

§ 14.4.2 Upon receipt of written notice from the Owner of such termination for the Owner’s convenience, the Contractor shall
  .1 cease operations as directed by the Owner in the notice;
  .2 take actions necessary, or that the Owner may direct, for the protection and preservation of the Work; and
  .3 except for Work directed to be performed prior to the effective date of termination stated in the notice, terminate all existing subcontracts and purchase orders and enter into no further subcontracts and purchase orders.

§ 14.4.3 In case of such termination for the Owner’s convenience, the Contractor shall be entitled to receive payment for Work executed, and costs incurred by reason of such termination, along with reasonable overhead and profit on the Work in place.

ARTICLE 15 CLAIMS AND DISPUTES
§ 15.1 CLAIMS
§ 15.1.1 DEFINITION
A Claim is a demand or assertion by the Contractor seeking, as a matter of right, payment of money, or other relief with respect to the terms of the Contract. The term “Claim” also includes other disputes and matters in question by the Contractor arising out of or relating to the Contract. The responsibility to substantiate Claims shall rest with the Contractor.

§ 15.1.2 NOTICE OF CLAIMS
Claims by either the Contractor must be initiated by written notice containing a clear statement of the basis of the Claim and the relief sought by the Contractor, and such notice shall be provided to the Owner and to the Initial Decision Maker with a copy sent to the Architect, if the Architect is not serving as the Initial Decision Maker. Claims by the Contractor must be initiated within 21 days after occurrence of the event giving rise to such Claim or within 21 days after the Contractor first recognizes the condition giving rise to the Claim, whichever is later; provided that, in the case of a Claim based upon delay to the Contractor, as a condition precedent to any Claim, the Contractor shall first provide initial notice of a delay within 3 days of the event giving rise to the delay, and then provide a Claim within such 21 day period thereafter; and further provided, however, that the Contractor shall use its best efforts to furnish the Architect and the Owner, as expeditiously as possible, with notice of any Claim including, without limitation, those in connection with concealed or unknown conditions, once such Claim is recognized, and shall cooperate with the Architect and the Owner in an effort to mitigate the alleged or potential damages, delay or other adverse consequences arising out of the condition which is the cause of such a Claim. THE CONTRACTOR
EXPRESSLY AGREES THAT FAILURE OF THE CONTRACTOR TO INITIATE A CLAIM WITHIN THE TIME LIMITS SPECIFIED IN THIS SECTION 15.1.2 SHALL RESULT IN SUCH CLAIM BEING WAIVED

§ 15.1.3 CONTINUING CONTRACT PERFORMANCE
Pending final resolution of a Claim, except as otherwise agreed in writing or as provided in Section 9.7 and Article 14, the Contractor shall proceed diligently with performance of the Contract and the Owner shall continue to make payments that are not in dispute in accordance with the Contract Documents. The Architect will prepare Change Orders and issue Certificates for Payment in accordance with the decisions of the Initial Decision Maker.

§ 15.1.4 CLAIMS FOR ADDITIONAL COST
If the Contractor wishes to make a Claim for an increase in the Contract Sum, written notice as provided in Section 15.1.2 shall be given before proceeding to execute the Work. Prior notice is not required for Claims relating to an emergency endangering life or property arising under Section 10.4.

§ 15.1.5 CLAIMS FOR ADDITIONAL TIME
§ 15.1.5.1 Contractor shall advise the Owner and Architect in writing of any known delay within three (3) days of its knowledge of the same (including delays in the receipt of drawings or designs from designer or Architect), and shall include an identification of the delay, its anticipated duration and its anticipated effect on the prosecution and completion of the Work. If the Contractor wishes to make a Claim for an increase in the Contract Time, written notice as provided in Section 15.1.2 shall be given. The Contractor’s Claim shall include an estimate of cost and of probable effect of delay on progress of the Work. In the case of a continuing delay, only one Claim is necessary. The Contractor shall have the burden of demonstrating the effect of the claimed delay on the Contract Time, and shall furnish the Owner and Architect with such documentation relating thereto as they may reasonably require. The Contractor shall take all prudent steps necessary to minimize the delay, and shall diligently proceed to complete the Work as required by the Contract Documents. Notwithstanding the foregoing, time for performance of a party’s obligations hereunder shall not be tolled unless and until the party claiming such excuse has provided the other party with written notice of the event.

§ 15.1.5.2 If adverse weather conditions are the basis for a Claim for additional time, such Claim shall be documented by data substantiating that weather conditions were abnormal for the period of time, could not have been reasonably anticipated and had an adverse effect on the scheduled construction. Claims arising from adverse weather conditions shall be subject to the provisions of Section 8.3.5.

§ 15.1.6 Intentionally omitted.

§ 15.1.7 No extension of time shall be granted to the Contractor for delays occurring to parts of the Work that have no measurable impact on the completion of the Milestone Dates; nor shall any extension of time be granted for delays to parts of the Work that are not located on the critical path. The Contractor acknowledges and agrees that an excusable delay in a portion of the Work or schedule activity does not necessarily result in a delay of equal duration in the completion of the entire Project.

§ 15.1.8 Direct Negotiation. Any dispute arising at any time during or after the construction of the Project shall be resolved, if possible, by negotiations between duly authorized representatives of the Contractor and the Owner. If such duly authorized representatives are unable to resolve any dispute within ten (10) days after written notice of such dispute together with all relevant supporting documentation is given by either party to the other, the matter may be submitted by either party to the dispute resolution process set forth below.

§ 15.2 INITIAL DECISION
§ 15.2.1 Claims, excluding those arising under Sections 10.3, 10.4, 11.3.9, and 11.3.10, shall be referred to the Initial Decision Maker for initial decision. The Architect will serve as the Initial Decision Maker, unless otherwise indicated in the Agreement. Except for those Claims excluded by this Section 15.2.1, an initial decision shall be required as a condition precedent to mediation of any Claim arising prior to the date final payment is due, unless 30 days have passed after the Claim has been referred to the Initial Decision Maker with no decision having been rendered. Unless the Initial Decision Maker and all affected parties agree, the Initial Decision Maker will not decide disputes between the Contractor and persons or entities other than the Owner.
§ 15.2.2 The Initial Decision Maker will review Claims and within ten days of the receipt of a Claim take one or more of the following actions: (1) request additional supporting data from the claimant or a response with supporting data from the other party, (2) reject the Claim in whole or in part, (3) approve the Claim, (4) suggest a compromise, or (5) advise the parties that the Initial Decision Maker is unable to resolve the Claim if the Initial Decision Maker lacks sufficient information to evaluate the merits of the Claim or if the Initial Decision Maker concludes that, in the Initial Decision Maker’s sole discretion, it would be inappropriate for the Initial Decision Maker to resolve the Claim.

§ 15.2.3 In evaluating Claims, the Initial Decision Maker may, but shall not be obligated to, consult with or seek information from either party or from persons with special knowledge or expertise who may assist the Initial Decision Maker in rendering a decision. The Initial Decision Maker may request the Owner to authorize retention of such persons at the Owner’s expense.

§ 15.2.4 If the Initial Decision Maker requests a party to provide a response to a Claim or to furnish additional supporting data, such party shall respond, within ten days after receipt of such request, and shall either (1) provide a response on the requested supporting data, (2) advise the Initial Decision Maker when the response or supporting data will be furnished or (3) advise the Initial Decision Maker that no supporting data will be furnished. Upon receipt of the response or supporting data, if any, the Initial Decision Maker will either reject or approve the Claim in whole or in part.

§ 15.2.5 The Initial Decision Maker will render an initial decision approving or rejecting the Claim, or indicating that the Initial Decision Maker is unable to resolve the Claim. This initial decision shall (1) be in writing; (2) state the reasons therefor; and (3) notify the parties and the Architect, if the Architect is not serving as the Initial Decision Maker, of any change in the Contract Sum or Contract Time or both. The initial decision shall be final and binding on the parties but subject to mediation and, if the parties fail to resolve their dispute through mediation, to binding dispute resolution.

§ 15.2.6 Either party may file for mediation of an initial decision at any time, subject to the terms of Section 15.2.6.1.

§ 15.2.6.1 Either party may, within 30 days from the date of an initial decision, demand in writing that the other party file for mediation within 60 days of the initial decision. If such a demand is made and the party receiving the demand fails to file for mediation within the time required, then both parties waive their rights to mediate or pursue binding dispute resolution proceedings with respect to the initial decision.

§ 15.2.7 In the event of a Claim against the Contractor, the Owner may, but is not obligated to, notify the surety, if any, of the nature and amount of the Claim. If the Claim relates to a possibility of a Contractor’s default, the Owner may, but is not obligated to, notify the surety and request the surety’s assistance in resolving the controversy.

§ 15.2.8 If a Claim relates to or is the subject of a mechanic’s lien, the party asserting such Claim may proceed in accordance with applicable law to comply with the lien notice or filing deadlines.

§ 15.3 MEDIATION

§ 15.3.1 Claims, disputes, or other matters in controversy arising out of or related to the Contract except those waived as provided for in Sections 9.10.4, 9.10.5, and 15.1.6 shall be subject to mediation as a condition precedent to binding dispute resolution.

§ 15.3.2 The parties shall endeavor to resolve their Claims by mediation which, unless the parties mutually agree otherwise, shall be administered by the American Arbitration Association in accordance with its Construction Industry Mediation Procedures in effect on the date of the Agreement. A request for mediation shall be made in writing, delivered to the other party to the Contract, and filed with the person or entity administering the mediation. The request may be made concurrently with the filing of a civil action but, in such event, mediation shall proceed in advance of such civil action, which shall be stayed pending mediation for a period of 60 days from the date of filing, unless stayed for a longer period by agreement of the parties or court order.
§ 15.3.3 The parties shall share the mediator’s fee and any filing fees equally. The mediation shall be held in the place where the Project is located, unless another location is mutually agreed upon. Agreements reached in mediation shall be enforceable as settlement agreements in any court having jurisdiction thereof.

§ 15.4 LITIGATION AND ARBITRATION
§ 15.4.1 Any dispute that is not resolved by negotiation or mediation or arbitration shall be resolved by litigation in state or federal court. Contractor assents to jurisdiction in the state or federal courts of New Hampshire and agrees that the sole venue of any litigation between Contractor and Owner shall be Hillsborough County, New Hampshire. To the extent, the parties have agreed in the Owner-Contractor Agreement that claims below a certain dollar threshold shall be decided by binding arbitration, such arbitration shall be conducted and the arbitrator(s) selected in accordance with the Construction Industry Rules of the American Arbitration Association then pertaining unless the parties mutually agree otherwise.
TITLE I
THE STATE AND ITS GOVERNMENT

CHAPTER 21-I
DEPARTMENT OF ADMINISTRATIVE SERVICES

Public Works Design and Construction

Section 21-I:81-a

21-I:81-a Requirement for Listing Subcontractor Bids for State Construction Contracts. — The following requirements apply to the construction, reconstruction, installation, demolition, maintenance, or repair of any building by a state agency, including the community college system and university system of New Hampshire, that is required to be awarded through competitive bidding.

I. A general contractor shall provide to the awarding state agency, community college, or university system a list of the names, addresses, CEO, CFO, other LLC principals, and each subcontractor to be used in the performance of the contract as soon as is practicable after the contract award, but in any event prior to the date on which the subcontractor begins work on the project. This provision applies to all subcontractors engaged to work on the project, regardless of the date of their engagement.

II. This section provides minimum disclosure standards regarding subcontractors and shall not preclude an awarding state agency or the community college or university system from setting more rigorous standards for construction work under their jurisdiction.

Performance Bond

CONTRACTOR:
(Name, legal status and address)

SURETY:
(Name, legal status and principal place of business)

OWNER:
(Name, legal status and address)

CONSTRUCTION CONTRACT
Date:
Amount: $
Description:
(Name and location)

BOND
Date:
(Not earlier than Construction Contract Date)
Amount: $
Modifications to this Bond: None See Section 16

CONTRACTOR AS PRINCIPAL
Company: (Corporate Seal)

SURETY
Company: (Corporate Seal)

Signature: __________________________
Name and Title: __________________________

(Any additional signatures appear on the last page of this Performance Bond.)

(FOR INFORMATION ONLY — Name, address and telephone)
AGENT or BROKER: 

OWNER’S REPRESENTATIVE:
(Architect, Engineer or other party:)

ADDITIONS AND DELETIONS:
The author of this document has added information needed for its completion. The author may also have revised the text of the original AIA standard form. An Additions and Deletions Report that notes added information as well as revisions to the standard form text is available from the author and should be reviewed. A vertical line in the left margin of this document indicates where the author has added necessary information and where the author has added to or deleted from the original AIA text.

This document has important legal consequences. Consultation with an attorney is encouraged with respect to its completion or modification.

Any singular reference to Contractor, Surety, Owner or other party shall be considered plural where applicable.
§ 1 The Contractor and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors and assigns to the Owner for the performance of the Construction Contract, which is incorporated herein by reference.

§ 2 If the Contractor performs the Construction Contract, the Surety and the Contractor shall have no obligation under this Bond, except when applicable to participate in a conference as provided in Section 3.

§ 3 If there is no Owner Default under the Construction Contract, the Surety’s obligation under this Bond shall arise after:
   .1 the Owner first provides notice to the Contractor and the Surety that the Owner is considering declaring a Contractor Default. Such notice shall indicate whether the Owner is requesting a conference among the Owner, Contractor and Surety to discuss the Contractor’s performance. If the Owner does not request a conference, the Surety may, within five (5) business days after receipt of the Owner’s notice, request such a conference. If the Surety timely requests a conference, the Owner shall attend. Unless the Owner agrees otherwise, any conference requested under this Section 3.1 shall be held within ten (10) business days of the Surety’s receipt of the Owner’s notice. If the Owner, the Contractor and the Surety agree, the Contractor shall be allowed a reasonable time to perform the Construction Contract, but such an agreement shall not waive the Owner’s right, if any, subsequently to declare a Contractor Default;
   .2 the Owner declares a Contractor Default, terminates the Construction Contract and notifies the Surety; and
   .3 the Owner has agreed to pay the Balance of the Contract Price in accordance with the terms of the Construction Contract to the Surety or to a contractor selected to perform the Construction Contract.

§ 4 Failure on the part of the Owner to comply with the notice requirement in Section 3.1 shall not constitute a failure to comply with a condition precedent to the Surety’s obligations, or release the Surety from its obligations, except to the extent the Surety demonstrates actual prejudice.

§ 5 When the Owner has satisfied the conditions of Section 3, the Surety shall promptly and at the Surety’s expense take one of the following actions:

§ 5.1 Arrange for the Contractor, with the consent of the Owner, to perform and complete the Construction Contract;

§ 5.2 Undertake to perform and complete the Construction Contract itself, through its agents or independent contractors;

§ 5.3 Obtain bids or negotiated proposals from qualified contractors acceptable to the Owner for a contract for performance and completion of the Construction Contract, arrange for a contract to be prepared for execution by the Owner and a contractor selected with the Owner’s concurrence, to be secured with performance and payment bonds executed by a qualified surety equivalent to the bonds issued on the Construction Contract, and pay to the Owner the amount of damages as described in Section 7 in excess of the Balance of the Contract Price incurred by the Owner as a result of the Contractor Default; or

§ 5.4 Waive its right to perform and complete, arrange for completion, or obtain a new contractor and with reasonable promptness under the circumstances:
   .1 After investigation, determine the amount for which it may be liable to the Owner and, as soon as practicable after the amount is determined, make payment to the Owner; or
   .2 Deny liability in whole or in part and notify the Owner, citing the reasons for denial.

§ 6 If the Surety does not proceed as provided in Section 5 with reasonable promptness, the Surety shall be deemed to be in default on this Bond seven days after receipt of an additional written notice from the Owner to the Surety demanding that the Surety perform its obligations under this Bond, and the Owner shall be entitled to enforce any remedy available to the Owner. If the Surety proceeds as provided in Section 5.4, and the Owner refuses the payment or the Surety has denied liability, in whole or in part, without further notice the Owner shall be entitled to enforce any remedy available to the Owner.
§ 7 If the Surety elects to act under Section 5.1, 5.2 or 5.3, then the responsibilities of the Surety to the Owner shall not be greater than those of the Contractor under the Construction Contract, and the responsibilities of the Owner to the Surety shall not be greater than those of the Owner under the Construction Contract. Subject to the commitment by the Owner to pay the Balance of the Contract Price, the Surety is obligated, without duplication, for
.1 the responsibilities of the Contractor for correction of defective work and completion of the Construction Contract;
.2 additional legal, design professional and delay costs resulting from the Contractor’s Default, and resulting from the actions or failure to act of the Surety under Section 5; and
.3 liquidated damages, or if no liquidated damages are specified in the Construction Contract, actual damages caused by delayed performance or non-performance of the Contractor.

§ 8 If the Surety elects to act under Section 5.1, 5.3 or 5.4, the Surety’s liability is limited to the amount of this Bond.

§ 9 The Surety shall not be liable to the Owner or others for obligations of the Contractor that are unrelated to the Construction Contract, and the Balance of the Contract Price shall not be reduced or set off on account of any such unrelated obligations. No right of action shall accrue on this Bond to any person or entity other than the Owner or its heirs, executors, administrators, successors and assigns.

§ 10 The Surety hereby waives notice of any change, including changes of time, to the Construction Contract or to related subcontracts, purchase orders and other obligations.

§ 11 Any proceeding, legal or equitable, under this Bond may be instituted in any court of competent jurisdiction in the location in which the work or part of the work is located and shall be instituted within two years after a declaration of Contractor Default or within two years after the Contractor ceased working or within two years after the Surety refuses or fails to perform its obligations under this Bond, whichever occurs first. If the provisions of this Paragraph are void or prohibited by law, the minimum period of limitation available to sureties as a defense in the jurisdiction of the suit shall be applicable.

§ 12 Notice to the Surety, the Owner or the Contractor shall be mailed or delivered to the address shown on the page on which their signature appears.

§ 13 When this Bond has been furnished to comply with a statutory or other legal requirement in the location where the construction was to be performed, any provision in this Bond conflicting with said statutory or legal requirement shall be deemed deleted herefrom and provisions conforming to such statutory or other legal requirement shall be deemed incorporated herein. When so furnished, the intent is that this Bond shall be construed as a statutory bond and not as a common law bond.

§ 14 Definitions

§ 14.1 Balance of the Contract Price. The total amount payable by the Owner to the Contractor under the Construction Contract after all proper adjustments have been made, including allowance to the Contractor of any amounts received or to be received by the Owner in settlement of insurance or other claims for damages to which the Contractor is entitled, reduced by all valid and proper payments made to or on behalf of the Contractor under the Construction Contract.

§ 14.2 Construction Contract. The agreement between the Owner and Contractor identified on the cover page, including all Contract Documents and changes made to the agreement and the Contract Documents.

§ 14.3 Contractor Default. Failure of the Contractor, which has not been remedied or waived, to perform or otherwise to comply with a material term of the Construction Contract.

§ 14.4 Owner Default. Failure of the Owner, which has not been remedied or waived, to pay the Contractor as required under the Construction Contract or to perform and complete or comply with the other material terms of the Construction Contract.

§ 14.5 Contract Documents. All the documents that comprise the agreement between the Owner and Contractor.
§ 15 If this Bond is issued for an agreement between a Contractor and subcontractor, the term Contractor in this Bond shall be deemed to be Subcontractor and the term Owner shall be deemed to be Contractor.

§ 16 Modifications to this bond are as follows:

(Space is provided below for additional signatures of added parties, other than those appearing on the cover page.)

**CONTRACTOR AS PRINCIPAL**

Company: ____________________________ (Corporate Seal)

Signature: ____________________________
Name and Title: _______________________
Address: ______________________________

**SURETY**

Company: ____________________________ (Corporate Seal)

Signature: ____________________________
Name and Title: _______________________
Address: ______________________________
CONTRACTOR:  
(Name, legal status and address)  

SURETY:  
(Name, legal status and principal place of business)  

OWNER:  
(Name, legal status and address)  

CONSTRUCTION CONTRACT  
Date:  
Amount: $  
Description:  
(Name and location)  

BOND  
Date:  
(Not earlier than Construction Contract Date)  
Amount: $  
Modifications to this Bond: [ ] None [ ] See Section 18  

CONTRACTOR AS PRINCIPAL  
Company: [Corporate Seal]  
Signature:  
Name and Title:  
(Any additional signatures appear on the last page of this Payment Bond.)  

SURETY  
Company: [Corporate Seal]  
Signature:  
Name and Title:  

ADDITIONS AND DELETIONS:  
The author of this document has added information needed for its completion. The author may also have revised the text of the original AIA standard form. An Additions and Deletions Report that notes added information as well as revisions to the standard form text is available from the author and should be reviewed. A vertical line in the left margin of this document indicates where the author has added necessary information and where the author has added to or deleted from the original AIA text.  

This document has important legal consequences. Consultation with an attorney is encouraged with respect to its completion or modification.  

Any singular reference to Contractor, Surety, Owner or other party shall be considered plural where applicable.
§ 1 The Contractor and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors and assigns to the Owner to pay for labor, materials and equipment furnished for use in the performance of the Construction Contract, which is incorporated herein by reference, subject to the following terms.

§ 2 If the Contractor promptly makes payment of all sums due to Claimants, and defends, indemnifies and holds harmless the Owner from claims, demands, liens or suits by any person or entity seeking payment for labor, materials or equipment furnished for use in the performance of the Construction Contract, then the Surety and the Contractor shall have no obligation under this Bond.

§ 3 If there is no Owner Default under the Construction Contract, the Surety’s obligation to the Owner under this Bond shall arise after the Owner has promptly notified the Contractor and the Surety (at the address described in Section 13) of claims, demands, liens or suits against the Owner or the Owner’s property by any person or entity seeking payment for labor, materials or equipment furnished for use in the performance of the Construction Contract and tendered defense of such claims, demands, liens or suits to the Contractor and the Surety.

§ 4 When the Owner has satisfied the conditions in Section 3, the Surety shall promptly and at the Surety’s expense defend, indemnify and hold harmless the Owner against a duly tendered claim, demand, lien or suit.

§ 5 The Surety’s obligations to a Claimant under this Bond shall arise after the following:

§ 5.1 Claimants, who do not have a direct contract with the Contractor,
  .1 have furnished a written notice of non-payment to the Contractor, stating with substantial accuracy the amount claimed and the name of the party to whom the materials were, or equipment was, furnished or supplied or for whom the labor was done or performed, within ninety (90) days after having last performed labor or last furnished materials or equipment included in the Claim; and
  .2 have sent a Claim to the Surety (at the address described in Section 13).

§ 5.2 Claimants, who are employed by or have a direct contract with the Contractor, have sent a Claim to the Surety (at the address described in Section 13).

§ 6 If a notice of non-payment required by Section 5.1.1 is given by the Owner to the Contractor, that is sufficient to satisfy a Claimant’s obligation to furnish a written notice of non-payment under Section 5.1.1.

§ 7 When a Claimant has satisfied the conditions of Sections 5.1 or 5.2, whichever is applicable, the Surety shall promptly and at the Surety’s expense take the following actions:

§ 7.1 Send an answer to the Claimant, with a copy to the Owner, within sixty (60) days after receipt of the Claim, stating the amounts that are undisputed and the basis for challenging any amounts that are disputed; and

§ 7.2 Pay or arrange for payment of any undisputed amounts.

§ 7.3 The Surety’s failure to discharge its obligations under Section 7.1 or Section 7.2 shall not be deemed to constitute a waiver of defenses the Surety or Contractor may have or acquire as to a Claim, except as to undisputed amounts for which the Surety and Claimant have reached agreement. If, however, the Surety fails to discharge its obligations under Section 7.1 or Section 7.2, the Surety shall indemnify the Claimant for the reasonable attorney’s fees the Claimant incurs thereafter to recover any sums found to be due and owing to the Claimant.

§ 8 The Surety’s total obligation shall not exceed the amount of this Bond, plus the amount of reasonable attorney’s fees provided under Section 7.3, and the amount of this Bond shall be credited for any payments made in good faith by the Surety.

§ 9 Amounts owed by the Owner to the Contractor under the Construction Contract shall be used for the performance of the Construction Contract and to satisfy claims, if any, under any construction performance bond. By the Contractor furnishing and the Owner accepting this Bond, they agree that all funds earned by the Contractor in the performance of the Construction Contract are dedicated to satisfy obligations of the Contractor and Surety under this Bond, subject to the Owner’s priority to use the funds for the completion of the work.
§ 10 The Surety shall not be liable to the Owner, Claimants or others for obligations of the Contractor that are unrelated to the Construction Contract. The Owner shall not be liable for the payment of any costs or expenses of any Claimant under this Bond, and shall have under this Bond no obligation to make payments to, or give notice on behalf of, Claimants or otherwise have any obligations to Claimants under this Bond.

§ 11 The Surety hereby waives notice of any change, including changes of time, to the Construction Contract or to related subcontracts, purchase orders and other obligations.

§ 12 No suit or action shall be commenced by a Claimant under this Bond other than in a court of competent jurisdiction in the state in which the project that is the subject of the Construction Contract is located or after the expiration of one year from the date (1) on which the Claimant sent a Claim to the Surety pursuant to Section 5.1.2 or 5.2, or (2) on which the last labor or service was performed by anyone or the last materials or equipment were furnished by anyone under the Construction Contract, whichever of (1) or (2) first occurs. If the provisions of this Paragraph are void or prohibited by law, the minimum period of limitation available to sureties as a defense in the jurisdiction of the suit shall be applicable.

§ 13 Notice and Claims to the Surety, the Owner or the Contractor shall be mailed or delivered to the address shown on the page on which their signature appears. Actual receipt of notice or Claims, however accomplished, shall be sufficient compliance as of the date received.

§ 14 When this Bond has been furnished to comply with a statutory or other legal requirement in the location where the construction was to be performed, any provision in this Bond conflicting with said statutory or legal requirement shall be deemed deleted herefrom and provisions conforming to such statutory or other legal requirement shall be deemed incorporated herein. When so furnished, the intent is that this Bond shall be construed as a statutory bond and not as a common law bond.

§ 15 Upon request by any person or entity appearing to be a potential beneficiary of this Bond, the Contractor and Owner shall promptly furnish a copy of this Bond or shall permit a copy to be made.

§ 16 Definitions
§ 16.1 Claim. A written statement by the Claimant including at a minimum:
.1 the name of the Claimant;
.2 the name of the person for whom the labor was done, or materials or equipment furnished;
.3 a copy of the agreement or purchase order pursuant to which labor, materials or equipment was furnished for use in the performance of the Construction Contract;
.4 a brief description of the labor, materials or equipment furnished;
.5 the date on which the Claimant last performed labor or last furnished materials or equipment for use in the performance of the Construction Contract;
.6 the total amount earned by the Claimant for labor, materials or equipment furnished as of the date of the Claim;
.7 the total amount of previous payments received by the Claimant; and
.8 the total amount due and unpaid to the Claimant for labor, materials or equipment furnished as of the date of the Claim.

§ 16.2 Claimant. An individual or entity having a direct contract with the Contractor or with a subcontractor of the Contractor to furnish labor, materials or equipment for use in the performance of the Construction Contract. The term Claimant also includes any individual or entity that has rightfully asserted a claim under an applicable mechanic’s lien or similar statute against the real property upon which the Project is located. The intent of this Bond shall be to include without limitation in the terms “labor, materials or equipment” that part of water, gas, power, light, heat, oil, gasoline, telephone service or rental equipment used in the Construction Contract, architectural and engineering services required for performance of the work of the Contractor and the Contractor’s subcontractors, and all other items for which a mechanic’s lien may be asserted in the jurisdiction where the labor, materials or equipment were furnished.

§ 16.3 Construction Contract. The agreement between the Owner and Contractor identified on the cover page, including all Contract Documents and all changes made to the agreement and the Contract Documents.
§ 16.4 Owner Default. Failure of the Owner, which has not been remedied or waived, to pay the Contractor as required under the Construction Contract or to perform and complete or comply with the other material terms of the Construction Contract.

§ 16.5 Contract Documents. All the documents that comprise the agreement between the Owner and Contractor.

§ 17 If this Bond is issued for an agreement between a Contractor and subcontractor, the term Contractor in this Bond shall be deemed to be Subcontractor and the term Owner shall be deemed to be Contractor.

§ 18 Modifications to this bond are as follows:

(Space is provided below for additional signatures of added parties, other than those appearing on the cover page.)

CONTRACTOR AS PRINCIPAL
Company: (Corporate Seal) 
Signature: 
Name and Title: 
Address: 

SURETY
Company: (Corporate Seal)
Signature: 
Name and Title: 
Address: 

Init. /
SECTION 011000 - SUMMARY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:
   1. Work covered by the Contract Documents.
   2. Type of the Contract.
   3. Work schedule.
   4. Work under other contracts.
   5. Use of premises.
   6. Owner's occupancy requirements.
   7. Work restrictions.
   8. Specification formats and conventions.

B. Related Sections include the following:
   1. Division 01 Section "Temporary Facilities and Controls" for limitations and procedures governing temporary use of Owner's facilities.

1.3 WORK COVERED BY CONTRACT DOCUMENTS

A. Project Identification: Manchester Community College, Knox Building Window Wall and HVAC Renovations.
   1. Project Location: Manchester, New Hampshire.

B. Owner: Manchester Community College – A component of the Community College System of New Hampshire (CCSNH).

C. Architect: Harriman, One Perimeter Road, Manchester, New Hampshire.

1.4 TYPE OF CONTRACT

A. Project will be constructed under a single prime contract.

1.5 WORK SCHEDULE

A. Construction Start: The facility will be available to start work on May 20, 2013.
   1. The facility will be made available to the Contractor for measuring and inspection by appointment. Facility shall be left with rooms and equipment undisturbed for completion of the academic year.
   2. The Owner will be removing the contents of rooms to be extensively renovated the week of May 13 through May 17, 2013.

B. Portions of the Knox Building will remain occupied during the entire construction period.
C. Substantial completion date for the work:
1. All work shall be substantially complete, including testing and balancing of the mechanical system, on or before August 1, 2013.
2. The Owner will move back into the vacated spaces August 22 to August 26, 2013.

D. Final Completion: Final completion of all work, including punch list items, shall be completed on or before August 30, 2013.

1.6 WORK UNDER OTHER CONTRACTS

A. General: Cooperate fully with separate contractors so work on those contracts may be carried out smoothly, without interfering with or delaying work under this Contract. Coordinate the Work of this Contract with work performed under separate contracts.

1.7 USE OF PREMISES

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

B. Use of Site: Limit use of premises to areas within the Contract limits indicated. Do not disturb portions of Project site beyond areas in which the Work is indicated.
1. Owner Occupancy: Allow for Owner occupancy of Project site.
2. Driveways and Entrances: The parking lot immediately facing the Northeast Elevation of the Knox Building will be available for the contractor’s use, including: staging of the work, storage of materials, parking for vehicles and equipment, work and storage trailers, etc. Keep driveways, handicap accessible parking, and entrances serving premises clear and available to Owner, Owner's employees, traffic, upon Owner occupancy, and emergency vehicles at all times. Do not use these areas for parking or storage of materials.
   a. Schedule deliveries to minimize use of driveways and entrances.
   b. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.

C. Use of Existing Building: Maintain existing building in a weathertight condition throughout construction period. Repair damage caused by construction operations. Protect building and its occupants during construction period.

1.8 OWNER’S OCCUPANCY REQUIREMENTS

A. Owner Occupancy: Owner will occupy the portions of the Knox Building and adjacent site during entire construction period. Cooperate with Owner during construction operations to minimize conflicts and facilitate Owner usage. Perform the Work so as not to interfere with Owner's day-to-day operations. Maintain existing exits, unless otherwise indicated.
1. Maintain access to existing walkways, corridors, and other adjacent occupied or used facilities. Do not close or obstruct walkways, corridors, or other occupied or used facilities without written permission from Owner and authorities having jurisdiction.
2. Provide not less than 72 hours' notice to Owner of activities that will affect Owner's operations.

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

1. Architect will prepare a Certificate of Substantial Completion for each specific portion of the Work to be occupied before Owner occupancy.
2. Contractor shall obtain a Certificate of Occupancy from authorities having jurisdiction before Owner occupancy.
3. Before partial Owner occupancy, mechanical and electrical systems shall be fully operational, and required tests and inspections shall be successfully completed. On occupancy, Owner will operate and maintain mechanical and electrical systems serving occupied portions of building.
4. On occupancy, Owner will assume responsibility for maintenance and custodial service for occupied portions of building.

1.9 WORK RESTRICTIONS

A. Utility Interruptions: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
1. Notify Architect and Owner not less than three days in advance of proposed utility interruptions.
2. Do not proceed with utility interruptions without Owner's written permission.
3. Shut down of utilities shall be scheduled for when the building is not occupied.

1.10 SPECIFICATION FORMATS AND CONVENTIONS

A. Specification Format: The Specifications are organized into Divisions and Sections using the 33-division format and CSI/CSC's "MasterFormat" numbering system.
1. Section Identification: The Specifications use Section numbers and titles to help cross-referencing in the Contract Documents. Sections in the Project Manual are in numeric sequence; however, the sequence is incomplete because all available Section numbers are not used. Consult the table of contents at the beginning of the Project Manual to determine numbers and names of Sections in the Contract Documents.
2. Division 1: Sections in Division 1 govern the execution of the Work of all Sections in the Specifications.

B. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:
1. Abbreviated Language: Language used in the Specifications and other Contract Documents is abbreviated. Words and meanings shall be interpreted as appropriate. Words implied, but not stated, shall be inferred, as the sense requires. Singular words shall be interpreted as plural, and plural words shall be interpreted as singular where applicable as the context of the Contract Documents indicates.
2. Imperative mood and streamlined language are generally used in the Specifications. Requirements expressed in the imperative mood are to be performed by Contractor. Occasionally, the indicative or subjunctive mood may be used in the Section Text for clarity to describe responsibilities that must be fulfilled indirectly by Contractor or by others when so noted.
   a. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.
1.11 MISCELLANEOUS PROVISIONS

A. Material safety data sheets shall be made available in accordance with OSHA requirements.

B. No asbestos containing materials shall be used in the work.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 011000
SECTION 012600 - CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section specifies administrative and procedural requirements for handling and processing
Contract modifications.

B. Related Sections include the following:
1. Division 01 Section "Unit Prices" for administrative requirements for using unit prices.
2. Division 01 Section "Product Requirements" for administrative procedures for handling
requests for substitutions made after Contract award.

1.3 MINOR CHANGES IN THE WORK

A. Architect will issue supplemental instructions authorizing Minor Changes in the Work, not
involving adjustment to the Contract Sum or the Contract Time, on AIA Document G710,
"Architect's Supplemental Instructions."

1.4 PROPOSAL REQUESTS

A. Owner-Initiated Proposal Requests: Architect will issue a detailed description of proposed
changes in the Work that may require adjustment to the Contract Sum or the Contract Time. If
necessary, the description will include supplemental or revised Drawings and Specifications.
1. Proposal Requests issued by Architect are for information only. Do not consider them
instructions either to stop work in progress or to execute the proposed change.
2. Within 20 days after receipt of Proposal Request or earlier as specified in Proposal
Request issued, submit a quotation estimating cost adjustments to the Contract Sum and
the Contract Time necessary to execute the change.
   a. Include a list of quantities of products required or eliminated and unit costs, with
total amount of purchases and credits to be made. If requested, furnish survey data
to substantiate quantities.
   b. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade
discounts.
   c. Include costs of labor and supervision directly attributable to the change.
   d. Include quotes on supplier’s and subcontractor’s letterhead for the requested
change.
   e. Include an updated Contractor's Construction Schedule that indicates the effect of
the change, including, but not limited to, changes in activity duration, start and
finish times, and activity relationship. Use available total float time before
requesting an extension of the Contract Time.

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


1.5 CHANGE ORDER PROCEDURES

A. On Owner's approval of a Proposal Request, Architect will issue a Change Order form for signatures of Owner and Contractor.

1.6 CONSTRUCTION CHANGE DIRECTIVE


1. Construction Change Directive contains a complete description of change in the Work. It also designates method to be followed to determine change in the Contract Sum or the Contract Time.

B. Documentation: Maintain detailed records on a time and material basis of work required by the Construction Change Directive.

1. After completion of change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012600
SECTION 012900 - PAYMENT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section specifies administrative and procedural requirements necessary to prepare and process Applications for Payment.

B. Related Sections include the following:
   1. Division 01 Section "Contract Modification Procedures" for administrative procedures for handling changes to the Contract.
   2. Division 01 Section "Construction Progress Documentation" for administrative requirements governing preparation and submittal of Contractor's Construction Schedule and Submittals Schedule.

1.3 DEFINITIONS

A. Schedule of Values: A statement furnished by Contractor allocating portions of the Contract Sum to various portions of the Work and used as the basis for reviewing Contractor's Applications for Payment.

1.4 SCHEDULE OF VALUES

A. Coordination: Coordinate preparation of the Schedule of Values with preparation of Contractor's Construction Schedule.
   1. Correlate line items in the Schedule of Values with other required administrative forms and schedules, including the following:
      a. Application for Payment forms with Continuation Sheets.
      b. Submittals Schedule.
      c. Contractor's Construction Schedule.
   2. Submit the Schedule of Values to Architect at earliest possible date but no later than seven days before the date scheduled for submittal of initial Applications for Payment.
   3. Subschedules: Where the Work is separated into phases requiring separately phased payments, provide subschedules showing values correlated with each phase of payment.

B. Format and Content: Use the Project Manual table of contents as a guide to establish line items for the Schedule of Values. Provide at least one line item for each Specification Section.
   1. Cover Sheet Identification: Include the following Project identification on the Schedule of Values:
      a. Project name and location.
      b. Name of Architect.
      c. Architect's project number.
      d. Contractor's name and address.
      e. Date of submittal.
f. Certification that Record Drawings have been updated and verified.

2. Submit draft of AIA Document G703 Continuation Sheets.

3. Arrange the Schedule of Values in tabular form with separate columns to indicate the following for each item listed:
   a. Related Specification Section or Division.
   b. Description of the Work.
   c. Name of subcontractor.
   d. Name of manufacturer or fabricator.
   e. Name of supplier.
   f. Change Orders (numbers) that affect value.
   g. Dollar value.
      1) Percentage of the Contract Sum to nearest one-hundredth percent, adjusted
to total 100 percent.

4. Provide a breakdown of the Contract Sum in enough detail to facilitate continued
evaluation of Applications for Payment and progress reports. Coordinate with the Project
Manual table of contents, providing at least one line item for each Specification Section.
Provide several line items for principal subcontract amounts, where appropriate.

5. Documentation: Submit proper documentation for the amounts being requisitioned from
subcontractors and material suppliers with each Application for Payment.

6. Round amounts to nearest whole dollar; total shall equal the Contract Sum.

7. Provide a separate line item in the Schedule of Values for each part of the Work where
Applications for Payment may include materials or equipment purchased or fabricated
and stored, but not yet installed.
   a. Differentiate between items stored on-site and items stored off-site. If specified,
      include evidence of insurance or bonded warehousing.
   b. Only major long lead delivery items may be considered for off-site storage
      (Example: Long lead custom mechanical unit). Standard order and production
      materials and products shall be delivered to the site before including in Application
      of Payment on such items.

8. Provide separate line items in the Schedule of Values for initial cost of materials, for each
subsequent stage of completion, and for total installed value of that part of the Work.

9. Allowances: Provide a separate line item in the Schedule of Values for each allowance.
Show line-item value of unit-cost allowances, as a product of the unit cost, multiplied by
measured quantity. Use information indicated in the Contract Documents to determine
quantities.

10. Each item in the Schedule of Values and Applications for Payment shall be complete.
   a. Temporary facilities and other major cost items that are not direct cost of actual
      work-in-place shall be shown as separate line items in the Schedule of Values.

11. Schedule Updating: Update and resubmit the Schedule of Values before the next
Applications for Payment when Change Orders or Construction Change Directives result
in a change in the Contract Sum.

C. The Contractor shall furnish to the Architect at the beginning of the project an expected
monthly requisition estimate for the Owner’s use in planning funding.

1.5 APPLICATIONS FOR PAYMENT

A. Each Application for Payment shall be consistent with previous applications and payments as
certified by Architect and paid for by Owner.
1. Initial Application for Payment, Application for Payment at time of Substantial
Completion, and final Application for Payment involve additional requirements.
B. Payment Application Times: Progress Payment Applications shall be submitted to Architect not less than 7 days before progress meeting. The period covered by each Application for Payment is one month, ending on the last day of the month.

C. Payment Application Forms: Use AIA Document G702 and AIA Document G703 Continuation Sheets as form for Applications for Payment.

D. Application Preparation: Complete every entry on form. Notarize and execute by a person authorized to sign legal documents on behalf of Contractor. Architect will return incomplete applications without action.
   1. Entries shall match data on the Schedule of Values and Contractor's Construction Schedule. Use updated schedules if revisions were made.
   2. Include amounts of Change Orders and Construction Change Directives issued before last day of construction period covered by application.

E. Transmittal: Submit 3 signed and notarized original copies of each Application for Payment to Architect by a method ensuring receipt within 24 hours. One copy shall include waivers of lien and similar attachments if required.
   1. Transmit each copy with a transmittal form listing attachments and recording appropriate information about application.
   2. Transmit electronic copies of Notarized document as requested.

F. Waivers of Mechanic's Lien: With each Application for Payment, submit waivers of mechanic's liens from subcontractors, sub-subcontractors, and suppliers for construction period covered by the previous application.
   1. Submit partial waivers on each item for amount requested in previous application, after deduction for retainage, on each item.
   2. When an application shows completion of an item, submit final or full waivers.
   3. Owner reserves the right to designate which entities involved in the Work must submit waivers.
   4. Submit final Application for Payment with or preceded by final waivers from every entity involved with performance of the Work covered by the application who is lawfully entitled to a lien.
   5. Waiver Forms: Submit waivers of lien on forms, executed in a manner acceptable to Owner.

G. Record Drawing Updates: With each Application of Payment, record documents shall be maintained and current for all trades, available for viewing at a central location.

H. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment include the following:
   1. List of subcontractors.
   2. Schedule of Values.
   3. Contractor's Construction Schedule (preliminary if not final).
   4. Products list.
   5. Schedule of unit prices.
   7. List of Contractor's staff assignments.
   8. List of Contractor's principal consultants.
   9. Copies of building permits and other required permits.
11. Initial progress report.
13. Certificates of insurance and insurance policies.

I. Progress Applications for Payment: Administrative actions and submittals that must precede or coincide with submittal of progress Applications for Payment include the following:
1. Contractor's Construction Schedule update.
2. Submittals for Work being requisitioned for are complete and approved.
3. Submit list of completed tests, checklists, commissioning, reports, and similar requirements for the work are submitted and in compliance with the Contract Documents.
4. Minutes of previous month’s progress meeting have been distributed.
5. Record drawings are current.

J. Application for Payment at Substantial Completion: After issuing the Certificate of Substantial Completion, submit an Application for Payment showing 100 percent completion less retainage, for portion of the Work claimed as substantially complete.
1. Include documentation supporting claim that the Work is substantially complete and a statement showing an accounting of changes to the Contract Sum.
2. This application shall reflect Certificates of Partial Substantial Completion issued previously for Owner occupancy of designated portions of the Work.

K. Final Payment Application: Submit final Application for Payment with releases and supporting documentation not previously submitted and accepted, including, but not limited, to the following:
1. Evidence of completion of Project closeout requirements, record documents, operation and maintenance data, and demonstration and training.
2. Mechanical commissioning completed and all systems in full compliance.
3. Insurance certificates for products and completed operations where required and proof that taxes, fees, and similar obligations were paid.
4. Updated final statement, accounting for final changes to the Contract Sum.
5. AIA Document G706, "Contractor's Affidavit of Payment of Debts and Claims."
7. AIA Document G707, "Consent of Surety to Final Payment."
8. Evidence that claims have been settled.
9. Final meter readings for utilities, a measured record of stored fuel, and similar data as of date of Substantial Completion or when Owner took possession of and assumed responsibility for corresponding elements of the Work.
10. Final, liquidated damages settlement statement.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012900
SECTION 013100 - PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes administrative provisions for coordinating construction operations on Project including, but not limited to, the following:
   1. Coordination Drawings.
   2. Administrative and supervisory personnel.
   3. Project meetings.

B. Related Sections include the following:
   1. Division 01 Section "Construction Progress Documentation" for preparing and submitting Contractor's Construction Schedule.
   2. Division 01 Section "Execution Requirements" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.
   3. Division 01 Section "Closeout Procedures" for coordinating Contract closeout.

1.3 COORDINATION

A. Coordination: Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations, included in different Sections that depend on each other for proper installation, connection, and operation.
   1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
   2. Coordinate installation of different components with other contractors to ensure maximum accessibility for required maintenance, service, and repair.
   3. Make adequate provisions to accommodate items scheduled for later installation.
   4. Where availability of space is limited, coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair of all components, including mechanical and electrical. Coordinate location of pipes, conduits, ducts and similar items in confined areas to assure proper fit and access. Contractor is responsible for handling interferences created by the work of subcontractors (example, sprinkler pipe interfering with installation of duct work; duct work interfering with installation of light fixtures).
   5. Coordinate the work to provide smoke and fire seals for component interfaces and penetrations of smoke walls and fire rated construction.

B. Coordinate with contractors doing work for the Owner under separate contracts.
C. Prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and list of attendees at meetings.

1. Prepare similar memoranda for Owner and separate contractors if coordination of their Work is required.

D. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities and activities of other contractors to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:

1. Preparation of Contractor's Construction Schedule.
2. Preparation of the Schedule of Values.
3. Installation and removal of temporary facilities and controls.
4. Delivery and processing of submittals.
5. Progress meetings.
6. Preinstallation conferences.
7. Project closeout activities.
8. Progress meetings.
9. Project closeout activities.

E. Conservation: Coordinate construction activities to ensure that operations are carried out with consideration given to conservation of energy, water, and materials.

1.4 SUBMITTALS

A. Key Personnel Names: Within 15 days of starting construction operations, submit a list of key personnel assignments, including superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities; list addresses and telephone numbers, including home and office telephone numbers. Provide names, addresses, and telephone numbers of individuals assigned as standbys in the absence of individuals assigned to Project.

1. Post copies of list in Project meeting room, in temporary field office, and by each temporary telephone. Keep list current at all times.

1.5 ADMINISTRATIVE AND SUPERVISORY PERSONNEL

A. General: In addition to Project superintendent, provide other administrative and supervisory personnel as required for proper performance of the Work.

1. Include special personnel required for coordination of operations with other contractors.

1.6 PROJECT MEETINGS

A. General: Schedule and conduct meetings and conferences at Project site, unless otherwise indicated.

1. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify Owner and Architect of scheduled meeting dates and times.
2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees.
3. Minutes: Record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner and Architect, within three days of the meeting.
B. Preconstruction Conference: Schedule a preconstruction conference before starting construction, at a time convenient to Owner and Architect, but no later than 15 days after execution of the Agreement. Hold the conference at Project site or another convenient location. Conduct the meeting to review responsibilities and personnel assignments.

1. Attendees: Authorized representatives of Owner, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the conference. All participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.

2. Agenda: Discuss items of significance that could affect progress, including the following:
   a. Tentative construction schedule.
   b. Phasing.
   c. Critical work sequencing and long-lead items.
   d. Designation of key personnel and their duties.
   e. Procedures for processing field decisions and Change Orders.
   f. Procedures for requests for interpretations (RFIs).
   g. Procedures for testing and inspecting.
   h. Procedures for processing Applications for Payment.
   i. Distribution of the Contract Documents.
   j. Submittal procedures.
   k. Preparation of Record Documents.
   l. Use of the premises and existing building.
   m. Work restrictions.
   n. Owner's occupancy requirements.
   o. Responsibility for temporary facilities and controls.
   p. Completion of insulation over air/vapor barrier before application of temporary heat.
   q. Construction waste management and recycling.
   r. Parking availability.
   s. Office, work, and storage areas.
   t. Equipment deliveries and priorities.
   u. First aid.
   w. Progress cleaning.
   x. Working hours.

3. Minutes: Record and distribute meeting minutes.
   a. Include action items and responsible party.

C. Preinstallation Conferences: Conduct a preinstallation conference at Project site before each construction activity that requires coordination with other construction.

1. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise Architect of scheduled meeting dates.

2. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration, including requirements for the following:
   b. Options.
   c. Related requests for interpretations (RFIs).
   d. Related Change Orders.
   e. Purchases.
f. Deliveries.
g. Submittals.
h. Review of mockups.
i. Possible conflicts.
j. Compatibility problems.
k. Time schedules.
l. Weather limitations.
m. Manufacturer's written recommendations.
n. Warranty requirements.
o. Compatibility of materials.
p. Acceptability of substrates.
q. Temporary facilities and controls.
r. Space and access limitations.
s. Regulations of authorities having jurisdiction.
t. Testing and inspecting requirements.
u. Installation procedures.
v. Coordination with other work.
w. Required performance results.
x. Protection of adjacent work.
y. Protection of construction and personnel.
z. Record drawing process.

3. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.
   a. Include action items and responsible party.

4. Reporting: Distribute minutes of the meeting to each party present and to parties who should have been present.

5. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.

D. Project/Progress Meetings: Conduct progress meetings at biweekly intervals. Coordinate dates of meetings with preparation of payment requests.
   1. Attendees: In addition to representatives of Owner and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
   2. Agenda: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
      a. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's Construction Schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
         1) Review schedule for next period.
      b. Application for Payment (Monthly): Contractor shall bring copy of Application for Payment to meetings on a monthly basis. Review Application for Payment and required attachments, including record drawing and documents status, waivers of mechanic's liens, list of completed tests, checklists, commissioning, reports, and
similar requirements for the work are submitted and in compliance with the Contract Documents.

c. Review present and future needs of each entity present, including the following:
   1) Interface requirements.
   2) Sequence of operations.
   3) Status of submittals.
   4) Deliveries.
   5) Off-site fabrication.
   6) Access.
   7) Site utilization.
   8) Temporary facilities and controls.
   9) Work hours.
  10) Hazards and risks.
  11) Progress cleaning.
  12) Quality and work standards.
  13) Status of correction of deficient items.
  14) Field observations.
  15) Requests for interpretations (RFIs).
  16) Status of proposal requests.
  17) Pending changes.
  18) Status of Change Orders.
  19) Pending claims and disputes.
  20) Documentation of information for payment requests.

3. Minutes: Record and distribute the meeting minutes.
   a. Include action items and responsible party.

4. Reporting: Distribute minutes of the meeting to each party present and to parties who should have been present.
   a. Schedule Updating: Revise Contractor's Construction Schedule after each progress meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting.

E. Coordination/Progress Meetings: Conduct Project coordination/progress meetings at weekly intervals. Project coordination meetings are in addition to specific meetings held for other purposes, such as progress meetings and preinstallation conferences.

1. Attendees: Each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.

2. Agenda: Review and correct or approve minutes of the previous coordination meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
   a. Combined Contractor's Construction Schedule: Review progress since the last coordination meeting. Determine whether each contract is on time, ahead of schedule, or behind schedule, in relation to Combined Contractor's Construction Schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.

   b. Schedule Updating: Revise Combined Contractor's Construction Schedule after each coordination meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with report of each meeting.
c. Review present and future needs of each contractor present, including the following:
   1) Interface requirements.
   2) Sequence of operations.
   3) Status of submittals.
   4) Deliveries.
   5) Off-site fabrication.
   6) Access.
   7) Site utilization.
   8) Temporary facilities and controls.
   9) Work hours.
  10) Hazards and risks.
  11) Progress cleaning.
  12) Quality and work standards.
  13) Change Orders.

3. Conduct coordination meetings with the mechanical, plumbing, sprinkler and electrical trades. Before the trades start work in an area of the building, review structural clearances and locations of ducts, pipes, conduits, light fixtures, equipment and other items that affect location and proper fit. Prepare coordination drawings where limited space availability necessitates maximum utilization of space for efficient installation of different components. Verify depths and clearances before fabrication of ductwork.

4. Reporting: Record meeting results and distribute copies to everyone in attendance and to others affected by decisions or actions resulting from each meeting.
   a. Include action items and responsible party.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013100
SECTION 013200 - CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work, including the following:
   1. Preliminary Construction Schedule.
   2. Contractor's Construction Schedule.
   4. Daily construction reports.
   5. Field condition reports.
   6. Special reports.

B. Related Sections include the following:
   1. Division 01 Section "Payment Procedures" for submitting the Schedule of Values.
   2. Division 01 Section "Project Management and Coordination" for submitting and distributing meeting and conference minutes.
   3. Division 01 Section "Submittal Procedures" for submitting schedules and reports.
   4. Division 01 Section "Quality Requirements" for submitting a schedule of tests and inspections.

1.3 SUBMITTALS

A. Qualification Data: For scheduling consultant.

B. Submittals Schedule: Submit three copies of schedule and elec. Arrange the following information in a tabular format:
   1. Scheduled date for first submittal.
   2. Specification Section number and title.
   3. Submittal category (action or informational).
   4. Name of subcontractor.
   5. Description of the Work covered.
   6. Scheduled date for Architect's final release or approval.

C. Preliminary Construction Schedule: Submit three copies.

D. Contractor's Construction Schedule: Submit three copies of initial schedule, large enough to show entire schedule for entire construction period.

E. Daily Construction Reports: Keep daily reports available on site.

F. Field Condition Reports: Submit three copies at time of discovery of differing conditions.
G. Special Reports: Submit three copies at time of unusual event.

1.4 COORDINATION

A. Coordinate preparation and processing of schedules and reports with performance of construction activities and with scheduling and reporting of separate contractors.

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

PART 2 - PRODUCTS

2.1 SUBMITTALS SCHEDULE

A. Preparation: Submit a schedule of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, resubmittal, ordering, manufacturing, fabrication, and delivery when establishing dates.
   1. Coordinate Submittals Schedule with list of subcontracts, the Schedule of Values, and Contractor's Construction Schedule.
   2. The Owner will review the schedule of submittals and identify the submittals that they want to receive a copy of at the same time that the Architect’s copies are sent out.

2.2 CONTRACTOR'S CONSTRUCTION SCHEDULE

A. Procedures: Comply with procedures contained in AGC's "Construction Planning & Scheduling."

B. Time Frame: Extend schedule from date established for commencement of the Work to date of Final Completion.
   1. Contract completion date shall not be changed by submission of a schedule that shows an early completion date, unless specifically authorized by Change Order.

C. Activities: Treat each story or separate area as a separate numbered activity for each principal element of the Work. Comply with the following:
   1. Activity Duration: Define activities so no activity is longer than 20 days, unless specifically allowed by Architect.
   2. Procurement Activities: Include procurement process activities for major items, separate activities in schedule. Procurement cycle activities include, but are not limited to, submittals, approvals, purchasing, fabrication, and delivery.
   4. Startup and Testing Time: Include times for startup and testing.
   5. Mechanical Commissioning: Include adequate time and activities for mechanical commissioning activities.
6. Substantial Completion: Indicate completion in advance of date established for Substantial Completion, and allow time for Architect's administrative procedures necessary for certification of Substantial Completion.

D. Constraints: Include constraints and work restrictions indicated in the Contract Documents and as follows in schedule, and show how the sequence of the Work is affected.
   1. Phasing: Arrange list of activities on schedule by phase.
   2. Work by Owner: Include a separate activity for each portion of the Work performed by Owner.
   3. Work Stages: Indicate important stages of construction for each major portion of the Work, including, but not limited to, the following:
      a. Subcontract awards.
      b. Submittals.
      c. Purchases.
      d. Mockups.
      e. Fabrication.
      f. Sample testing.
      g. Deliveries.
      h. Installation.
      i. Tests and inspections.
      j. Adjusting.
      k. Startup and placement into final use and operation.
   4. Area Separations: Identify each major area of construction for each major portion of the Work. Indicate where each construction activity within a major area must be sequenced or integrated with other construction activities to provide for the following:
      a. Structural completion.
      b. Permanent space enclosure.
      c. Completion of mechanical installation.
      d. Completion of electrical installation.
      e. Substantial Completion.

E. Contract Modifications: For each proposed contract modification and concurrent with its submission, prepare a time-impact analysis using fragnets to demonstrate the effect of the proposed change on the overall project schedule.

F. Computer Software: Prepare schedules using a program that has been developed specifically to manage construction schedules.

2.3 REPORTS

A. Daily Construction Reports: Prepare a daily construction report recording the following information concerning events at Project site:
   1. List of subcontractors at Project site.
   2. Approximate count of personnel at Project site.
   3. Equipment at Project site.
   5. High and low temperatures and general weather conditions.
   6. Accidents.
   7. Meetings and significant decisions.
   8. Unusual events (refer to special reports).
   9. Stoppages, delays, shortages, and losses.
10. Emergency procedures.
11. Orders and requests of authorities having jurisdiction.
12. Change Orders received and implemented.
13. Construction Change Directives received and implemented.
14. Services connected and disconnected.
15. Equipment or system tests and startups.
16. Partial Completions and occupancies.
17. Substantial Completions authorized.

B. Field Condition Reports: Immediately on discovery of a difference between field conditions and the Contract Documents, prepare and submit a detailed report. Submit with a request for interpretation. Include a detailed description of the differing conditions, together with recommendations for changing the Contract Documents.

2.4 SPECIAL REPORTS

A. General: Submit special reports to Architect within one day of an occurrence. Distribute copies of report to parties affected by the occurrence.

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

PART 3 - EXECUTION

3.1 CONTRACTOR'S CONSTRUCTION SCHEDULE

A. Contractor's Construction Schedule Updating: At biweekly intervals, update schedule to reflect actual construction progress and activities. Issue a schedule one week before each regularly scheduled progress meeting.
1. Revise schedule immediately after each meeting or other activity where revisions have been recognized or made. Issue updated schedule concurrently with the report of each such meeting.
2. Include a report with updated schedule that indicates every change, including, but not limited to, changes in logic, durations, actual starts and finishes, and activity durations.
3. As the Work progresses, indicate Actual Completion percentage for each activity.

B. Distribution: Distribute copies of approved schedule to Architect, Owner, separate contractors, testing and inspecting agencies, and other parties identified by Contractor with a need-to-know schedule responsibility.
1. Post copies in Project meeting rooms and temporary field offices.
2. When revisions are made, distribute updated schedules to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in performance of construction activities.

END OF SECTION 013200
SECTION 013300 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

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

B. Related Requirements:
   1. Section 012900 "Payment Procedures" for submitting Applications for Payment and the schedule of values.
   2. Section 013200 "Construction Progress Documentation" for submitting schedules and reports, including Contractor's construction schedule.
   3. Section 014000 "Quality Requirements" for submitting test and inspection reports and for mockup requirements.
   4. Section 017700 "Closeout Procedures" for submitting warranties.
   5. Section 017823 "Operation and Maintenance Data" for submitting operation and maintenance manuals.
   6. Section 017839 "Project Record Documents" for submitting record Drawings, record Specifications, and record Product Data.
   7. Section 017900 "Demonstration and Training" for submitting documentation of demonstration of equipment and training of Owner's personnel.
   8. Division 01 to 26 Sections for specific requirements for submittals in those Sections.

1.3 DEFINITIONS

A. Action Submittals: Written and graphic information and physical samples that require Architect's responsive action. Action submittals are those submittals indicated in individual Specification Sections as "action submittals."

B. Informational Submittals: Written and graphic information and physical samples that do not require Architect's responsive action. Submittals may be rejected for not complying with requirements. Informational submittals are those submittals indicated in individual Specification Sections as "informational submittals."

C. File Transfer Protocol (FTP): Communications protocol that enables transfer of files to and from another computer over a network and that serves as the basis for standard Internet protocols. An FTP site is a portion of a network located outside of network firewalls within which internal and external users are able to access files.

1.4 SUBMITTAL ADMINISTRATIVE REQUIREMENTS

A. Architect's Digital Data Files: Electronic digital data files of the Contract Drawings will not be provided by Architect for Contractor's use in preparing submittals.

B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.
   1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
   2. Submit all submittal items required for each Specification Section concurrently.
   3. Submit action submittals and informational submittals required by the same Specification Section as separate packages under separate transmittals.
   4. Coordinate transmittal of different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination.
      a. Architect reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.
   5. No products shall be incorporated into the work unless they have been approved by the Contractor and Architect. No work will be paid for until required submittals for applicable work have been submitted and approved.

C. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Architect's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.
   1. Initial Review: Allow 14 calendar days minimum for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Architect will advise Contractor when a submittal being processed must be delayed for coordination.
   2. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
   3. Resubmittal Review: Allow 14 calendar days minimum for review of each resubmittal.
   4. Sequential Review: Where sequential review of submittals by Architect's consultants, Owner, or other parties is indicated, allow 21 calendar days minimum for initial review of each submittal.

D. Electronic Submittals: Architect is using Newforma software to process electronic submittals. Identify and incorporate information in each electronic submittal file as follows:
   1. Assemble complete submittal package into single files incorporating submittal requirements of a single specification section and transmittal form.
      a. Provide a separate transmittal form for Product Data, a separate transmittal form for Shop Drawings, and a separate transmittal form for Informational Submittals required by each Specification Section.
      b. Maximum File Size: A single file size, up to 18 MB can be received. Contact Architect for instructions if file exceeds 18 MB.
      c. For each transmittal, attach one single PDF only. Where multiple PDFs are required for a transmittal, utilize Adobe Acrobat combine feature to merge the PDFs into a single PDF.
         1) Unacceptable Formats: In order to process the transmittals in Newforma, the single PDF file protocol must be followed. Transmittals zip files or
grouped PDFs cannot be electronically processed and will be returned without action for correction and resubmittal.

2) Submittals will be returned without action for correction and resubmittal if:
   a) Submittal does not have an electronic Transmittal Form.
   b) Multiple specification sections are contained within a single Transmittal form. Submittals must be separated into individual Specification Sections.

2. Name file with submittal number or other unique identifier, including revision identifier.
   a. File name shall use project identifier and Specification Section number followed by a dash and then a sequential number (e.g., LNHS-061000-01). Resubmittals shall include an alphabetic suffix after another dash (e.g., LNHS-061000-01-A).

3. Provide means for insertion to permanently record Contractor's review and approval markings and action taken by Architect.

4. Transmittal Form for Electronic Submittals: Use electronic form acceptable to Owner, containing the following information:
   a. Project name.
   b. Date.
   c. Name and address of Architect.
   d. Name of Construction Manager.
   e. Name of Contractor.
   f. Name of firm or entity that prepared submittal.
   g. Names of subcontractor, manufacturer, and supplier.
   h. Category and type of submittal.
   i. Submittal purpose and description.
   j. Specification Section number and title.
   k. Specification paragraph number or drawing designation and generic name for each of multiple items.
   l. Drawing number and detail references, as appropriate.
   m. Location(s) where product is to be installed, as appropriate.
   n. Related physical samples submitted directly.
   o. Indication of full or partial submittal.
   p. Transmittal number.
   q. Submittal and transmittal distribution record.
   r. Other necessary identification.
   s. Remarks.

E. Options: Identify options requiring selection by Architect.

F. Deviations and Additional Information: On an attached separate sheet, prepared on Contractor's letterhead, record relevant information, requests for data, revisions other than those requested by Architect on previous submittals, and deviations from requirements in the Contract Documents, including minor variations and limitations. Include same identification information as related submittal.

G. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.
1. Note date and content of previous submittal.
2. Note date and content of revision in label or title block and clearly indicate extent of revision.
3. Resubmit submittals until they are marked with approval notation from Architect's action stamp.
H. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.

I. Use for Construction: Retain complete copies of submittals on Project site. Use only final action submittals that are marked with approval notation from Architect’s action stamp.

PART 2 - PRODUCTS

2.1 SUBMITTAL PROCEDURES

A. General Submittal Procedure Requirements: Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.

1. Submit electronic submittals by either of the following methods:
   a. Via email as PDF electronic file to submittals@harriman.com.
   b. Post electronic submittals as PDF electronic files directly to Architect’s FTP site specifically established for Project.

2. Certificates and Certifications Submittals: Provide a statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity.
   a. Provide a digital signature with digital certificate on electronically submitted certificates and certifications where indicated.

B. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.

1. If information must be specially prepared for submittal because standard published data are not suitable for use, submit as Shop Drawings, not as Product Data.

2. Mark each copy of each submittal to show which products and options are applicable.

3. Include the following information, as applicable:
   a. Manufacturer's catalog cuts.
   b. Manufacturer's product specifications.
   c. Standard color charts.
   d. Statement of compliance with specified referenced standards.
   e. Testing by recognized testing agency.
   f. Application of testing agency labels and seals.
   g. Notation of coordination requirements.
   h. Availability and delivery time information.

4. For equipment, include the following in addition to the above, as applicable:
   a. Wiring diagrams showing factory-installed wiring.
   b. Printed performance curves.
   c. Operational range diagrams.
   d. Clearances required to other construction, if not indicated on accompanying Shop Drawings.
5. Submit Product Data before or concurrent with Samples.
6. Submit Product Data in the following format:
   a. PDF electronic file.
7. Do not submit Material Safety Data Sheets (MSDSs).

C. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data.
   1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
      a. Identification of products.
      b. Schedules.
      c. Compliance with specified standards.
      d. Notation of coordination requirements.
      e. Notation of dimensions established by field measurement.
      f. Relationship and attachment to adjoining construction clearly indicated.
      g. Seal and signature of professional engineer if specified.
   2. Submit Shop Drawings in the following format:
      a. PDF electronic file.

D. Samples: Submit Samples for review of kind, color, pattern, and texture for a check of these characteristics with other elements and for a comparison of these characteristics between submittal and actual component as delivered and installed.
   1. Transmit Samples that contain multiple, related components such as accessories together in one submittal package.
   2. Identification: Attach label on unexposed side of Samples that includes the following:
      a. Generic description of Sample.
      b. Product name and name of manufacturer.
      c. Sample source.
      d. Number and title of applicable Specification Section.
      e. Specification paragraph number and generic name of each item.
   3. For projects where electronic submittals are required, provide corresponding electronic submittal of Sample transmittal, digital image file illustrating Sample characteristics, and identification information for record.
   4. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.
      a. Samples that may be incorporated into the Work are indicated in individual Specification Sections. Such Samples must be in an undamaged condition at time of use.
      b. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.
   5. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available.
      a. Number of Samples: Submit one full set(s) of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Architect will return submittal with options selected.
   6. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or
containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.

a. Number of Samples: Submit two sets of Samples. Architect will retain one Sample sets; remainder will be returned.
   1) Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.
   2) If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, submit at least three sets of paired units that show approximate limits of variations.

E. Product Schedule: As required in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location. Include the following information in tabular form:
   1. Type of product. Include unique identifier for each product indicated in the Contract Documents or assigned by Contractor if none is indicated.
   2. Manufacturer and product name, and model number if applicable.
   3. Number and name of room or space.
   4. Location within room or space.
   5. Submit product schedule in the following format:
      a. PDF electronic file.

F. Coordination Drawing Submittals: Comply with requirements specified in Section 013100 "Project Management and Coordination."

G. Contractor's Construction Schedule: Comply with requirements specified in Section 013200 "Construction Progress Documentation."

H. Application for Payment and Schedule of Values: Comply with requirements specified in Section 012900 "Payment Procedures."

I. Test and Inspection Reports and Schedule of Tests and Inspections Submittals: Comply with requirements specified in Section 014000 "Quality Requirements."

J. Closeout Submittals and Maintenance Material Submittals: Comply with requirements specified in Section 017700 "Closeout Procedures."

K. Maintenance Data: Comply with requirements specified in Section 017823 "Operation and Maintenance Data."

L. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, contact information of architects and owners, and other information specified.

M. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of Welding Procedure Specification and Procedure Qualification Record on AWS forms. Include names of firms and personnel certified.
N. Installer Certificates: Submit written statements on manufacturer's letterhead certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.

O. Manufacturer Certificates: Submit written statements on manufacturer's letterhead certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.

P. Product Certificates: Submit written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.

Q. Material Certificates: Submit written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.

R. Material Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.

S. Product Test Reports: Submit written reports indicating that current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.

T. Research Reports: Submit written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project. Include the following information:
1. Name of evaluation organization.
2. Date of evaluation.
3. Time period when report is in effect.
4. Product and manufacturers' names.
5. Description of product.
6. Test procedures and results.
7. Limitations of use.

U. Preconstruction Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.

V. Compatibility Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for primers and substrate preparation needed for adhesion.

W. Field Test Reports: Submit written reports indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.

X. Design Data: Prepare and submit written and graphic information, including, but not limited to, performance and design criteria, list of applicable codes and regulations, and calculations. Include list of assumptions and other performance and design criteria and a summary of loads.
Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Include page numbers.

Y. Material Safety Data Sheets (MSDSs): Submit information directly to Owner at end of the project; do not submit to Architect. Maintain copy at the site for the duration of the construction.
1. Architect will not review submittals that include MSDSs and will return them.

2.2 DELEGATED-DESIGN SERVICES

A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.
1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Architect.

B. Delegated-Design Services Certification: In addition to Shop Drawings, Product Data, and other required submittals, submit digitally signed PDF electronic file paper copies of certificate, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional.
1. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.

PART 3 - EXECUTION

3.1 CONTRACTOR'S REVIEW

A. Action and Informational Submittals: Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Architect.
1. The Contractor shall review submittals for completeness and compliance with the Contract Documents. If submittal contains substitutions, Contractor shall process substitutions in accordance with Division 01 Section “Substitutions and Product Options,” and not part of specified Shop Drawings or Product Data submittals. Contractor is responsible for keeping Subcontractors on time with the submittal schedule. If the Contractor submits submittals that are repeatedly rejected, requiring the Architect to perform multiple reviews of the same submittal because of the failure to properly prepare and complete the submittals:
   a. Owner will compensate Architect for such additional services.
   b. Owner will deduct the amount of such compensation from the final payment to the Contractor.

B. Project Closeout and Maintenance Material Submittals: See requirements in Section 017700 "Closeout Procedures."

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

A. Action Submittals: Architect will review each submittal, make marks to indicate corrections or revisions required, and return it. Architect will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action.
   1. The Architect’s marking of “Approved,” Approved as Noted” or similar verbiage means submittal has been reviewed for general conformance to the contract documents only and does not mean unqualified acceptance. The Contractor is fully responsible for compliance with the contract documents.

B. Informational Submittals: Architect will review each submittal and will not return it, or will return it if it does not comply with requirements. Architect will forward each submittal to appropriate party.

C. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from Architect.

D. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review.

E. Submittals not required by the Contract Documents may be returned by the Architect without action.

END OF SECTION 013300
SECTION 014000 - QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for quality assurance and quality control.

B. Testing and inspecting services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.

1. Specific quality-assurance and -control requirements for individual construction activities are specified in the Sections that specify those activities. Requirements in those Sections may also cover production of standard products.

2. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and -control procedures that facilitate compliance with the Contract Document requirements.

3. Requirements for Contractor to provide quality-assurance and -control services required by Architect, Owner, or authorities having jurisdiction are not limited by provisions of this Section.

C. Related Sections include the following:

1. Division 01 Section "Construction Progress Documentation" for developing a schedule of required tests and inspections.

2. Division 01 Section "Cutting and Patching" for repair and restoration of construction disturbed by testing and inspecting activities.

3. Divisions 02 through 33 Sections for specific test and inspection requirements.

1.3 DEFINITIONS

A. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.

B. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Services do not include contract enforcement activities performed by Architect.

C. Mockups: Full-size, physical assemblies that are constructed on-site. Mockups are used to verify selections made under sample submittals, to demonstrate aesthetic effects and, where indicated, qualities of materials and execution, and to review construction, coordination, testing, or operation; they are not Samples.
D. Laboratory Mockups: Full-size, physical assemblies that are constructed at testing facility to verify performance characteristics.

E. Preconstruction Testing: Tests and inspections that are performed specifically for the Project before products and materials are incorporated into the Work to verify performance or compliance with specified criteria.

F. Product Testing: Tests and inspections that are performed by an NRTL, an NVLAP, or a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with industry standards.

G. Source Quality-Control Testing: Tests and inspections that are performed at the source, i.e., plant, mill, factory, or shop.

H. Field Quality-Control Testing: Tests and inspections that are performed on-site for installation of the Work and for completed Work.

I. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.

J. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, Subcontractor, or Sub-subcontractor, to perform a particular construction operation, including installation, erection, application, and similar operations.
   1. Using a term such as "carpentry" does not imply that certain construction activities must be performed by accredited or unionized individuals of a corresponding generic name, such as "carpenter." It also does not imply that requirements specified apply exclusively to tradespeople of the corresponding generic name.

K. Experienced: When used with an entity, "experienced" means having successfully completed a minimum of five previous projects similar in size and scope to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.

1.4 CONFLICTING REQUIREMENTS

A. General: If compliance with two or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer uncertainties and requirements that are different, but apparently equal, to Architect for a decision before proceeding.

B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Architect for a decision before proceeding.
1.5 SUBMITTALS

A. Qualification Data: For testing agencies specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.

B. Schedule of Tests and Inspections: Prepare in tabular form and include the following:
   1. Specification Section number and title.
   2. Description of test and inspection.
   3. Identification of applicable standards.
   4. Identification of test and inspection methods.
   5. Number of tests and inspections required.
   6. Time schedule or time span for tests and inspections.
   7. Entity responsible for performing tests and inspections.
   8. Requirements for obtaining samples.
   9. Unique characteristics of each quality-control service.

C. Reports: Prepare and submit certified written reports that include the following:
   1. Date of issue.
   2. Project title and number.
   3. Name, address, and telephone number of testing agency.
   4. Dates and locations of samples and tests or inspections.
   5. Names of individuals making tests and inspections.
   6. Description of the Work and test and inspection method.
   8. Complete test or inspection data.
   9. Test and inspection results and an interpretation of test results.
  10. Record of temperature and weather conditions at time of sample taking and testing and inspecting.
  11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
  12. Name and signature of laboratory inspector.
  13. Recommendations on retesting and reinspecting.

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

1.6 QUALITY ASSURANCE

A. General: Qualifications paragraphs in this Article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.

B. Installer Qualifications: A firm or individual experienced in installing, erecting, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.

C. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
D. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

E. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that are similar to those indicated for this Project in material, design, and extent.

F. Specialists: Certain sections of the Specifications require that specific construction activities shall be performed by entities who are recognized experts in those operations. Specialists shall satisfy qualification requirements indicated and shall be engaged for the activities indicated.  
   1. Requirement for specialists shall not supersede building codes and regulations governing the Work.

G. Testing Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspecting indicated, as documented according to ASTM E 548; and with additional qualifications specified in individual Sections; and where required by authorities having jurisdiction, that is acceptable to authorities.  
   1. NRTL: A nationally recognized testing laboratory according to 29 CFR 1910.7.  
   2. NVLAP: A testing agency accredited according to NIST’s National Voluntary Laboratory Accreditation Program.

H. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of manufacturer’s products that are similar in material, design, and extent to those indicated for this Project.

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

K. Laboratory Mockups: Comply with requirements of preconstruction testing and those specified in individual Sections in Divisions 2 through 33.

1.7 QUALITY CONTROL

A. Owner Responsibilities: Where quality-control services are indicated as Owner's responsibility, Owner will engage a qualified testing agency to perform these services.
1. Owner will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of types of testing and inspecting they are engaged to perform.
2. Payment for these services will be made from testing and inspecting allowances, as authorized by Change Orders.
3. Costs for retesting and reinspecting construction that replaces or is necessitated by work that failed to comply with the Contract Documents will be charged to Contractor.

B. Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Unless otherwise indicated, provide quality-control services specified and those required by authorities having jurisdiction. Perform quality-control services required of Contractor by authorities having jurisdiction, whether specified or not.
1. Where services are indicated as Contractor's responsibility, engage a qualified testing agency to perform these quality-control services.
   a. Contractor shall not employ same entity engaged by Owner, unless agreed to in writing by Owner.
2. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspecting will be performed.
3. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
4. Testing and inspecting requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
5. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.

C. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing as specified in Division 1 Section "Submittal Procedures."
D. Retesting/Reinspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspecting, for construction that replaced Work that failed to comply with the Contract Documents.

   1. Notify Architect and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
   2. Determine the location from which test samples will be taken and in which in-situ tests are conducted.
   3. Conduct and interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from requirements.
   4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
   5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
   6. Do not perform any duties of Contractor.

F. Associated Services: Cooperate with agencies performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:
   1. Access to the Work.
   2. Incidental labor and facilities necessary to facilitate tests and inspections.
   3. Adequate quantities of representative samples of materials that require testing and inspecting. Assist agency in obtaining samples.
   4. Facilities for storage and field curing of test samples.
   5. Delivery of samples to testing agencies.
   6. Preliminary design mix proposed for use for material mixes that require control by testing agency.
   7. Security and protection for samples and for testing and inspecting equipment at Project site.

G. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and -control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.
   1. Schedule times for tests, inspections, obtaining samples, and similar activities.

H. Schedule of Tests and Inspections: Prepare a schedule of tests, inspections, and similar quality-control services required by the Contract Documents. Submit schedule within 30 days of date established for commencement of the Work.
   1. Distribution: Distribute schedule to Owner, Architect, testing agencies, and each party involved in performance of portions of the Work where tests and inspections are required.

1.8 SPECIAL TESTS AND INSPECTIONS

A. Special Tests and Inspections: Owner will engage a qualified registered engineer to conduct special tests and inspections required by authorities having jurisdiction as the responsibility of Owner, in compliance with applicable building code.
PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 TEST AND INSPECTION LOG

A. Prepare a record of tests and inspections. Include the following:
   1. Date test or inspection was conducted.
   2. Description of the Work tested or inspected.
   3. Date test or inspection results were transmitted to Architect.
   4. Identification of testing agency or special inspector conducting test or inspection.

B. Maintain log at Project site. Post changes and modifications as they occur. Provide access to test and inspection log for Architect's reference during normal working hours.

3.2 REPAIR AND PROTECTION

A. General: On completion of testing, inspecting, sample taking, and similar services, repair damaged construction and restore substrates and finishes.
   1. Comply with the Contract Document requirements for Division 01 Section "Cutting and Patching."

B. Protect construction exposed by or for quality-control service activities.

C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

END OF SECTION 014000
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 DEFINITIONS

A. General: Basic Contract definitions are included in the Conditions of the Contract.

B. "Approved": When used to convey Architect's action on Contractor's submittals, applications, and requests, "approved" is limited to Architect's duties and responsibilities as stated in the Conditions of the Contract.

C. "Directed": A command or instruction by Architect. Other terms including "requested," "authorized," "selected," "required," and "permitted" have the same meaning as "directed."

D. "Indicated": Requirements expressed by graphic representations or in written form on Drawings, in Specifications, and in other Contract Documents. Other terms including "shown," "noted," "scheduled," and "specified" have the same meaning as "indicated."

E. "Regulations": Laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, and rules, conventions, and agreements within the construction industry that control performance of the Work.

F. "Furnish": Supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.

G. "Install": Operations at Project site including unloading, temporarily storing, unpacking, assembling, erecting, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations.

H. "Provide": Furnish and install, complete and ready for the intended use.

I. "Project Site": Space available for performing construction activities. The extent of Project site is shown on Drawings and may or may not be identical with the description of the land on which Project is to be built.

1.3 INDUSTRY STANDARDS

A. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference.

B. Publication Dates: Comply with standards in effect as of date of the Contract Documents unless otherwise indicated.
C. Copies of Standards: Each entity engaged in construction on Project should be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound with the Contract Documents.
   1. Where copies of standards are needed to perform a required construction activity, obtain copies directly from publication source.

1.4 ABBREVIATIONS AND ACRONYMS

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

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

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Name of Organization</th>
<th>Phone Number</th>
<th>Website</th>
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<tbody>
<tr>
<td>AA</td>
<td>Aluminum Association, Inc. (The)</td>
<td>(703) 358-2960</td>
<td><a href="http://www.aluminum.org">www.aluminum.org</a></td>
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<tr>
<td>AAADM</td>
<td>American Association of Automatic Door Manufacturers</td>
<td>(216) 241-7333</td>
<td><a href="http://www.aaadm.com">www.aaadm.com</a></td>
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<tr>
<td>AABC</td>
<td>Associated Air Balance Council</td>
<td>(202) 737-0202</td>
<td><a href="http://www.aabchq.com">www.aabchq.com</a></td>
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<tr>
<td>AAMA</td>
<td>American Architectural Manufacturers Association</td>
<td>(847) 303-5664</td>
<td><a href="http://www.aamanet.org">www.aamanet.org</a></td>
</tr>
<tr>
<td>AASHTO</td>
<td>American Association of State Highway and Transportation Officials</td>
<td>(202) 624-5800</td>
<td><a href="http://www.transportation.org">www.transportation.org</a></td>
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<tr>
<td>AATCC</td>
<td>American Association of Textile Chemists and Colorists (The)</td>
<td>(919) 549-8141</td>
<td><a href="http://www.aatcc.org">www.aatcc.org</a></td>
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<tr>
<td>ABAA</td>
<td>Air Barrier Association of America</td>
<td>(866) 956-5888</td>
<td><a href="http://www.airbarrier.org">www.airbarrier.org</a></td>
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<tr>
<td>ABMA</td>
<td>American Bearing Manufacturers Association</td>
<td>(202) 367-1155</td>
<td><a href="http://www.abma-dc.org">www.abma-dc.org</a></td>
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<tr>
<td>ACI</td>
<td>ACI International (American Concrete Institute)</td>
<td>(248) 848-3700</td>
<td><a href="http://www.aci-int.org">www.aci-int.org</a></td>
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<tr>
<td>ACPA</td>
<td>American Concrete Pipe Association</td>
<td>(972) 506-7216</td>
<td><a href="http://www.concrete-pipe.org">www.concrete-pipe.org</a></td>
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<td>Organization</td>
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<td>AEIC</td>
<td>Association of Edison Illuminating Companies, Inc. (The) (205) 257-2530 <a href="http://www.aeic.org">www.aeic.org</a></td>
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<td>AF&amp;PA</td>
<td>American Forest &amp; Paper Association (800) 878-8878 <a href="http://www.afandpa.org">www.afandpa.org</a> (202) 463-2700</td>
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<td>AGA</td>
<td>American Gas Association (202) 824-7000 <a href="http://www.aga.org">www.aga.org</a></td>
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<td>AGC</td>
<td>Associated General Contractors of America (The) (703) 548-3118 <a href="http://www.agc.org">www.agc.org</a></td>
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<td>AHA</td>
<td>American Hardboard Association (Now part of CPA) (202) 872-5955 <a href="http://www.aga.org">www.aga.org</a></td>
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<td>AHAM</td>
<td>Association of Home Appliance Manufacturers (202) 872-5955 <a href="http://www.aham.org">www.aham.org</a></td>
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<td>AI</td>
<td>Asphalt Institute (859) 288-4960 <a href="http://www.asphaltinstitute.org">www.asphaltinstitute.org</a></td>
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<td>AIA</td>
<td>American Institute of Architects (The) (800) 242-3837 <a href="http://www.aia.org">www.aia.org</a> (202) 626-7300</td>
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<td>AISC</td>
<td>American Institute of Steel Construction (800) 644-2400 <a href="http://www.aisc.org">www.aisc.org</a> (312) 670-2400</td>
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<td>AISI</td>
<td>American Iron and Steel Institute (202) 452-7100 <a href="http://www.steel.org">www.steel.org</a></td>
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<td>AITC</td>
<td>American Institute of Timber Construction (303) 792-9559 <a href="http://www.aite-glulam.org">www.aite-glulam.org</a></td>
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<td>ALCA</td>
<td>Associated Landscape Contractors of America (Now PLANET - Professional Landcare Network)</td>
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<td>ALSC</td>
<td>American Lumber Standard Committee, Incorporated (301) 972-1700 <a href="http://www.alsc.org">www.alsc.org</a></td>
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<td>ANSI</td>
<td>American National Standards Institute (202) 293-8020 <a href="http://www.ansi.org">www.ansi.org</a></td>
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<td>AOSA</td>
<td>Association of Official Seed Analysts, Inc. (405) 780-7372 <a href="http://www.aosaseed.com">www.aosaseed.com</a></td>
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<td>APA</td>
<td>Architectural Precast Association (239) 454-6989 <a href="http://www.archprecast.org">www.archprecast.org</a></td>
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<td>APA</td>
<td>APA - The Engineered Wood Association</td>
<td>(253) 565-6600</td>
<td><a href="http://www.apawood.org">www.apawood.org</a></td>
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</table>
| APA EWS      | APA - The Engineered Wood Association; Engineered Wood Systems  
(See APA - The Engineered Wood Association) | | |
| API          | American Petroleum Institute | (202) 682-8000 | www.api.org |
| ARI          | Air-Conditioning & Refrigeration Institute | (703) 524-8800 | www.ari.org |
| ARMA         | Asphalt Roofing Manufacturers Association | (202) 207-0917 | www.asphaltroofing.org |
| ASCE         | American Society of Civil Engineers | (800) 548-2723 | www.asce.org |
| ASCE/SEI     | American Society of Civil Engineers/Structural Engineering Institute  
(See ASCE) | (703) 295-6300 | |
| ASHRAE       | American Society of Heating, Refrigerating and Air-Conditioning Engineers | (800) 527-4723 | www.ashrae.org |
| ASME         | ASME International  
(The American Society of Mechanical Engineers International) | (800) 843-2763 | www.asme.org |
| ASSE         | American Society of Sanitary Engineering | (440) 835-3040 | www.asse-plumbing.org |
| ASTM         | ASTM International  
| AWCI         | AWCI International  
(Association of the Wall and Ceiling Industry International) | (703) 534-8300 | www.awci.org |
| AWCMA        | American Window Covering Manufacturers Association  
(Now WCSC) | | |
<p>| AWI          | Architectural Woodwork Institute | (571) 323-3636 | <a href="http://www.awinet.org">www.awinet.org</a> |
| AWPA         | American Wood-Preservers' Association | (205) 733-4077 | <a href="http://www.awpa.com">www.awpa.com</a> |</p>
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<tr>
<td>AWS</td>
<td>American Welding Society</td>
<td>(800) 443-9353</td>
<td><a href="http://www.aws.org">www.aws.org</a></td>
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<tr>
<td>AWWA</td>
<td>American Water Works Association</td>
<td>(800) 926-7337</td>
<td><a href="http://www.awwa.org">www.awwa.org</a></td>
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<td>BHMA</td>
<td>Builders Hardware Manufacturers Association</td>
<td>(212) 297-2122</td>
<td><a href="http://www.buildershardware.com">www.buildershardware.com</a></td>
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<tr>
<td>BIA</td>
<td>Brick Industry Association</td>
<td>(703) 620-0010</td>
<td><a href="http://www.bia.org">www.bia.org</a></td>
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<tr>
<td>BICSI</td>
<td>BICSI</td>
<td>(800) 242-7405</td>
<td><a href="http://www.bicsi.org">www.bicsi.org</a></td>
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<td>BIFMA</td>
<td>BIFMA International</td>
<td>(616) 285-3963</td>
<td><a href="http://www.bifma.com">www.bifma.com</a></td>
</tr>
<tr>
<td>BISSC</td>
<td>Baking Industry Sanitation Standards Committee</td>
<td>(866) 342-4772</td>
<td><a href="http://www.bissc.org">www.bissc.org</a></td>
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<td>CCC</td>
<td>Carpet Cushion Council</td>
<td>(610) 527-3880</td>
<td><a href="http://www.carpetcushion.org">www.carpetcushion.org</a></td>
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<tr>
<td>CDA</td>
<td>Copper Development Association</td>
<td>(800) 232-3282</td>
<td><a href="http://www.copper.org">www.copper.org</a></td>
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<tr>
<td>CEA</td>
<td>Canadian Electricity Association</td>
<td>(613) 230-9263</td>
<td><a href="http://www.canelect.ca">www.canelect.ca</a></td>
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<td>CFFA</td>
<td>Chemical Fabrics &amp; Film Association, Inc.</td>
<td>(216) 241-7333</td>
<td><a href="http://www.chemicalfabricsandfilm.com">www.chemicalfabricsandfilm.com</a></td>
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<td>CGA</td>
<td>Compressed Gas Association</td>
<td>(703) 788-2700</td>
<td><a href="http://www.cganet.com">www.cganet.com</a></td>
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<td>CIMA</td>
<td>Cellulose Insulation Manufacturers Association</td>
<td>(888) 881-2462</td>
<td><a href="http://www.cellulose.org">www.cellulose.org</a></td>
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<tr>
<td>CISCA</td>
<td>Ceilings &amp; Interior Systems Construction Association</td>
<td>(630) 584-1919</td>
<td><a href="http://www.cisca.org">www.cisca.org</a></td>
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<td>CISPI</td>
<td>Cast Iron Soil Pipe Institute</td>
<td>(423) 892-0137</td>
<td><a href="http://www.cispi.org">www.cispi.org</a></td>
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<td>CLFMI</td>
<td>Chain Link Fence Manufacturers Institute</td>
<td>(301) 596-2583</td>
<td><a href="http://www.chainlinkinfo.org">www.chainlinkinfo.org</a></td>
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### CRCC
Cool Roof Rating Council  
www.coolroofs.org  
(866) 465-2523  
(510) 485-7175

### CPA
Composite Panel Association  
www.pbmdf.com  
(301) 670-0604

### CPPA
Corrugated Polyethylene Pipe Association  
www.cppa-info.org  
(800) 510-2772  
(202) 462-9607

### CRI
Carpet & Rug Institute (The)  
www.carpet-rug.com  
(800) 882-8846  
(706) 278-3176

### CRSI
Concrete Reinforcing Steel Institute  
www.crsi.org  
(847) 517-1200

### CSA
Canadian Standards Association  
(800) 463-6727  
(416) 747-4000

### CSA
CSA International  
(Formerly: IAS - International Approval Services)  
www.csa-international.org  
(866) 797-4272  
(416) 747-4000

### CSI
Cast Stone Institute  
www.caststone.org  
(717) 272-3744

### CSI
Construction Specifications Institute (The)  
www.csinet.org  
(800) 689-2900  
(703) 684-0300

### CSSB
Cedar Shake & Shingle Bureau  
www.cedarbureau.org  
(604) 820-7700

### CTI
Cooling Technology Institute  
(Formerly: Cooling Tower Institute)  
www.cti.org  
(281) 583-4087

### DHI
Door and Hardware Institute  
www.dhi.org  
(703) 222-2010

### EIA
Electronic Industries Alliance  
www.eia.org  
(703) 907-7500

### EIMA
EIFS Industry Members Association  
www.eima.com  
(800) 294-3462  
(770) 968-7945

### EJCDC
Engineers Joint Contract Documents Committee  
www.ejdc.org  
(703) 295-5000

### EJMA
Expansion Joint Manufacturers Association, Inc.  
www.ejma.org  
(914) 332-0040
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<td>ESD</td>
<td>ESD Association</td>
<td>(315) 339-6937</td>
<td><a href="http://www.esda.org">www.esda.org</a></td>
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<td>FIBA</td>
<td>Federation Internationale de Basketball</td>
<td>41 22 545 00 00</td>
<td>(The International Basketball Federation) <a href="http://www.fiba.com">www.fiba.com</a></td>
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<td>FIVB</td>
<td>Federation Internationale de Volleyball</td>
<td>41 21 345 35 35</td>
<td>(The International Volleyball Federation) <a href="http://www.fivb.ch">www.fivb.ch</a></td>
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<tr>
<td>FM Approvals</td>
<td>FM Approvals</td>
<td>(781) 762-4300</td>
<td><a href="http://www.fmglobal.com">www.fmglobal.com</a></td>
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<td>FM Global</td>
<td>FM Global</td>
<td>(401) 275-3000</td>
<td>(Formerly: FMG - FM Global)  <a href="http://www.fmglobal.com">www.fmglobal.com</a></td>
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<td>FMRC</td>
<td>Factory Mutual Research</td>
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<td>(Now FM Global)</td>
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<td>FRSA</td>
<td>Florida Roofing, Sheet Metal &amp; Air</td>
<td>(407) 671-3772</td>
<td>Conditioning Contractors     <a href="http://www.floridaroof.com">www.floridaroof.com</a></td>
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<td></td>
<td>Association, Inc.</td>
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<td>FSA</td>
<td>Fluid Sealing Association</td>
<td>(610) 971-4850</td>
<td><a href="http://www.fluidsealing.com">www.fluidsealing.com</a></td>
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<td>FSC</td>
<td>Forest Stewardship Council</td>
<td>49 228 367 66 0</td>
<td><a href="http://www.fsc.org">www.fsc.org</a></td>
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<td>GA</td>
<td>Gypsum Association</td>
<td>(202) 289-5440</td>
<td><a href="http://www.gypsum.org">www.gypsum.org</a></td>
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<td>GANA</td>
<td>Glass Association of North America</td>
<td>(785) 271-0208</td>
<td><a href="http://www.glasswebsite.com">www.glasswebsite.com</a></td>
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<td>GRI</td>
<td>(Now GSI)</td>
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<td>GS</td>
<td>Green Seal</td>
<td>(202) 872-6400</td>
<td><a href="http://www.greenseal.org">www.greenseal.org</a></td>
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<td>GSI</td>
<td>Geosynthetic Institute</td>
<td>(610) 522-8440</td>
<td><a href="http://www.geosynthetic-institute.org">www.geosynthetic-institute.org</a></td>
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<td>HI</td>
<td>Hydraulic Institute</td>
<td>(888) 786-7744</td>
<td><a href="http://www.pumps.org">www.pumps.org</a></td>
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<td>Hydronics Institute</td>
<td>(973) 267-9700</td>
<td><a href="http://www.gamanet.org">www.gamanet.org</a></td>
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<td>(908) 464-8200</td>
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<td>HMMA</td>
<td>Hollow Metal Manufacturers Association</td>
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<td>HPVA</td>
<td>Hardwood Plywood &amp; Veneer Association</td>
<td><a href="http://www.hpva.org">www.hpva.org</a></td>
<td>(703) 435-2900</td>
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<td>HPW</td>
<td>H. P. White Laboratory, Inc.</td>
<td><a href="http://www.hpwhite.com">www.hpwhite.com</a></td>
<td>(410) 838-6550</td>
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<td>IAS</td>
<td>International Approval Services</td>
<td>(Now CSA International)</td>
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<td>IBF</td>
<td>International Badminton Federation</td>
<td><a href="http://www.internationalbadminton.org">www.internationalbadminton.org</a></td>
<td>(6-03) 9283-7155</td>
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<td>ICEA</td>
<td>Insulated Cable Engineers Association, Inc.</td>
<td><a href="http://www.icea.net">www.icea.net</a></td>
<td>(770) 830-0369</td>
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<td>ICRI</td>
<td>International Concrete Repair Institute, Inc.</td>
<td><a href="http://www.icri.org">www.icri.org</a></td>
<td>(847) 827-0830</td>
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<td>IEC</td>
<td>International Electrotechnical Commission</td>
<td><a href="http://www.iec.ch">www.iec.ch</a></td>
<td>41 22 919 02 11</td>
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<td>IEEE</td>
<td>Institute of Electrical and Electronics Engineers, Inc. (The)</td>
<td><a href="http://www.ieee.org">www.ieee.org</a></td>
<td>(212) 419-7900</td>
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<td>IESNA</td>
<td>Illuminating Engineering Society of North America</td>
<td><a href="http://www.iesna.org">www.iesna.org</a></td>
<td>(212) 248-5000</td>
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<td>IEST</td>
<td>Institute of Environmental Sciences and Technology</td>
<td><a href="http://www.iest.org">www.iest.org</a></td>
<td>(847) 255-1561</td>
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<td>IGCC</td>
<td>Insulating Glass Certification Council</td>
<td><a href="http://www.igcc.org">www.igcc.org</a></td>
<td>(315) 646-2234</td>
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<td>IGMA</td>
<td>Insulating Glass Manufacturers Alliance</td>
<td><a href="http://www.igmaonline.org">www.igmaonline.org</a></td>
<td>(613) 233-1510</td>
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<td>ILI</td>
<td>Indiana Limestone Institute of America, Inc.</td>
<td><a href="http://www.iliai.com">www.iliai.com</a></td>
<td>(812) 275-4426</td>
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<td>ISO</td>
<td>International Organization for Standardization</td>
<td><a href="http://www.iso.ch">www.iso.ch</a></td>
<td>41 22 749 01 11</td>
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<td>Available from ANSI</td>
<td><a href="http://www.ansi.org">www.ansi.org</a></td>
<td>(202) 293-8020</td>
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<td>ISSFA</td>
<td>International Solid Surface Fabricators Association</td>
<td><a href="http://www.issfa.net">www.issfa.net</a></td>
<td>(877) 464-7732</td>
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<td>(702) 567-8150</td>
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<td>ITS</td>
<td>Intertek Testing Service NA</td>
<td>(972) 238-5591</td>
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<td>ITU</td>
<td>International Telecommunication Union</td>
<td>41 22 730 51 11</td>
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<td>KCMA</td>
<td>Kitchen Cabinet Manufacturers Association</td>
<td>(703) 264-1690</td>
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<td>LMA</td>
<td>Laminating Materials Association (Now part of CPA)</td>
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<td>LPI</td>
<td>Lightning Protection Institute</td>
<td>(800) 488-6864</td>
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<td>MBMA</td>
<td>Metal Building Manufacturers Association</td>
<td>(216) 241-7333</td>
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<td>MFMA</td>
<td>Maple Flooring Manufacturers Association, Inc.</td>
<td>(847) 480-9138</td>
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<td>MFMA</td>
<td>Metal Framing Manufacturers Association, Inc.</td>
<td>(312) 644-6610</td>
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<td>MH</td>
<td>Material Handling (Now MHIA)</td>
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<td>MHIA</td>
<td>Material Handling Industry of America</td>
<td>(800) 345-1815 (704) 676-1190</td>
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<td>MIA</td>
<td>Marble Institute of America</td>
<td>(440) 250-9222</td>
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<td>MPI</td>
<td>Master Painters Institute</td>
<td>(888) 674-8937</td>
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<td>MSS</td>
<td>Manufacturers Standardization Society of The Valve and Fittings Industry Inc.</td>
<td>(703) 281-6613</td>
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<td>NAAMM</td>
<td>National Association of Architectural Metal Manufacturers</td>
<td>(312) 332-0405</td>
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<td>NACE</td>
<td>NACE International (National Association of Corrosion Engineers International)</td>
<td>(800) 797-6623 (281) 228-6200</td>
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<td>NADCA</td>
<td>National Air Duct Cleaners Association</td>
<td>(202) 737-2926</td>
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<td>NAGWS</td>
<td>National Association for Girls and Women in Sport</td>
<td>(800) 213-7193, ext. 453</td>
<td><a href="http://www.aahperd.org/nagws/">www.aahperd.org/nagws/</a></td>
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<td>NAIMA</td>
<td>North American Insulation Manufacturers Association</td>
<td>(703) 684-0084</td>
<td><a href="http://www.naima.org">www.naima.org</a></td>
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<td>NBGQA</td>
<td>National Building Granite Quarries Association, Inc.</td>
<td>(800) 557-2848</td>
<td><a href="http://www.nbgqa.com">www.nbgqa.com</a></td>
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<tr>
<td>NCAA</td>
<td>National Collegiate Athletic Association (The)</td>
<td>(317) 917-6222</td>
<td><a href="http://www.ncaa.org">www.ncaa.org</a></td>
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<td>NCMA</td>
<td>National Concrete Masonry Association</td>
<td>(703) 713-1900</td>
<td><a href="http://www.ncma.org">www.ncma.org</a></td>
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<td>NCPI</td>
<td>National Clay Pipe Institute</td>
<td>(262) 248-9094</td>
<td><a href="http://www.ncpi.org">www.ncpi.org</a></td>
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<td>NCTA</td>
<td>National Cable &amp; Telecommunications Association</td>
<td>(202) 775-3550</td>
<td><a href="http://www.ncta.com">www.ncta.com</a></td>
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<td>NEBB</td>
<td>National Environmental Balancing Bureau</td>
<td>(301) 977-3698</td>
<td><a href="http://www.nebb.org">www.nebb.org</a></td>
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<td>NECA</td>
<td>National Electrical Contractors Association</td>
<td>(301) 657-3110</td>
<td><a href="http://www.necanet.org">www.necanet.org</a></td>
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<td>NeLMA</td>
<td>Northeastern Lumber Manufacturers’ Association</td>
<td>(207) 829-6901</td>
<td><a href="http://www.nelma.org">www.nelma.org</a></td>
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<td>NEMA</td>
<td>National Electrical Manufacturers Association</td>
<td>(703) 841-3200</td>
<td><a href="http://www.nema.org">www.nema.org</a></td>
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<tr>
<td>NETA</td>
<td>InterNational Electrical Testing Association</td>
<td>(888) 300-6382 (303) 697-8441</td>
<td><a href="http://www.netaworld.org">www.netaworld.org</a></td>
</tr>
<tr>
<td>NFHS</td>
<td>National Federation of State High School Associations</td>
<td>(317) 972-6900</td>
<td><a href="http://www.nfhs.org">www.nfhs.org</a></td>
</tr>
<tr>
<td>NFPA</td>
<td>NFPA (National Fire Protection Association)</td>
<td>(800) 344-3555 (617) 770-3000</td>
<td><a href="http://www.nfpa.org">www.nfpa.org</a></td>
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<td>NFRC</td>
<td>National Fenestration Rating Council</td>
<td>(301) 589-1776</td>
<td><a href="http://www.nfrc.org">www.nfrc.org</a></td>
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<td>NGA</td>
<td>National Glass Association</td>
<td>(866) 342-5642 (703) 442-4890</td>
<td><a href="http://www.glass.org">www.glass.org</a></td>
</tr>
<tr>
<td>NHLA</td>
<td>National Hardwood Lumber Association</td>
<td>(800) 933-0318 (901) 377-1818</td>
<td><a href="http://www.natlhardwood.org">www.natlhardwood.org</a></td>
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<tr>
<td>NLGA</td>
<td>National Lumber Grades Authority</td>
<td><a href="http://www.nlga.org">www.nlga.org</a></td>
<td>(604) 524-2393</td>
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<td>NOFMA</td>
<td>NOFMA: The Wood Flooring Manufacturers Association</td>
<td><a href="http://www.nofma.com">www.nofma.com</a></td>
<td>(901) 526-5016</td>
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<td>NRCA</td>
<td>National Roofing Contractors Association</td>
<td><a href="http://www.nrca.net">www.nrca.net</a></td>
<td>(800) 323-9545</td>
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<tr>
<td>NRMCA</td>
<td>National Ready Mixed Concrete Association</td>
<td><a href="http://www.nrmca.org">www.nrmca.org</a></td>
<td>(888) 846-7622</td>
</tr>
<tr>
<td>NSF</td>
<td>NSF International</td>
<td><a href="http://www.nsf.org">www.nsf.org</a></td>
<td>(800) 673-6275</td>
</tr>
<tr>
<td>NSSGA</td>
<td>National Stone, Sand &amp; Gravel Association</td>
<td><a href="http://www.nssga.org">www.nssga.org</a></td>
<td>(800) 342-1415</td>
</tr>
<tr>
<td>NTMA</td>
<td>National Terrazzo &amp; Mosaic Association, Inc. (The)</td>
<td><a href="http://www.ntma.com">www.ntma.com</a></td>
<td>(800) 323-9736</td>
</tr>
<tr>
<td>NTRMA</td>
<td>National Tile Roofing Manufacturers Association (Now TRI)</td>
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<td>NWWDA</td>
<td>National Wood Window and Door Association</td>
<td><a href="http://www.nwwda.org">www.nwwda.org</a></td>
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<tr>
<td>OPL</td>
<td>Omega Point Laboratories, Inc. (Now ITS)</td>
<td></td>
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<tr>
<td>PCI</td>
<td>Precast/Prestressed Concrete Institute</td>
<td><a href="http://www.pci.org">www.pci.org</a></td>
<td>(312) 786-0300</td>
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<tr>
<td>PDCA</td>
<td>Painting &amp; Decorating Contractors of America</td>
<td><a href="http://www.pdca.com">www.pdca.com</a></td>
<td>(800) 332-7322</td>
</tr>
<tr>
<td>PDI</td>
<td>Plumbing &amp; Drainage Institute</td>
<td><a href="http://www.pdionline.org">www.pdionline.org</a></td>
<td>(800) 589-8956</td>
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<tr>
<td>PGI</td>
<td>PVC Geomembrane Institute</td>
<td><a href="http://pgi-tc.ce.uiuc.edu">http://pgi-tc.ce.uiuc.edu</a></td>
<td>(217) 333-3929</td>
</tr>
<tr>
<td>PLANET</td>
<td>Professional Landcare Network (Formerly: ACLA - Associated Landscape Contractors of America)</td>
<td><a href="http://www.landcarenetwork.org">www.landcarenetwork.org</a></td>
<td>(800) 395-2522</td>
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<td>PTI</td>
<td>Post-Tensioning Institute</td>
<td><a href="http://www.post-tensioning.org">www.post-tensioning.org</a></td>
<td>(602) 870-7540</td>
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<tr>
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<tr>
<td>RCSC</td>
<td>Research Council on Structural Connections</td>
<td></td>
<td><a href="http://www.boltcouncil.org">www.boltcouncil.org</a></td>
</tr>
<tr>
<td>RFCI</td>
<td>Resilient Floor Covering Institute</td>
<td>(301) 340-8580</td>
<td><a href="http://www.rfci.com">www.rfci.com</a></td>
</tr>
<tr>
<td>RIS</td>
<td>Redwood Inspection Service</td>
<td>(888) 225-7339</td>
<td><a href="http://www.calredwood.org">www.calredwood.org</a></td>
</tr>
<tr>
<td>SAE</td>
<td>SAE International</td>
<td>(877) 606-7323</td>
<td><a href="http://www.sae.org">www.sae.org</a></td>
</tr>
<tr>
<td>SDI</td>
<td>Steel Deck Institute</td>
<td>(847) 458-4647</td>
<td><a href="http://www.sdi.org">www.sdi.org</a></td>
</tr>
<tr>
<td>SDI</td>
<td>Steel Door Institute</td>
<td>(440) 899-0010</td>
<td><a href="http://www.steeldoor.org">www.steeldoor.org</a></td>
</tr>
<tr>
<td>SEFA</td>
<td>Scientific Equipment and Furniture Association</td>
<td>(516) 294-5424</td>
<td><a href="http://www.sefalabs.com">www.sefalabs.com</a></td>
</tr>
<tr>
<td>SEI/ASCE</td>
<td>Structural Engineering Institute/American Society of Civil Engineers (See ASCE)</td>
<td></td>
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<tr>
<td>SGCC</td>
<td>Safety Glazing Certification Council</td>
<td>(315) 646-2234</td>
<td><a href="http://www.sgcc.org">www.sgcc.org</a></td>
</tr>
<tr>
<td>SIA</td>
<td>Security Industry Association</td>
<td>(703) 683-2075</td>
<td><a href="http://www.siaonline.org">www.siaonline.org</a></td>
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<tr>
<td>SIGMA</td>
<td>Sealed Insulating Glass Manufacturers Association</td>
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<td>SJI</td>
<td>Steel Joist Institute</td>
<td>(843) 626-1995</td>
<td><a href="http://www.steeljoist.org">www.steeljoist.org</a></td>
</tr>
<tr>
<td>SMA</td>
<td>Screen Manufacturers Association</td>
<td>(561) 533-0991</td>
<td><a href="http://www.smacentral.org">www.smacentral.org</a></td>
</tr>
<tr>
<td>SMACNA</td>
<td>Sheet Metal and Air Conditioning Contractors' National Association</td>
<td>(703) 803-2980</td>
<td><a href="http://www.smacna.org">www.smacna.org</a></td>
</tr>
<tr>
<td>SMPTE</td>
<td>Society of Motion Picture and Television Engineers</td>
<td>(914) 761-1100</td>
<td><a href="http://www.smpte.org">www.smpte.org</a></td>
</tr>
<tr>
<td>SPFA</td>
<td>Spray Polyurethane Foam Alliance</td>
<td>(800) 523-6154</td>
<td><a href="http://www.sprayfoam.org">www.sprayfoam.org</a></td>
</tr>
</tbody>
</table>

**REFERENCES**

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SPIB  Southern Pine Inspection Bureau (The)  www.spib.org  (850) 434-2611

SPRI  Single Ply Roofing Industry  www.spri.org  (781) 647-7026

SSINA  Specialty Steel Industry of North America  www.ssina.com  (800) 982-0355  (202) 342-8630

SSPC  SSPC: The Society for Protective Coatings  www.sspc.org  (877) 281-7772  (412) 281-2331

STI  Steel Tank Institute  www.steeltank.com  (847) 438-8265

SWI  Steel Window Institute  www.steelwindows.com  (216) 241-7333

SWRI  Sealant, Waterproofing, & Restoration Institute  www.swrionline.org  (816) 472-7974

TCA  Tile Council of America, Inc.  www.tileusa.com  (864) 646-8453

TIA/EIA  Telecommunications Industry Association/Electronic Industries Alliance  www.tiaonline.org  (703) 907-7700

TMS  The Masonry Society  www.masonrysociety.org  (303) 939-9700

TPI  Truss Plate Institute, Inc.  www.tpinst.org  (703) 683-1010

TPI  Turfgrass Producers International  www.turfgrasssod.org  (800) 405-8873  (847) 649-5555

TRI  Tile Roofing Institute  www.tileroofing.org  (312) 670-4177

UL  Underwriters Laboratories Inc.  www.ul.com  (877) 854-3577  (847) 272-8800

UNI  Uni-Bell PVC Pipe Association  www.uni-bell.org  (972) 243-3902

USAV  USA Volleyball  www.usavolleyball.org  (888) 786-5539  (719) 228-6800

USITT  United States Institute for Theatre Technology, Inc. (800) 938-7488
www.usitt.org (315) 463-6463

WASTEC  Waste Equipment Technology Association (800) 424-2869
www.wastec.org (202) 244-4700

WCLIB  West Coast Lumber Inspection Bureau (800) 283-1486
www.wclib.org (503) 639-0651

WCMA  Window Covering Manufacturers Association (Now WCSC)

WCSC  Window Covering Safety Council (800) 506-4636
(Formerly: WCMA - Window Covering Manufacturers Association) (212) 297-2109
www.windowcoverings.org

WDMA  Window & Door Manufacturers Association (800) 223-2301
(Formerly: NWWDA - National Wood Window and Door Association) (847) 299-5200
www.wdma.com

WI  Woodwork Institute (Formerly: WIC - Woodwork Institute of California) (916) 372-9943
www.wicnet.org

WIC  Woodwork Institute of California (Now WI)

WMMPA  Wood Moulding & Millwork Producers Association (800) 550-7889
www.wmmpa.com (530) 661-9591

WSRCA  Western States Roofing Contractors Association (800) 725-0333
www.wsrca.com (650) 570-5441

WWPA  Western Wood Products Association (503) 224-3930
www.wwpa.org

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

BOCA  BOCA International, Inc. (See ICC)

IAPMO  International Association of Plumbing and Mechanical Officials (909) 472-4100
www.iapmo.org
D. Federal Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Names, telephone numbers, and Web sites are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

<table>
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<th>Abbreviation</th>
<th>Full Name</th>
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<tr>
<td>CE</td>
<td>Army Corps of Engineers</td>
<td></td>
<td><a href="http://www.usace.army.mil">www.usace.army.mil</a></td>
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<tr>
<td>DOC</td>
<td>Department of Commerce</td>
<td>(202) 482-2000</td>
<td><a href="http://www.commerce.gov">www.commerce.gov</a></td>
</tr>
<tr>
<td>DOD</td>
<td>Department of Defense</td>
<td>(215) 697-6257</td>
<td><a href="http://dodssp.daps.dla.mil">http://dodssp.daps.dla.mil</a></td>
</tr>
<tr>
<td>DOE</td>
<td>Department of Energy</td>
<td>(202) 586-9220</td>
<td><a href="http://www.energy.gov">www.energy.gov</a></td>
</tr>
<tr>
<td>EPA</td>
<td>Environmental Protection Agency</td>
<td>(202) 272-0167</td>
<td><a href="http://www.epa.gov">www.epa.gov</a></td>
</tr>
<tr>
<td>FAA</td>
<td>Federal Aviation Administration</td>
<td>(866) 835-5322</td>
<td><a href="http://www.faa.gov">www.faa.gov</a></td>
</tr>
<tr>
<td>FCC</td>
<td>Federal Communications Commission</td>
<td>(888) 225-5322</td>
<td><a href="http://www.fcc.gov">www.fcc.gov</a></td>
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<tr>
<td>FDA</td>
<td>Food and Drug Administration</td>
<td>(888) 463-6332</td>
<td><a href="http://www.fda.gov">www.fda.gov</a></td>
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<tr>
<td>GSA</td>
<td>General Services Administration</td>
<td>(800) 488-3111</td>
<td><a href="http://www.gsa.gov">www.gsa.gov</a></td>
</tr>
<tr>
<td>LBL</td>
<td>Lawrence Berkeley National Laboratory</td>
<td>(510) 486-4000</td>
<td><a href="http://www.lbl.gov">www.lbl.gov</a></td>
</tr>
<tr>
<td>NCHRP</td>
<td>National Cooperative Highway Research Program</td>
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<td></td>
<td>(See TRB)</td>
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<tr>
<td>NIST</td>
<td>National Institute of Standards and Technology</td>
<td>(301) 975-6478</td>
<td><a href="http://www.nist.gov">www.nist.gov</a></td>
</tr>
<tr>
<td>OSHA</td>
<td>Occupational Safety &amp; Health Administration</td>
<td>(800) 321-6742</td>
<td><a href="http://www.osha.gov">www.osha.gov</a></td>
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<tr>
<td></td>
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<td>(202) 693-1999</td>
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<td>PBS</td>
<td>Public Building Service</td>
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<td></td>
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<td>RUS</td>
<td>Rural Utilities Service</td>
<td>(202) 720-9540</td>
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<td></td>
<td>(See USDA)</td>
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<tr>
<td>SD</td>
<td>State Department</td>
<td>(202) 647-4000</td>
<td><a href="http://www.state.gov">www.state.gov</a></td>
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<tr>
<td>TRB</td>
<td>Transportation Research Board</td>
<td>(202) 334-2934</td>
<td><a href="http://gulliver.trb.org">http://gulliver.trb.org</a></td>
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<tr>
<td>USDA</td>
<td>Department of Agriculture</td>
<td>(202) 720-2791</td>
<td><a href="http://www.usda.gov">www.usda.gov</a></td>
</tr>
<tr>
<td>USPS</td>
<td>Postal Service</td>
<td>(202) 268-2000</td>
<td><a href="http://www.usps.com">www.usps.com</a></td>
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**E. Standards and Regulations:** Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the standards and regulations in the following list. Names, telephone numbers, and Web sites are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

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<th>Agency</th>
<th>Description</th>
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<tr>
<td>ADAAG</td>
<td>Americans with Disabilities Act (ADA)</td>
<td>(800) 872-2253</td>
<td><a href="http://www.access-board.gov">www.access-board.gov</a></td>
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<tr>
<td></td>
<td>Architectural Barriers Act (ABA)</td>
<td>(202) 272-0080</td>
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<td></td>
<td>Accessibility Guidelines for Buildings and Facilities</td>
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<td>Available from Access Board</td>
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**REFERENCES**

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<td>DSCC</td>
<td>Defense Supply Center Columbus (See FS)</td>
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<tr>
<td>FED-STD</td>
<td>Federal Standard (See FS)</td>
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<td>FTMS</td>
<td>Federal Test Method Standard (See FS)</td>
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<tr>
<td>MIL</td>
<td>(See MILSPEC)</td>
</tr>
<tr>
<td>MIL-STD</td>
<td>(See MILSPEC)</td>
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<tr>
<td>UFAS</td>
<td>Uniform Federal Accessibility Standards (800) 872-2253 Available from Access Board (202) 272-0080 <a href="http://www.access-board.gov">www.access-board.gov</a></td>
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F.  State Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Names, telephone numbers, and Web sites are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

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<th>Agency</th>
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<tr>
<td>CBHF</td>
<td>(800) 952-5210</td>
<td><a href="http://www.dca.ca.gov/bhfti">www.dca.ca.gov/bhfti</a> (916) 574-2041</td>
</tr>
</tbody>
</table>
CCR  California Code of Regulations  (916) 323-6815
    www.calregs.com

CPUC  California Public Utilities Commission  (415) 703-2782
    www.cpuc.ca.gov

TFS  Texas Forest Service  (979) 458-6650
    Forest Resource Development
    http://txforestservice.tamu.edu

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 014200
SECTION 015000 - TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes requirements for temporary facilities and controls, including temporary utilities, support facilities, and security and protection facilities.

B. Temporary utilities include, but are not limited to, the following:
   1. Sanitary facilities, including toilets, wash facilities, and drinking-water facilities.
   2. Electric power.
   3. Lighting.
   4. Telephone service.

C. Support facilities include, but are not limited to, the following:
   1. Project identification and temporary signs.
   2. Waste disposal facilities.
   3. Field offices.
   4. Storage sheds.
   5. Lifts and hoists.
   6. Construction aids and miscellaneous services and facilities.
   7. Snow removal.

D. Security and protection facilities include, but are not limited to, the following:
   1. Tree and plant protection.
   2. Perimeter enclosure fence for the site.
   4. Barricades, warning signs, and lights.
   5. Covered walkways.
   6. Temporary enclosures.
   7. Fire protection.

E. Related Sections include the following:
   1. Division 01 Section "Submittal Procedures" for procedures for submitting copies of implementation and termination schedule and utility reports.
   2. Division 01 Section “Construction Waste Management and Disposal” for handling and processing demolition and construction debris.
   3. Division 01 Section "Execution Requirements" for progress cleaning requirements.
   4. Divisions 02 through 33 for temporary heat, ventilation, and humidity requirements for products in those Sections.
1.3 DEFINITIONS

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

1.4 USE CHARGES

A. General: Cost or use charges for temporary facilities are not chargeable to Owner or Architect and shall be included in the Contract Sum. Allow other entities to use temporary services and facilities without cost, including, but not limited to, the following:
   1. Owner's construction forces.
   2. Occupants of Project.
   3. Architect.
   4. Construction Observer.
   5. Testing agencies.
   7. Personnel of authorities having jurisdiction.

B. Water Service: The use of existing water service will be allowed without charge, for water used by all entities engaged in construction activities at Project site.

C. Electric Power Service: The use of existing electric power service will be allowed without charge, for electricity used by all entities engaged in construction activities at Project site.

D. Power and other utility charges incurred for testing and start-up of equipment will be paid for by the Owner.

1.5 SUBMITTALS

A. Cold-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with cold-weather requirements to protect install concrete and masonry.

1.6 QUALITY ASSURANCE

   1. Trade Jurisdictions: Assigned responsibilities for installation and operation of temporary utilities are not intended to interfere with trade regulations and union jurisdictions.
   2. Electric Service and Connections: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service and connections to existing building electrical. Install service to comply with NFPA 70.

B. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.

C. The Contractor is responsible for the implementation, monitoring, and maintenance of job site safety program for the duration of the contract.
1.7 PROJECT CONDITIONS

A. Temporary Utilities: At earliest feasible time, when acceptable to Owner, change over from use of temporary service to use of permanent service.
   1. Temporary Use of Permanent Facilities: Installer of each permanent service shall assume responsibility for operation, maintenance, and protection of each permanent service during its use as a construction facility before Owner's acceptance, regardless of previously assigned responsibilities.

B. Conditions of Use: The following conditions apply to use of temporary services and facilities by all parties engaged in the Work:
   1. Keep temporary services and facilities clean and neat.
   2. Relocate temporary services and facilities as required by progress of the Work.

C. Restrict use of noise-making tools and equipment to hours that will minimize complaints from persons or firms near the site. Construction noise from machinery, equipment, construction traffic, hammering and similar loud noises shall be restricted to the hours of 7:00 a.m. to 5:00 p.m. Obey State and local noise ordinances.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General: Provide new materials. Undamaged, previously used materials in serviceable condition may be used if approved by Architect. Provide materials suitable for use intended.

B. Lumber and Plywood: Comply with requirements in Division 6 Section "Rough Carpentry."

C. Tarpaulins: Fire-resistive labeled with flame-spread rating of 15 or less.

D. Water: Potable.

2.2 EQUIPMENT

A. General: Provide equipment suitable for use intended.

B. Field Offices: Prefabricated, mobile units with lockable entrances, operable windows, and serviceable finishes; heated and air conditioned; on foundations adequate for normal loading.

C. Fire Extinguishers: Hand carried, portable, UL rated. Provide class and extinguishing agent as indicated or a combination of extinguishers of NFPA-recommended classes for exposures.
   1. Comply with NFPA 10 and NFPA 241 for classification, extinguishing agent, and size required by location and class of fire exposure.

D. Self-Contained Toilet Units: Single-occupant units of chemical, aerated recirculation, or combustion type; vented; fully enclosed with a glass-fiber-reinforced polyester shell or similar nonabsorbent material.

E. Drinking-Water Fixtures: Containerized, tap-dispenser, bottled-water drinking-water units, including paper cup supply.
F. Lamps and Light Fixtures: Provide general service incandescent lamps of wattage required for adequate illumination, and where existing light fixtures are not in operation. Provide guard cages or tempered-glass enclosures where exposed to breakage. Provide exterior fixtures where exposed to moisture.

G. Security Fence: Perimeter security fencing enclosure fence around the work, in accordance with the Contractor’s safety plan and security plan for the construction site. Fence shall keep the public and pets out the construction site.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Locate facilities where they will serve Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required.
   1. Coordinate with the Architect and Owner at the preconstruction meeting.

B. Provide each facility ready for use when needed to avoid delay. Maintain and modify as required. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

3.2 TEMPORARY UTILITY INSTALLATION

A. General: Engage appropriate local utility company to install temporary service or connect to existing service. Where utility company provides only part of the service, provide the remainder with matching, compatible materials and equipment. Comply with utility company recommendations.
   1. Arrange with utility company, Owner, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services.
   2. Provide adequate capacity at each stage of construction.

B. Water Service: Provide rubber hoses as necessary to serve Project site, connecting to existing hose bibs. Sanitary Facilities: Provide temporary toilets and drinking-water fixtures. Comply with regulations and health codes for type, number, location, operation, and maintenance of fixtures and facilities.
   1. Disposable Supplies: Provide toilet tissue, paper towels, paper cups, and similar disposable materials for each facility. Maintain adequate supply. Provide covered waste containers for disposal of used material.
   2. Toilets: Install self-contained toilet units. Shield toilets to ensure privacy.
   3. Drinking-Water Facilities: Provide bottled-water, drinking-water units.
   4. Use of the Owner's existing toilet facilities will not be permitted.

C. Heating: Provide temporary heating required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of low temperatures or high humidity. Select equipment from that specified that will not have a harmful effect on completed installations or elements being installed.
   1. Use of existing heating system will be permitted for temporary heat. Contractor shall provide temporary enclosures and minimize heat loss to the maximum extent possible. Cost of fuel will be paid for by the Owner.
D. Ventilation and Humidity Control: Provide temporary ventilation required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of high humidity. Select equipment from that specified that will not have a harmful effect on completed installations or elements being installed. Coordinate ventilation requirements to produce ambient condition required and minimize energy consumption.

E. Temporary Electric Power Service: Provide grounded electric power distribution of sufficient size, capacity, and power characteristics during construction period, connecting to the existing building power service. Verify

F. Temporary Lighting: Use of existing lighting will be permitted.
1. Install and operate temporary lighting that will fulfill security and protection requirements without operating the entire system. Provide additional temporary lighting that will provide adequate illumination for construction operations and traffic conditions. A minimum of 80 foot candles shall be supplied at mid-height of surfaces for taping, painting and finish work.

G. Telephone Service: Provide temporary telephone service throughout construction period. Cellular phone service, if desired, shall be provided by the Contractor.
1. At each telephone, post a list of important telephone numbers.
   a. Police and fire departments.
   b. Ambulance service.
   c. Contractor's home office.
   d. Architect's office.
   e. Owner's office.
   f. Principal subcontractors' field and home offices.

3.3 SUPPORT FACILITIES INSTALLATION

A. General: Comply with the following:
1. Locate field offices, storage sheds, sanitary facilities, and other temporary construction and support facilities for easy access.
2. Provide incombustible construction for offices, shops, and sheds located within construction area or within 30 feet of building lines. Comply with NFPA 241.
3. Maintain support facilities until near Substantial Completion. Remove before Substantial Completion. Personnel remaining after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to Owner.

B. Project Identification and Temporary Signs: Prepare Project identification and other signs in sizes indicated. Install signs where indicated to inform public and persons seeking entrance to Project. Do not permit installation of unauthorized signs.
1. Prepare temporary signs to provide directional information to construction personnel and visitors.

C. Waste Disposal Facilities: Provide waste-collection containers in sizes adequate to handle waste from construction operations. Containerize and clearly label hazardous, dangerous, or unsanitary waste materials separately from other waste. Comply with Division 01 Section "Execution Requirements" for progress cleaning requirements.
1. See Division 1 Section “Construction Waste Management and Disposal” for additional requirements.
2. Each trade shall pick up the debris and rubbish generated by that trade and dispose of in the appropriate dumpsters furnished by the Contractor.

D. Contractor’s Field Office: Provide an insulated, weathertight, air-conditioned field office for use as a common facility by all personnel engaged in construction activities; of sufficient size to accommodate required office personnel and meetings of 5 persons at Project site. Keep office clean and orderly. Pay utility costs for field office for the duration of the project.
   1. Furnishings: The Contractor shall provide all furniture, including desks, chairs, plan racks, file drawers, computers and software, photocopiers, waste receptacles, answering machine, conference room table and chairs for their office,
   2. The Contractor is responsible for cleaning of their floors and emptying trash.
   3. Conference Room: Coordinate with Owner for location of meetings and conferences on the University campus.

E. Storage and Fabrication Sheds: Provide sheds sized, furnished, and equipped to accommodate materials and equipment involved, including temporary utility services.

F. Lifts and Hoists: Provide facilities for hoisting materials and personnel. Truck cranes and similar devices used for hoisting materials are considered "tools and equipment" and not temporary facilities.

3.4 SECURITY AND PROTECTION FACILITIES INSTALLATION

A. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction in ways and by methods that comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects. Avoid using tools and equipment that produce harmful noise. Restrict use of noisemaking tools and equipment to hours that will minimize complaints from persons or firms near Project site.

B. Tree and Plant Protection: Install temporary fencing located as indicated or outside the drip line of trees to protect vegetation from construction damage. Protect tree root systems from damage, flooding, and erosion.

C. Security Fence: Before work begins, install a security enclosure fence around the building site. Fencing shall be such to limit access to the work area by pedestrian traffic around the site. Install in a manner that will prevent people, dogs, and other animals from easily entering the site, except by the entrance gates.
   1. Locate fence so as to not hinder site work or progress on the building. Relocate without additional expense as needed during progress of the work.
   2. Provide signage to warn people to “keep out” and area is dangerous to non-construction personnel.

D. Security Enclosure and Lockup: Install substantial temporary enclosure around areas of the building made accessible by demolition operations, and for partially completed areas of the building. Provide Protection to prevent unauthorized entrance, vandalism, theft, and similar violations of security.

E. Barricades, Warning Signs, and Lights: Comply with standards and code requirements for erecting structurally adequate barricades. Paint with appropriate colors, graphics, and warning
signs to inform personnel and public of possible hazard. Where appropriate and needed, provide lighting, including flashing red or amber lights.

F. Temporary Enclosures: Provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weathertight and secure enclosure for building exterior at all times.
   1. Where heating is needed and permanent enclosure is not complete, provide sealed temporary enclosures.
   2. Vertical Openings: Close openings of 25 sq. ft. (2.3 sq. m) or less with plywood or similar materials.
   3. Horizontal Openings: Close openings in floor or roof decks and horizontal surfaces with load-bearing, wood-framed construction.
   4. Install tarpaulins securely using wood framing and other materials.
   5. Building shall remain protected and watertight. Water damage shall be corrected by the Contractor at no cost to the Owner.

G. Temporary Dust Partitions:
   1. Provide temporary dust partitions isolating the work from occupied spaces before starting any demolition and remove after work is completed. Obtain approval from Architect before removal of partitions.
   2. Construct temporary dust partitions out of metal studs and 1/2" fire-retardant plywood on one side. Seal all gaps and around perimeter with duct tape. Temporary doors for partitions shall be 3'-0" x 6'-8" hollow core doors with standard mortise hardware, closers, weatherstripping and keyed locksets to match Owner's. Insulate partition to provide noise protection to occupied areas.
   3. All temporary dust partitions in place less than 3 days may be Cirvico fire-retardant vinyl and adequately supported sealed with duct tape.
   4. Hang vinyl around area while stud and plywood temporary partition is being constructed.
   5. Insulate and weatherproof temporary partitions and doors exposed to exterior and exposed to unheated spaces.

H. Temporary Fire Protection: Until fire-protection needs are supplied by permanent facilities, install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 241.
   1. Provide fire extinguishers, installed on walls on mounting brackets, visible and accessible from space being served, with sign mounted above.
      a. Field Offices: Class A stored-pressure -type extinguishers.
      b. Other Locations: Class ABC dry-chemical extinguishers or a combination of extinguishers of NFPA-recommended classes for exposures.
      c. Locate fire extinguishers where convenient and effective for their intended purpose; provide not less than one extinguisher on each floor at or near each usable stairwell.
   2. Store combustible materials in containers in fire-safe locations.
   3. Maintain unobstructed access to fire extinguishers, fire hydrants, temporary fire-protection facilities, stairways, and other access routes for firefighting. Prohibit smoking in hazardous fire-exposure areas.
   4. Supervise welding and steel cutting operations, combustion-type temporary heating units, and similar sources of fire ignition. Provide fire watchman for cutting and welding operations.
5. Permanent Fire Protection: At earliest feasible date in each area of Project, complete installation of permanent fire-protection facility, including connected services, and place into operation and use. Instruct key personnel on use of facilities.

6. Develop and supervise an overall fire-prevention and first-aid fire-protection program for personnel at Project site. Review needs with local fire department and establish procedures to be followed. Instruct personnel in methods and procedures. Post warnings and information.

7. Provide hoses for fire protection of sufficient length to reach construction areas. Hang hoses with a warning sign stating that hoses are for fire-protection purposes only and are not to be removed. Match hose size with outlet size and equip with suitable nozzles.

I. Covered Walkway: Erect a structurally adequate, protective covered walkway for passage of persons at exits from the building with potential danger from falling objects. Comply with regulations of authorities having jurisdiction.

3.5 OPERATION, TERMINATION, AND REMOVAL

A. Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.

B. Maintenance: Maintain facilities in good operating condition until removal. Protect from damage caused by freezing temperatures and similar elements.
  1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.
  2. Prevent water-filled piping from freezing. Protect from damage during excavation operations.
  3. Snow removal: Provide snow removal necessary to do the work and maintain access to materials, temporary facilities and offices.

C. Flooring Protection: Protect flooring against mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during construction period. Use protection methods indicated or recommended by flooring manufacturer, and as required for the type of exposure and work to be done in the area.
  1. Do not move heavy and sharp objects directly over flooring. Place plywood or hardboard panels over flooring and under objects while they are being moved. Slide or roll objects over panels without moving panels.

D. Restoration of Roadways and Pavement: Roadways, pavements and curbs that are broken, damaged, settled, or otherwise defective as a result of receiving, handling, storage of materials or the performance of any work under this Contract, shall be fully restored to the satisfaction of the authorities having jurisdiction.

E. Temporary Facility Changeover: Except for using permanent fire protection as soon as available, do not change over from using temporary security and protection facilities to permanent facilities until Substantial Completion.

F. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may
have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.

1. Materials and facilities that constitute temporary facilities are the property of Contractor.
2. Remove materials contaminated with road oil, asphalt and other petrochemical compounds, and other substances that might impair growth of plant materials or lawns. Repair or replace street paving, curbs, and sidewalks at temporary entrances, as required by authorities having jurisdiction.
3. At Substantial Completion, clean and renovate permanent facilities used during construction period. Comply with final cleaning requirements in Division 01 Section "Closeout Procedures."

END OF SECTION 015000
SECTION 016000 - PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; product substitutions; and comparable products.

B. Related Sections include the following:
   1. Division 01 Section "Unit Prices" for products selected using unit prices.
   2. Division 01 Section "References" for applicable industry standards for products specified.
   3. Division 01 Section “Substitutions and Product Options” for procedures and requirements for product substitutions.
   4. Division 01 Section "Closeout Procedures" for submitting warranties for Contract closeout.
   5. Divisions 02 through 33 Sections for specific requirements for warranties on products and installations specified to be warranted.

1.3 DEFINITIONS

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

B. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor.

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

1.4 QUALITY ASSURANCE

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

1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft. Comply with manufacturer's written instructions.

B. Delivery and Handling:
   1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
   2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
   3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
   4. Inspect products on delivery to ensure compliance with the Contract Documents and to ensure that products are undamaged and properly protected.

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

1.6 PRODUCT WARRANTIES

A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.
1. Manufacturer's Warranty: Preprinted written warranty published by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.

2. Special Warranty: Written warranty required by or incorporated into the Contract Documents, either to extend time limit provided by manufacturer's warranty or to provide more rights for Owner.

B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution. Submit a draft for approval before final execution.

1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.

2. Specified Form: When specified forms are included with the Specifications, prepare a written document using appropriate form properly executed.

3. Refer to Divisions 2 through 16 Sections for specific content requirements and particular requirements for submitting special warranties.

C. Submittal Time: Comply with requirements in Division 1 Section "Closeout Procedures."

PART 2 - PRODUCTS

2.1 PRODUCT SELECTION PROCEDURES

A. General Product Requirements: Provide products that comply with the Contract Documents, that are undamaged and, unless otherwise indicated, that are new at time of installation.

1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.

2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.

3. Owner reserves the right to limit selection to products with warranties not in conflict with requirements of the Contract Documents.

4. Where products are accompanied by the term "as selected," Architect will make selection.

5. Where products are accompanied by the term "match sample," sample to be matched is Architect's.


7. Or Equal: Where products are specified by name and accompanied by the term "or equal" or "or approved equal" or "or approved," comply with provisions in Division 01 Section “Substitutions and Product Options” to obtain approval for use of an unnamed product.

B. Product Selection Procedures:

1. Product: Where Specifications name a single product and manufacturer, provide the named product that complies with requirements.

2. Manufacturer/Source: Where Specifications name a single manufacturer or source, provide a product by the named manufacturer or source that complies with requirements.

3. Products: Where Specifications include a list of names of both products and manufacturers, provide one of the products listed that complies with requirements.
4. Manufacturers: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements.

5. Available Products: Where Specifications include a list of names of both products and manufacturers, provide one of the products listed, or an unnamed product, that complies with requirements. Comply with provisions in Part 2 "Comparable Products" Article for consideration of an unnamed product.

6. Available Manufacturers: Where Specifications include a list of manufacturers, provide a product by one of the manufacturers listed, or an unnamed manufacturer, that complies with requirements. Comply with provisions in Part 2 "Comparable Products" Article for consideration of an unnamed product.

7. Product Options: Where Specifications indicate that sizes, profiles, and dimensional requirements on Drawings are based on a specific product or system, provide the specified product or system. Comply with provisions in Part 2 "Product Substitutions" Article for consideration of an unnamed product or system.

8. Basis-of-Design Product: Where Specifications name a product and include a list of manufacturers, provide the specified product or a comparable product by one of the other named manufacturers. Drawings and Specifications indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with provisions in Part 2 "Comparable Products" Article for consideration of an unnamed product by the other named manufacturers.

   a. If no product available within specified category matches and complies with other specified requirements, comply with provisions in Part 2 "Product Substitutions" Article for proposal of product.

10. Visual Selection Specification: Where Specifications include the phrase "as selected from manufacturer's colors, patterns, textures" or a similar phrase, select a product that complies with other specified requirements.
    a. Standard Range: Where Specifications include the phrase "standard range of colors, patterns, textures" or similar phrase, Architect will select color, pattern, density, or texture from manufacturer's product line that does not include premium items.
    b. Full Range: Where Specifications include the phrase "full range of colors, patterns, textures" or similar phrase, Architect will select color, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.

PART 3 - EXECUTION (Not Used)

END OF SECTION 016000
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes general procedural requirements governing execution of the Work including, but not limited to, the following:
   1. General installation of products.
   2. Coordination of Owner-installed products.
   3. Progress cleaning.
   4. Starting and adjusting.
   5. Protection of installed construction.
   6. Correction of the Work.

B. Related Sections include the following:
   1. Division 01 Section "Project Management and Coordination" for procedures for coordinating field engineering with other construction activities.
   2. Division 01 Section "Cutting and Patching" for procedural requirements for cutting and patching necessary for the installation or performance of other components of the Work.
   3. Division 01 Section “Construction Waste Management and Disposal” for handling and processing construction debris.
   4. Division 01 Section "Closeout Procedures" for final cleaning.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Existing Conditions: The existence and location of site improvements, utilities, and other construction indicated as existing are not guaranteed. Before beginning work, investigate and verify the existence and location of mechanical and electrical systems and other construction affecting the Work.
   1. Before construction, verify the location and points of connection of utility services. Contact Digsafe prior to any onsite excavation.

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

3.2 PREPARATION

A. Existing Utility Information: Furnish information to local utility and Owner that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.

B. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.


3.3 INSTALLATION

A. General: Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.
1. Make vertical work plumb and make horizontal work level.
2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
3. Conceal pipes, ducts, and wiring in finished areas, unless otherwise indicated.
4. Maintain minimum headroom clearance of 8 feet in spaces without a suspended ceiling, unless indicated otherwise.
B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.

C. Install products at the time and under conditions that will ensure the best possible results. Maintain conditions required for product performance until Substantial Completion.

D. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.

E. Tools and Equipment: Do not use tools or equipment that produce harmful noise levels.

F. Templates: Obtain and distribute to the parties involved templates for work specified to be factory prepared and field installed. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.

G. Anchors and Fasteners: Provide anchors and fasteners as required to anchor each component securely in place, accurately located and aligned with other portions of the Work.
   1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect.
   2. Allow for building movement, including thermal expansion and contraction.
   3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

H. Joints: Make joints of uniform width. Where joint locations in exposed work are not indicated, arrange joints for the best visual effect. Fit exposed connections together to form hairline joints.

I. Hazardous Materials: Use products, cleaners, and installation materials that are not considered hazardous.
   1. No asbestos containing materials shall be used in the work.

3.4 OWNER-INSTALLED PRODUCTS

A. Site Access: Provide access to Project site for Owner's construction forces.

B. Coordination: Coordinate construction and operations of the Work with work performed by Owner's construction forces.
   1. Construction Schedule: Inform Owner of Contractor's preferred construction schedule for Owner's portion of the Work. Adjust construction schedule based on a mutually agreeable timetable. Notify Owner if changes to schedule are required due to differences in actual construction progress.
   2. Preinstallation Conferences: Include Owner's construction forces at preinstallation conferences covering portions of the Work that are to receive Owner's work. Attend preinstallation conferences conducted by Owner's construction forces if portions of the Work depend on Owner's construction.
3.5 PROGRESS CLEANING

A. General: Clean Project site and work areas daily, including common areas. Coordinate progress cleaning for joint-use areas where more than one installer has worked. Enforce requirements strictly. Dispose of materials lawfully.
   2. Do not hold materials more than 7 days during normal weather or 3 days if the temperature is expected to rise above 80 deg F.
   3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.

B. Site: Maintain Project site free of waste materials and debris.

C. Work Areas: Clean areas where work is in progress to the level of cleanliness necessary for proper execution of the Work. It is the Contactor’s responsibility for job site safety.
   1. Remove liquid spills promptly.
   2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.
      a. Clean interior spaces prior to the start of finish painting, and continue cleaning on an as-needed basis until painting is finished.
      b. Schedule operations so that dust and other contaminants resulting from cleaning process will not fall on wet or newly coated surfaces.
   3. Remove materials and debris that create tripping hazards.

D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.

E. Concealed Spaces: Remove dirt, debris and garbage from concealed spaces before enclosing the space.

F. Exposed Surfaces in Finished Areas: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.

G. Waste Disposal: Burying or burning waste materials on-site will not be permitted. Washing waste materials down sewers or into waterways will not be permitted.

H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.

I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.

J. Limiting Exposures: Supervise construction operations to assure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.
3.6 STARTING AND ADJUSTING

A. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.

B. Adjust operating components for proper operation without binding. Adjust equipment for proper operation.

C. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Manufacturer's Field Service: If a factory-authorized service representative is required to inspect field-assembled components and equipment installation, comply with qualification requirements in Division 01 Section "Quality Requirements."

3.7 PROTECTION OF INSTALLED CONSTRUCTION

A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.

B. Comply with manufacturer's written instructions for temperature and relative humidity.

3.8 CORRECTION OF THE WORK

A. Repair or remove and replace defective construction. Restore damaged substrates and finishes. Comply with requirements in Division 01 Section "Cutting and Patching."
   1. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment.

B. Restore permanent facilities used during construction to their specified condition.

C. Remove and replace damaged surfaces that are exposed to view if surfaces cannot be repaired without visible evidence of repair.

D. Repair components that do not operate properly. Remove and replace operating components that cannot be repaired.

E. Remove and replace chipped, scratched, and broken glass or reflective surfaces.

END OF SECTION 017300
SECTION 017329 - CUTTING AND PATCHING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes procedural requirements for cutting and patching.
   1. For correction of installed work.
   2. For repairs due to testing.

B. Related Sections include the following:
   1. Division 02 Section "Selective Demolition and Alterations" for demolition of selected portions of the building and additional patching requirements.
   2. Divisions 02 through 33 Sections for specific requirements and limitations applicable to cutting and patching individual parts of the Work.
   3. Division 07 Section "Through-Penetration Firestop Systems" for patching penetrations through fire-rated construction.
   4. Division 07 Section "Fire-Resistive Joint Systems" for patching fire-rated construction.

1.3 DEFINITIONS

A. Cutting: Removal of in-place construction necessary to permit installation or performance of other Work.

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

1.4 SUBMITTALS

A. Cutting and Patching Proposal: Submit a proposal describing procedures at least 10 days before the time cutting and patching will be performed, requesting approval to proceed. Include the following information:
   1. Structural Elements: Where cutting and patching involve adding reinforcement to structural elements, submit details and engineering calculations showing integration of reinforcement with original structure.
   2. Architect's Approval: Obtain approval of cutting and patching proposal before cutting and patching. Approval does not waive right to later require removal and replacement of unsatisfactory work.

1.5 QUALITY ASSURANCE

A. Structural Elements: Do not cut and patch structural elements in a manner that could change their load-carrying capacity or load-deflection ratio.
B. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety. Operating elements include the following:
1. Primary operational systems and equipment.
2. Air or smoke barriers.
3. Fire-suppression systems.
4. Mechanical systems piping and ducts.
5. Control systems.
6. Communication systems.
7. Conveying systems.
8. Electrical wiring systems.

C. Miscellaneous Elements: Do not cut and patch miscellaneous elements or related components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety. Miscellaneous elements include the following:
1. Water, moisture, or vapor barriers.
2. Membranes and flashings.
3. Equipment supports.
4. Piping, ductwork, vessels, and equipment.
5. Noise- and vibration-control elements and systems.

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

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

1.6 WARRANTY

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

PART 2 - PRODUCTS

2.1 MATERIALS

A. General: Comply with requirements specified in other Sections.

B. In-Place Materials: Use materials identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.
   1. If identical materials are unavailable or cannot be used, use materials that, when installed, will match the visual and functional performance of in-place materials.
PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine surfaces to be cut and patched and conditions under which cutting and patching are to be performed.
   1. Compatibility: Before patching, verify compatibility with and suitability of substrates, including compatibility with in-place finishes or primers.
   2. Proceed with installation only after unsafe or unsatisfactory conditions have been corrected.

3.2 PREPARATION

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

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

C. Adjoining Areas: Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.

D. Existing Utility Services and Mechanical/Electrical Systems: Where existing services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before cutting to minimize interruption to occupied areas.

3.3 PERFORMANCE

A. General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.
   1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.

B. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.
   1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots as small as possible, neatly to size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
   2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
   3. Concrete and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
   4. Proceed with patching after construction operations requiring cutting are complete.

C. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other Work. Patch with durable seams that are as invisible as possible. Provide materials and comply with installation requirements specified in other Sections.
1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate integrity of installation.

2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.
   a. Clean piping, conduit, and similar features before applying paint or other finishing materials.
   b. Restore damaged pipe covering to its original condition.

3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces. Provide an even surface of uniform finish, color, texture, and appearance. Remove in-place floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.
   a. Where patching occurs in a painted surface, apply primer and intermediate paint coats over the patch and apply final paint coat over entire unbroken surface containing the patch. Provide additional coats until patch blends with adjacent surfaces.

4. Ceilings: Patch, repair, or rehang in-place ceilings as necessary to provide an even-plane surface of uniform appearance.

5. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition.

D. Cleaning: Clean areas and spaces where cutting and patching are performed. Completely remove paint, mortar, oils, putty, and similar materials.

END OF SECTION 017329
SECTION 017419 - CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

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 "Temporary Facilities and Controls" for environmental-protection measures during construction, and location of waste containers at Project site.

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 materials resulting from demolition or selective demolition operations.

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: Recovery of demolition or construction waste for subsequent processing in preparation for reuse.

E. Salvage: Recovery of demolition or construction waste and subsequent sale or reuse in another facility.

1.4 PERFORMANCE GOALS

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

1.5 SUBMITTALS

A. Waste Reduction Calculations: Before request for Substantial Completion, submit three copies of calculated end-of-Project rates for salvage, recycling, and disposal as a percentage of total waste generated by the Work.
1.6 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with hauling and disposal regulations of authorities having jurisdiction.

B. Waste Management Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination." 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 each party involved.
   2. Review and finalize procedures for materials separation and verify availability of containers and bins needed.
   3. Review procedures for periodic waste collection and transportation to recycling and disposal facilities.
   4. Review waste management requirements for each trade.

1.7 WASTE MANAGEMENT PLAN

A. General: Develop plan consisting of waste identification, waste reduction work plan, and cost/revenue analysis. 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 demolition and construction waste generated by the Work.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 PLAN IMPLEMENTATION

A. General: Implement waste management plan. 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.

B. Training: Train workers, subcontractors, and suppliers on proper waste management procedures, as appropriate for the Work occurring at Project site.
   1. Distribute waste management plan to everyone concerned.
   2. Distribute waste management plan to entities when they first begin work on-site. Review plan procedures and locations established for salvage, recycling, and disposal.

C. 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.
   1. Designate and label specific areas on Project site necessary for separating materials that are to be salvaged, recycled, reused, donated, and sold.
2. 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 Sale and Donation: Not permitted on Project site.

3.3 RECYCLING DEMOLITION AND CONSTRUCTION WASTE, GENERAL
A. General: Recycle paper and beverage containers used by on-site workers.
B. Procedures: Separate recyclable waste from other waste materials, trash, and debris. Separate recyclable waste by type at Project site to the maximum extent practical.
   1. 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.
      a. Inspect containers and bins for contamination and remove contaminated materials if found.
   2. Stockpile processed materials on-site without intermixing with other materials. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
   3. Stockpile materials away from construction area. Do not store within drip line of remaining trees.
   4. Store components off the ground and protect from the weather.
   5. Remove recyclable waste off Owner's property and transport to recycling receiver or processor.

3.4 RECYCLING CONSTRUCTION WASTE
A. Packaging:
   1. Cardboard and Boxes: Break down packaging into flat sheets. Bundle and store in a dry location.
   3. 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.
   4. Crates: Break down crates into component wood pieces and comply with requirements for recycling wood.

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.
   1. Except as otherwise specified, do not allow waste materials that are to be disposed of accumulate on-site.
   2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
B. Burning: Do not burn waste materials.
C. Disposal: Transport waste materials off Owner's property and legally dispose of them.
SECTION 017700 - CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for contract closeout, including, but not limited to, the following:
   1. Inspection procedures.
   2. Warranties.
   3. Final cleaning.

B. Related Sections include the following:
   1. Division 01 Section "Payment Procedures" for requirements for Applications for Payment for Substantial and Final Completion.
   2. Division 01 Section "Execution Requirements" for progress cleaning of Project site.
   3. Division 01 Section "Project Record Documents" for submitting Record Drawings, Record Specifications, and Record Product Data.
   4. Division 01 Section "Operation and Maintenance Data" for operation and maintenance manual requirements.
   5. Division 01 Section "Demonstration and Training" for requirements for instructing Owner's personnel.
   6. Divisions 02 through 33 Sections for specific closeout and special cleaning requirements for the Work in those Sections.

1.3 SUBSTANTIAL COMPLETION

A. Preliminary Procedures: Before requesting inspection for determining date of Substantial Completion, complete the following. List items below that are incomplete in request.
   1. Prepare a list of items to be completed and corrected (punch list), the value of items on the list, and reasons why the Work is not complete.
   2. Advise Owner of pending insurance changeover requirements.
   3. Submit specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
   4. Obtain and submit releases permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
   5. Prepare and submit Project Record Documents, operation and maintenance manuals.
   6. Deliver tools, spare parts, extra materials, and similar items to location designated by Owner. Label with manufacturer's name and model number where applicable.
   7. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
   8. Complete startup testing of systems.
10. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
11. Advise Owner of changeover in heat and other utilities.
12. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.
13. Complete final cleaning requirements, including touchup painting.
14. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.

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

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

1.4 FINAL COMPLETION

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

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

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

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

1.5 INSPECTION FEES

A. If the Architect Perform Reinspections due to failure of the Work to comply with the Claims of Status of Completion Made by the Contractor, Or, Should the Contractor fail to complete the work, Or, Should the Contractor fail to promptly correct warranty items or work later found to be deficient:

1. Owner will compensate Architect for such additional services.
2. Owner will deduct the amount of such compensation from the final payment to the Contractor.
B. If the Work is not completed by the date set in the Agreement, and the Architect needs to perform additional Contract Administrative and on site observation duties:
   1. Owner will compensate Architect for such additional services.
   2. Owner will deduct the amount of such compensation from the final payment to the Contractor.

1.6 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

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

1.7 WARRANTIES

A. Submittal Time: Submit written warranties on request of Architect for designated portions of the Work where commencement of warranties other than date of Substantial Completion is indicated in the contract documents.
   1. Unless indicated otherwise, all warranties shall commence on the date of Substantial Completion.

B. Partial Occupancy: Submit properly executed warranties within 15 days of completion of designated portions of the Work that are completed and occupied or used by Owner during construction period by separate agreement with Contractor.

C. Organize warranty documents into an orderly sequence based on the table of contents of the Project Manual.
   1. Submit final warranties as a package for the entire project, assembled and identified as described below.
   2. Bind warranties and bonds in heavy-duty, D-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents but not greater than 2 inches, and sized to receive 8-1/2-by-11-inch paper. Do not over fill D-ring, allowing 1/2-inch space for future additions.
   3. Provide heavy paper dividers with plastic-covered tabs for each separate warranty. Mark tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product and the name, address, and telephone number of Installer.
   4. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project name, and name of Contractor.
   5. Electronic Media: Submit copy of warranty binder on CD-R in .PDF format. Bookmark based on the table of contents, and for each warranty within each section.
D. Provide additional electronic media copies of each warranty to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 MATERIALS

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

PART 3 - EXECUTION

3.1 FINAL CLEANING

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

B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.

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

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

END OF SECTION 017700
SECTION 017823 - OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:
   1. Operation and maintenance documentation directory.
   2. Operation manuals for systems, subsystems, and equipment.
   3. Maintenance manuals for the care and maintenance of products, materials, and finishes, systems and equipment.

B. Related Sections include the following:
   1. Division 01 Section "Submittal Procedures" for submitting copies of submittals for operation and maintenance manuals.
   2. Division 01 Section "Closeout Procedures" for submitting operation and maintenance manuals.
   3. Division 01 Section "Project Record Documents" for preparing Record Drawings for operation and maintenance manuals.
   4. Divisions 02 through 33 Sections for specific operation and maintenance manual requirements for the Work in those Sections.

1.3 DEFINITIONS

A. System: An organized collection of parts, equipment, or subsystems united by regular interaction.

B. Subsystem: A portion of a system with characteristics similar to a system.

1.4 SUBMITTALS

A. Initial Submittal: Submit 1 draft copy of each manual at least 15 days before requesting inspection for Substantial Completion. Include a complete operation and maintenance directory. Architect will return draft and mark whether general scope and content of manual are acceptable.

B. Final Submittal: Submit one copy of each manual in final form at least 15 days before final inspection. Architect will return copy with comments after final inspection.
   1. Correct or modify each manual to comply with Architect's comments. Submit copies of each corrected manual within 15 days of receipt of Architect's comments.
1.5 COORDINATION

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

PART 2 - PRODUCTS

2.1 OPERATION AND MAINTENANCE DOCUMENTATION DIRECTORY

A. Organization: Include a section in the directory for each of the following:
   1. List of documents.
   2. List of systems.
   3. List of equipment.
   4. Table of contents.

B. List of Systems and Subsystems: List systems alphabetically. Include references to operation and maintenance manuals that contain information about each system.

C. List of Equipment: List equipment for each system, organized alphabetically by system. For pieces of equipment not part of system, list alphabetically in separate list.

D. Tables of Contents: Include a table of contents for each emergency, operation, and maintenance manual.

E. Identification: In the documentation directory and in each operation and maintenance manual, identify each system, subsystem, and piece of equipment with same designation used in the Contract Documents. If no designation exists, assign a designation according to ASHRAE Guideline 4, "Preparation of Operating and Maintenance Documentation for Building Systems."

2.2 MANUALS, GENERAL

A. Organization: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain the following materials, in the order listed:
   1. Title page.
   2. Table of contents.

B. Title Page: Enclose title page in transparent plastic sleeve. Include the following information:
   1. Subject matter included in manual.
   2. Name and address of Project.
   3. Name and address of Owner.
   4. Date of submittal.
   5. Name, address, and telephone number of Contractor and primary subcontractors.
   6. Name and address of Architect.
   7. Cross-reference to related systems in other operation and maintenance manuals.
C. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.
1. If operation or maintenance documentation requires more than one volume to accommodate data, include comprehensive table of contents for all volumes in each volume of the set.

D. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.
1. Binders: Heavy-duty, D-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents but not greater than 2 inches, sized to hold 8-1/2-by-11-inch paper; with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets. Do not overfill D-ring, allowing 1/2-inch space for future additions.
   a. If two or more binders are necessary to accommodate data of a system, organize data in each binder into groupings by subsystem and related components. Cross-reference other binders if necessary to provide essential information for proper operation or maintenance of equipment or system.
   b. Identify each binder on front and spine, with printed title "OPERATION AND MAINTENANCE MANUAL," Project title or name, and subject matter of contents. Indicate volume number for multiple-volume sets.
2. Dividers: Heavy-paper dividers with plastic-covered tabs for each section. Mark each tab to indicate contents. Include typed list of products and major components of equipment included in the section on each divider, cross-referenced to Specification Section number and title of Project Manual.
3. Protective Plastic Sleeves: Transparent plastic sleeves designed to enclose diagnostic software diskettes for computerized electronic equipment.
5. Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.
   a. Maximum size of drawings to be included in the binders shall not exceed 11-by-17-inch. Fold drawings to same size as text pages and use as foldouts.
   b. If drawings are too large to be used as foldouts, fold and place drawings in labeled envelopes and submit envelopes with manual. At appropriate locations in manual, insert typewritten pages indicating drawing titles, descriptions of contents, and drawing locations.

E. Electronic Media: Submit one copy of each complete manual, including Record Shop Drawings and Product Data on CD-R in .PDF format. Bookmark based on the specifications table of contents and manual dividers.

2.3 EMERGENCY OPERATIONS

A. Content: Emergency information that must be immediately available during emergency situations to protect life and property and to minimize disruptions to building occupants. Include information in operations manual into a separate section of the operations manual for each of the following:
1. Type of emergency.
2. Emergency instructions.
3. Emergency procedures.
B. Type of Emergency: Where applicable for each type of emergency indicated below, include instructions and procedures for each system, subsystem, piece of equipment, and component:
1. Fire.
2. Flood.
5. Power failure.
7. System, subsystem, or equipment failure.
8. Chemical release or spill.

C. Emergency Instructions: Describe and explain warnings, trouble indications, error messages, and similar codes and signals. Include responsibilities of Owner's operating personnel for notification of Installer, supplier, and manufacturer to maintain warranties.

D. Emergency Procedures: Include the following, as applicable:
1. Instructions on stopping.
2. Shutdown instructions for each type of emergency.
3. Operating instructions for conditions outside normal operating limits.
4. Required sequences for electric or electronic systems.
5. Special operating instructions and procedures.

2.4 OPERATION MANUALS

A. Content: Daily operations and management of systems and equipment. In addition to requirements in this Section, include operation data required in individual Specification Sections and the following information:
1. System, subsystem, and equipment descriptions.
2. Performance and design criteria if Contractor is delegated design responsibility.
3. Operating standards.
4. Operating procedures.
5. Operating logs.
6. Wiring diagrams.
7. Control diagrams.
8. Piped system diagrams.
9. Precautions against improper use.
10. License requirements including inspection and renewal dates.

B. Descriptions: Include the following:
1. Product name and model number.
2. Manufacturer's name.
3. Equipment identification with serial number of each component.
4. Equipment function.
5. Operating characteristics.
6. Limiting conditions.
7. Performance curves.
8. Engineering data and tests.
9. Complete nomenclature and number of replacement parts.
C. Operating Procedures: Include the following, as applicable:
   1. Startup procedures.
   2. Equipment or system break-in procedures.
   3. Routine and normal operating instructions.
   4. Regulation and control procedures.
   5. Instructions on stopping.
   7. Seasonal and weekend operating instructions.
   8. Required sequences for electric or electronic systems.
   9. Special operating instructions and procedures.

D. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.

E. Piped Systems: Diagram piping as installed, and identify color-coding where required for identification.

2.5 PRODUCT MAINTENANCE MANUAL

A. Content: Organize manual into a separate section for each product, material, and finish. Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.

B. Source Information: List each product included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual.

C. Product Information: Include the following, as applicable:
   1. Product name and model number.
   2. Manufacturer's name.
   3. Color, pattern, and texture.
   5. Reordering information for specially manufactured products.

D. Maintenance Procedures: Include manufacturer's written recommendations and the following:
   1. Inspection procedures.
   2. Types of cleaning agents to be used and methods of cleaning.
   3. List of cleaning agents and methods of cleaning detrimental to product.
   4. Schedule for routine cleaning and maintenance.
   5. Repair instructions.

E. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.

F. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
   1. Include procedures to follow and required notifications for warranty claims.
2.6 SYSTEMS AND EQUIPMENT MAINTENANCE MANUAL

A. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranty and bond information, as described below.

B. Source Information: List each system, subsystem, and piece of equipment included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual.

C. Manufacturers' Maintenance Documentation: Manufacturers' maintenance documentation including the following information for each component part or piece of equipment:
   1. Standard printed maintenance instructions and bulletins.
   2. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.
   3. Identification and nomenclature of parts and components.
   4. List of items recommended to be stocked as spare parts.

D. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:
   1. Test and inspection instructions.
   2. Troubleshooting guide.
   3. Precautions against improper maintenance.
   4. Disassembly; component removal, repair, and replacement; and reassembly instructions.
   5. Aligning, adjusting, and checking instructions.
   6. Demonstration and training videotape, if available.

E. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.
   1. Scheduled Maintenance and Service: Tabulate actions for daily, weekly, monthly, quarterly, semiannual, and annual frequencies.
   2. Maintenance and Service Record: Include manufacturers' forms for recording maintenance.

F. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.

G. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.

H. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
   1. Include procedures to follow and required notifications for warranty claims.
PART 3 - EXECUTION

3.1 MANUAL PREPARATION

A. Operation and Maintenance Documentation Directory: Prepare a separate manual that provides an organized reference to emergency, operation, and maintenance manuals.

B. Emergency Manual: Assemble a complete set of emergency information indicating procedures for use by emergency personnel and by Owner's operating personnel for types of emergencies indicated.

C. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.

D. Operation and Maintenance Manuals: Assemble a complete set of operation and maintenance data indicating operation and maintenance of each system, subsystem, and piece of equipment not part of a system.
   1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
   2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.

E. Manufacturers' Data: Where manuals contain manufacturers' standard printed data, include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.
   1. Prepare supplementary text if manufacturers' standard printed data are not available and where the information is necessary for proper operation and maintenance of equipment or systems.

F. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in Record Drawings to ensure correct illustration of completed installation.
   1. Do not use original Project Record Documents as part of operation and maintenance manuals.

G. Comply with Division 01 Section "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

END OF SECTION 017823
SECTION 017839 - PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for Project Record Documents, including the following:
   1. Record Drawings.
   2. Record Specifications.
   3. Record Product Data.
   4. Record Shop Drawings.

B. Related Sections include the following:
   1. Division 01 Section "Closeout Procedures" for general closeout procedures.
   2. Division 01 Section "Operation and Maintenance Data" for operation and maintenance manual requirements.
   3. Divisions 02 through 33 Sections for specific requirements for Project Record Documents of the Work in those Sections.

1.3 SUBMITTALS

A. Record Drawings: Comply with the following:
   1. Number of Copies: Submit copies of Record Drawings as follows:
      a. Submit one set(s) of marked-up Record Prints and one copy on CD-R in .PDF format.

B. Record Specifications: Submit one hard copy and one copy on electronic media of Project's Specifications, including addenda and contract modifications.

C. Record Shop Drawings and Product Data: Submit one hard copy and one copy on electronic media of each Product Data submittal.
   1. Where Record Shop Drawings and Product Data is required as part of operation and maintenance manuals, submit marked-up Shop Drawings and Product Data as an insert in manual instead of submittal as Record Shop Drawings and Product Data. Insert typewritten pages indicating drawing titles, descriptions of contents, and Record Shop Drawings and Product Data locations drawing locations that are part of operation and maintenance manuals.
   2. Electronic Media: In addition to paper copy, submit record copy of record Shop Drawings and Product Data specification on CD-R in .PDF format. Bookmark Product Data based on the table of contents.
PART 2 - PRODUCTS

2.1 RECORD DRAWINGS

A. Record Prints: Maintain one set of blue- or black-line white prints of the Contract Drawings and Shop Drawings.

1. Preparation: Mark Record Prints to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to prepare the marked-up Record Prints.
   a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
   b. Accurately record information in an understandable drawing technique.
   c. Record data as soon as possible after obtaining it. Record and check the markup before enclosing concealed installations.

2. Content: Types of items requiring marking include, but are not limited to, the following:
   a. Dimensional changes to Drawings.
   b. Revisions to details shown on Drawings.
   c. Depths of foundations below first floor.
   d. Locations and depths of underground utilities.
   e. Revisions to routing of piping and conduits.
   f. Revisions to electrical circuitry.
   g. Actual equipment locations.
   h. Duct size and routing.
   i. Locations of concealed internal utilities.
   j. Changes made by Change Order or Construction Change Directive.
   k. Changes made following Architect's written orders.
   l. Details not on the original Contract Drawings.
   m. Field records for variable and concealed conditions.
   n. Record information on the Work that is shown only schematically.

3. Mark the Contract Drawings or Shop Drawings, whichever is most capable of showing actual physical conditions, completely and accurately. If Shop Drawings are marked, show cross-reference on the Contract Drawings.

4. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.

5. Mark important additional information that was either shown schematically or omitted from original Drawings.

6. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.

B. Format: Identify and date each Record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.

1. Record Prints: Organize Record Prints into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.

2.2 RECORD SPECIFICATIONS

A. Preparation: Mark Specifications to indicate the actual product installation where installation varies from that indicated in Specifications, addenda, and contract modifications.

1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
2. Mark copy with the proprietary name and model number of products, materials, and equipment furnished, including substitutions and product options selected.

3. Record the name of manufacturer, supplier, Installer, and other information necessary to provide a record of selections made.

4. For each principal product, indicate whether Record Product Data has been submitted in operation and maintenance manuals instead of submitted as Record Product Data.

5. Note related Change Orders, Record Product Data, and Record Drawings where applicable.


2.3 RECORD SHOP DRAWINGS AND PRODUCT DATA

A. Preparation: Mark Shop Drawings and Product Data to indicate the actual product installation where installation varies substantially from that indicated in Shop Drawings and Product Data submittal.

1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.

2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.

3. Note related Change Orders, Record Specifications, and Record Drawings where applicable.

4. Bind product data in heavy-duty, D-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents but not greater than 2 inches, and sized to receive 8-1/2-by-11-inch paper. Do not over fill D-ring, allowing 1/2 inch space for future additions.

5. Provide heavy paper dividers with plastic-covered tabs for each specification section with product data. Mark tab to identify the specification section. Provide a typed description of the product or installation, including the name of the product and the name, address, and telephone number of Installer.

6. Identify each binder on the front and spine with the typed or printed title "PRODUCT DATA," Project name, and name of Contractor.

7. Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.
   a. Maximum size of drawings to be included in the binders shall not exceed 11-by-17-inch. Fold drawings to same size as text pages and use as foldouts.
   b. If drawings are too large to be used as foldouts, fold and place drawings in labeled envelopes and submit envelopes with manual. At appropriate locations in manual, insert typewritten pages indicating drawing titles, descriptions of contents, and drawing locations.

8. Electronic Media: Submit record copy of marked-up Shop Drawings and Product Data on CD-R in .PDF format. Bookmark based on the table of contents, and for each Shop Drawings and Product Data within each section. Where Record Shop Drawings and Product Data is required as part of operation and maintenance manuals, submit electronic media of marked-up Shop Drawings and Product Data as part of manual instead of submittal as Record Shop Drawings and Product Data.

2.4 MISCELLANEOUS RECORD SUBMITTALS

A. Assemble miscellaneous records required by other Specification Sections for miscellaneous record keeping and submittal in connection with actual performance of the Work. Bind or file miscellaneous records and identify each, ready for continued use and reference.
PART 3 - EXECUTION

3.1 RECORDING AND MAINTENANCE

A. Recording: Maintain one copy of each submittal during the construction period for Project Record Document purposes. Post changes and modifications to Project Record Documents as they occur; do not wait until the end of Project.

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

END OF SECTION 017839
SECTION 017900 - DEMONSTRATION AND TRAINING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for instructing Owner's personnel, including the following:
   1. Demonstration of operation of systems, subsystems, and equipment.
   2. Training in operation and maintenance of systems, subsystems, and equipment.

B. Related Sections include the following:
   1. Division 01 Section "Project Management and Coordination" for requirements for preinstruction conferences.
   2. Divisions 02 through 33 Sections for specific requirements for demonstration and training for products in those Sections.

1.3 SUBMITTALS

A. Demonstration and Training: Submit list of systems and equipment to be demonstrated and training provided.

1.4 COORDINATION

A. Coordinate instruction schedule with Owner's operations. Adjust schedule as required to minimize disrupting Owner's operations.

PART 2 - PRODUCTS

2.1 INSTRUCTION PROGRAM

A. Provide demonstration and training for each system and equipment, as required by individual Specification Sections, and applicable items as follows:
   1. HVAC systems, including air-handling equipment, air distribution systems and terminal equipment and devices.
   2. HVAC instrumentation and controls.
   3. Lighting equipment and controls.

PART 3 - EXECUTION

3.1 PREPARATION

A. Assemble educational materials necessary for instruction, including documentation and training.
3.2 DEMONSTRATION AND TRAINING INSTRUCTION

A. Engage qualified personnel to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment.
   1. Owner will furnish Contractor with names and positions of participants.

B. Scheduling: Provide demonstration and training at mutually agreed on times. For equipment that requires seasonal operation, provide similar instruction at start of each season.
   1. Schedule training with Owner with at least fifteen days' advance notice.

C. Demonstration and Training: Provide instruction for equipment and systems operation. Include instruction as applicable for the following:
   1. System Design, Operational Requirements, and Criteria: Include the following:
      a. System, subsystem, and equipment descriptions.
      b. Performance and design criteria if Contractor is delegated design responsibility.
      c. Operating standards.
      d. Regulatory requirements.
      e. Equipment function.
      f. Operating characteristics.
      g. Limiting conditions.
      h. Performance curves.
   2. Documentation: Review the following items in detail:
      b. Maintenance manuals.
      c. Project Record Documents.
      d. Identification systems.
      e. Warranties and bonds.
      f. Maintenance service agreements and similar continuing commitments.
   3. Emergency Operation Procedures: Include the following, as applicable:
      a. Instructions on meaning of warnings, trouble indications, and error messages.
      b. Instructions on stopping.
      c. Shutdown instructions for each type of emergency.
      d. Operating instructions for conditions outside of normal operating limits.
      e. Sequences for electric or electronic systems.
      f. Special operating instructions and procedures.
   4. Operations: Include the following, as applicable:
      a. Startup procedures.
      b. Equipment or system break-in procedures.
      c. Routine and normal operating instructions.
      d. Regulation and control procedures.
      e. Control sequences.
      f. Safety procedures.
      g. Instructions on stopping.
      h. Normal shutdown instructions.
      i. Operating procedures for emergencies.
      j. Operating procedures for system, subsystem, or equipment failure.
      k. Seasonal and weekend operating instructions.
      l. Required sequences for electric or electronic systems.
      m. Special operating instructions and procedures.
   5. Adjustments: Include the following:
      a. Alignments.
b. Checking adjustments.
c. Noise and vibration adjustments.
d. Economy and efficiency adjustments.

6. Troubleshooting: Include the following:
   a. Diagnostic instructions.
   b. Test and inspection procedures.

7. Maintenance: Include the following:
   a. Inspection procedures.
   b. Types of cleaning agents to be used and methods of cleaning.
   c. List of cleaning agents and methods of cleaning detrimental to product.
   d. Procedures for routine cleaning
   e. Procedures for preventive maintenance.
   f. Procedures for routine maintenance.
   g. Instruction on use of special tools.

8. Repairs: Include the following:
   a. Diagnosis instructions.
   b. Repair instructions.
   c. Disassembly; component removal, repair, and replacement; and reassembly instructions.
   d. Instructions for identifying parts and components.
   e. Review of spare parts needed for operation and maintenance.

END OF SECTION 017900
Sample  
(Modify objectives and agenda subjects for systems and equipment being covered)

TRAINING AND ORIENTATION AGENDA

Project: __________________________ Date: __________________

Equipment / System: __________________ Spec Section: ______________

Section 1. Audience and General Scope

| Intended audience type (enter number of staff): | ___ facility manager,  ___ facility engineer,  ___ facility technician,  ___ project manager,  ___ tenant,  ___ other: |
|-----------------------------------------------|

General objectives and scope of training: (check all that apply)

___ A. Provide an overview of the purpose and operation of this equipment, including required interactions of trainees with the equipment.
___ B. Provide technical information regarding the purpose, operation and maintenance of this equipment at an intermediate level, expecting that serious malfunctions will be addressed by factory reps.
___ C. Provide technical information regarding the purpose, operation, troubleshooting and maintenance of this equipment at a very detailed level, expecting that almost all operation, service and repair will be provided by the trainees.

Section 2. Instructors

<table>
<thead>
<tr>
<th>ID</th>
<th>Trainer</th>
<th>Company</th>
<th>Position / Qualifications</th>
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<tbody>
<tr>
<td>1</td>
<td>__________</td>
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<td>3</td>
<td>__________</td>
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Section 3. Agenda [The responsible contractors have their trainers fill out this section and submit to Owner and Commissioning Agent for review and approval prior to conducting training.]

| Location: ___ site __________________________ Date __________________ |
|----------------|-----------------------------------------------|
| ___ classroom (location) ______________________ , Date__________________ |

Agenda of general subjects covered | Duration | Instructor | Completed |

<table>
<thead>
<tr>
<th>(√ all that will be covered)</th>
<th>(√ when completed)</th>
<th>(min.)</th>
<th>(ID)</th>
</tr>
</thead>
<tbody>
<tr>
<td>___ General purpose of this system or equipment (design intent)</td>
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</tr>
<tr>
<td>___ Review of control drawings and schematics (have copies for attendees)</td>
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<tr>
<td>___ Startup, loading, normal operation, unloading, shutdown, unoccupied operation, seasonal changeover, etc., as applicable</td>
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<td></td>
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<tr>
<td>___ Integral controls (packaged): programming, troubleshooting, alarms, manual operation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>___ Building automation controls (BAS): programming, troubleshooting, alarms, manual operation, interface with integral controls</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>___ Interactions with other systems, operation during power outage and fire</td>
<td></td>
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<tr>
<td>___ Relevant health and safety issues and concerns and special safety features</td>
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</tr>
</tbody>
</table>
__Energy conserving operation and strategies ____________ ____________ ____________

__Any special issues to maintain warranty ____________ ____________ ____________

__Common troubleshooting issues and methods, control system warnings and error messages, including using the control system for diagnostics ____________ ____________ ____________

__Special requirements of tenants for this equipment’s function ____________ ____________ ____________

__Service, maintenance, and preventative maintenance (sources, spare parts inventory, special tools, etc.) ____________ ____________ ____________

__Question and answer period ____________ ____________ ____________

Other subjects covered, specific to the equipment: Duration Instructor Completed

__________________________________________________________________________

__________________________________________________________________________

__________________________________________________________________________

__________________________________________________________________________

__________________________________________________________________________

__________________________________________________________________________

Total duration of training (hrs) ____________________________

Training methods that will be included (clarify as needed): (Trainer checks all that apply)

__use of the O&M manuals, illustrating where the verbal training information is found in writing

__each attendee will be provided: 1) the control drawing schematic and sequence of operations;

2) a copy of this agenda.

__discussion/lecture at site

__site demonstration of equipment operation

__written handouts

__manufacturer training manuals

__classroom lecture

__classroom hands-on equipment

__video presentation

__question and answer period

Section 4. Approvals and Use [Once the Agenda has been filled out by the Trainer, the Owner and Commissioning Agent review, make edits, sign and return to Contractor who provides to the Trainer for use during training. Copies of Agenda shall be provided to trainees.]

This plan has been approved by the following individuals, subject to the additions and clarifications noted in the left columns marked “add.” (This is not an approval of training completion.)

Owner’s Representative ____________ Date ____________

Commissioning Agent ____________ Date ____________
SECTION 024119 - SELECTIVE STRUCTURE DEMOLITION AND ALTERATIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:
   1. Demolition and removal of selected portions of a building or structure.
   2. Disconnecting, capping or sealing, and abandoning utilities.
   3. Demolition and removal of selected site elements.
   4. Repair procedures for selective demolition operations.
   5. Protection of existing materials exposed to the weather from damage.
   6. Patching and repairs.

B. Related Sections include the following:
   1. Division 01 Section "Cutting and Patching" for additional cutting and patching procedures for selective demolition operations.
   2. Division 01 Section “Construction Waste Management and Disposal” for handling and processing demolition and construction debris.
   3. Divisions 22 and 23 Sections for additional requirements regarding demolishing, cutting, patching, or relocating mechanical items.
   4. Division 26 Sections for additional requirements regarding demolishing, cutting, patching, or relocating electrical items.

1.3 DEFINITIONS

A. Remove: Remove and legally dispose of items except those indicated to be reinstalled, salvaged, or to remain the Owner's property.

B. Remove and Salvage: Items indicated to be removed and salvaged remain the Owner's property. Remove, clean, and pack or crate items to protect against damage. Identify contents of containers and deliver to Owner's designated storage area.

C. Remove and Reinstall: Remove items indicated; clean, service, and otherwise prepare them for reuse; store and protect against damage. Reinstall items in the same locations or in locations indicated.

D. Existing to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by the Architect, items may be removed to a suitable, protected storage location during selective demolition and then cleaned and reinstalled in their original locations.
1.4 MATERIALS OWNERSHIP

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

B. Carefully remove items indicated to be salvaged in a manner to prevent damage and deliver promptly to the Owner.

1.5 SUBMITTALS

A. General: Submit in accordance with Division 01 Section "Submittal Procedures."

B. Qualification Data: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

C. Proposed Dust-Control and Noise-Control Measures: Submit statement or drawing that indicates the measures proposed for use, proposed locations, and proposed time frame for their operation. Identify options if proposed measures are later determined to be inadequate.

D. Schedule of Selective Demolition Activities: Indicate the following:
   1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity.
   2. Interruption of utility services.
   3. Coordination for shutoff, capping, and continuation of utility services.
   4. Use of stairs.
   5. Detailed sequence of selective demolition and removal work to ensure uninterrupted progress of Owner's on-site operations.
   6. Coordination of Owner's continuing occupancy of portions of existing building.
   7. Locations of temporary partitions and means of egress.
   8. Coordination of removals with the installation of new materials to prevent unauthorized entry into the building, and for protection of existing materials and finishes to remain from damage from the weather.

E. Inventory of items to be removed and salvaged.

F. Inventory of items to be removed by Owner.

G. Record Drawings at Project closeout according to Division 01 Section "Project Record Documents."
   1. Identify and accurately locate capped utilities and other subsurface or hidden structural, electrical, or mechanical conditions.

H. Predemolition Photographs or Videotape: Show existing conditions of adjoining construction and site improvements, including finish surfaces, that might be misconstrued as damage caused by selective demolition operations. Submit before Work begins.
1.6 QUALITY ASSURANCE

A. Demolition Firm Qualifications: An experienced firm that has specialized in demolition work similar in material and extent to that indicated for this Project.

B. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that are similar to those indicated for this Project in material, design, and extent.

C. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.

D. Standards: Comply with ANSI A10.6 and NFPA 241.

E. Predemolition Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination." Review methods and procedures related to selective demolition including, but not limited to, the following:
1. Inspect and discuss condition of construction to be selectively demolished.
   a. Coordinate layout, locations and removal requirements for accommodating new work.
2. Review structural load limitations of existing structure.
3. Review and finalize selective demolition schedule and verify availability of materials, demolition personnel, equipment, and facilities needed to make progress and avoid delays.
4. Review shoring sequencing for maintaining existing structure without damage during removal of existing structural components.
5. Review methods of protecting remaining surfaces in weathertight conditions without damage during selective demolition operations and ensuing time frame until exterior envelope can be made permanently weathertight.
6. Review requirements of work performed by other trades that rely on substrates exposed by selective demolition operations.
7. Document proceedings, including corrective measures and actions required, and furnish copy of record to each participant.
8. Provide 5 day minimum advance notice to participants prior to convening predemolition conference.

1.7 PROJECT CONDITIONS

A. Owner will occupy portions of the building immediately adjacent to selective demolition area. Conduct selective demolition so that Owner's operations will not be disrupted. Provide not less than 72 hours' to Owner of activities that will affect Owner's operations.

B. Maintain access to existing walkways, and other adjacent occupied or used facilities.
   1. Do not close or obstruct walkways, or other occupied or used facilities without written permission from Owner and authorities having jurisdiction.
C. Owner assumes no responsibility for condition of areas to be selectively demolished.  
   1. Conditions existing at time of inspection for bidding purpose will be maintained by 
      Owner as far as practical.

D. Hazardous Materials: It is not expected that hazardous materials except vinyl asbestos tile will 
   be encountered in the Work. Hazardous materials will be removed by Owner.  
   1. Coordinate with the Owner, locations where floor penetrations occur that require removal 
      of vinyl asbestos tile.  
   2. Provide Owner with written notice a minimum of 72 hours in advance of locations where 
      vinyl asbestos tile needs to be removed for the work.  
   3. If materials suspected of containing asbestos are encountered, do not disturb; 
      immediately notify Architect and Owner.  
   4. If lead paint is encountered, notify the Architect. As a minimum, comply with OSHA 
      1926.62 federal guidelines regarding safety of employees in exposure to lead in 
      construction.

E. Storage or sale of removed items or materials on-site will not be permitted.

F. Utility Service: Maintain existing utilities indicated to remain in service and protect them 
   against damage during selective demolition operations.  
   1. Maintain fire-protection facilities in service during selective demolition operations.

1.8 SCHEDULING

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

PART 2 - PRODUCTS

2.1 REPAIR MATERIALS

A. Use repair materials identical to existing materials.  
   1. If identical materials are unavailable or cannot be used for exposed surfaces, use 
      materials that visually match existing adjacent surfaces to the fullest extent possible.  
   2. Use materials whose installed performance equals or surpasses that of existing materials.

B. Comply with material and installation requirements specified in individual Specification 
   Sections.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that utilities have been disconnected and capped.

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

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

E. Engage a professional engineer to survey condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during selective demolition operations.
1. Engineer shall develop shoring and underpinning plans and procedures for removal of structural components indicated to be removed.

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

3.2 UTILITY SERVICES

A. Existing Utilities: Maintain services indicated to remain and protect them against damage during selective demolition operations.
1. Do not interrupt existing utilities serving occupied or operating facilities, except when authorized in writing by Owner or authorities having jurisdiction. Provide temporary services during interruptions to existing utilities, as acceptable to Owner and to governing authorities.
   a. Provide not less than 72 hours’ notice to Owner if shutdown of service is required during changeover.

B. Utility Requirements: Locate, identify, disconnect, and seal or cap off indicated utilities serving areas to be selectively demolished.
1. Owner will arrange to shut off indicated utilities when requested by Contractor.
2. Where utility services are required to be removed, relocated, or abandoned, before proceeding with selective demolition provide temporary utilities that bypass area of selective demolition and that maintain continuity of service to other parts of building.
3. Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit after bypassing.
4. Existing piping, conduit, and panels to remain that are supported by walls and ceilings to be demolished, shall be temporarily re-supported to the existing structure until permanent construction is in place.

C. Utility Requirements: Refer to Divisions 22, 23 and 26 Sections for shutting off, disconnecting, removing, and sealing or capping utilities. Do not start selective demolition work until utility disconnecting and sealing have been completed and verified in writing.

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. Do not close or obstruct streets, walks, walkways, or other adjacent occupied or used facilities outside limits of Work, as defined on Drawings, without permission from Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by Owner or governing regulations.
2. Erect construction fence with entry gates.
3. Protect existing site improvements, appurtenances, and landscaping to remain.
4. Erect a plainly visible fence around drip line of individual trees or around perimeter drip line of groups of trees to remain.

B. Temporary Facilities: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
   1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.
   2. Provide temporary weather protection, during interval between selective demolition of existing construction on exterior surfaces and new construction, to prevent water leakage and damage to structure and interior areas.
      a. Damage due to failure of weather protection shall be repaired or replaced as applicable at no additional cost to the Owner.
   3. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations. Surfaces to remain that are damaged by demolition and construction operations shall be repaired at no cost to Owner.

C. Temporary Enclosures: Provide temporary enclosures for protection of existing building and construction, in progress and completed, from exposure, foul weather, other construction operations, unauthorized entry, and similar activities. Provide temporary weathertight enclosure for building exterior.
   1. Where heating is needed and permanent enclosure is not complete, provide insulated temporary enclosures.

D. Temporary Shoring: Provide and maintain interior and exterior shoring, bracing, or structural support to preserve stability and prevent movement, settlement, or collapse of construction to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.
   1. Strengthen or add new supports when required during progress of selective demolition.

E. Core Drilling and Saw Cutting: All penetrations shall be fully planned and coordinated by the Contractor. Vacuum up water created by cutting operations to prevent damage to materials to remain.

F. Enclose openings to the exterior and to unconditioned spaces to prevent heat loss and maintain temperature at an acceptable level for Owner.

G. Furniture Removal:
   1. The Owner will remove all movable furniture, equipment and contents of fixed shelving prior to start of work by Contractor. Contractor shall cover nonremovable casework and equipment with 6 mil polyethylene to protect from dust and dirt, and other measures to protect and prevent damage as required by the Contractor’s work plan, means and methods to do the work. Cover countertops, lab tops and tops of shelving with plywood or similar protective covering at locations where overhead demolition and construction could land and cause damage.
   2. Prevent workers from standing on fixed casework, shelving, furniture and equipment, and from using same to support staging planks, ladders and other equipment. Contractor is responsible for damage caused by workers.
      a. If the Contractor fails to keep workers from using fixed casework, shelving, furniture and equipment to stand on, or to support staging planks, ladders and other equipment for access to the work, the Owner shall serve notice to the Contractor, and the Contractor shall at the request of the Owner, remove fixed item from the
work spaces, store, and return back to the original locations upon completion of the work, or shall build protective enclosures, at no additional cost to the Owner.

3.4 POLLUTION CONTROLS

A. Dust Control: Use suitable methods to limit spread of dust and dirt. Comply with governing environmental-protection regulations.
   1. Do not use water when it may damage existing construction or create hazardous or objectionable conditions, such as ice, flooding, and pollution.

B. Disposal: Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
   1. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.

C. Cleaning: 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.

3.5 SELECTIVE DEMOLITION

A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:
   1. Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.
   2. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping, to minimize disturbance of adjacent surfaces. Temporarily cover openings to remain.
   3. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
   4. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain fire watch and portable fire-suppression devices during flame-cutting operations and welding operations, and remain after until chance of fire has past.
   5. Maintain adequate ventilation when using cutting torches.
   6. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
   7. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.
   8. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
   9. Dispose of demolished items and materials promptly. On-site storage or sale of removed items is prohibited.
  10. Remove and replace or reinstall existing construction as necessary to permit installation and alteration of mechanical and electrical work. Coordinate all removals with appropriate trades.
B. Existing Facilities: Comply with Owner's requirements for using and protecting walkways, building entries, and other building facilities during selective demolition operations.

C. Concrete: Demolish in sections. Cut concrete full depth at junctures with construction to remain and at regular intervals, using power-driven saw, then remove concrete between saw cuts.

D. Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain, using power-driven saw, then remove masonry between saw cuts. At exposed locations, masonry shall be removed to permit toothing in new masonry.

E. Wall Removals: Cut wall to wall and wall to ceiling interface to minimize the amount of area disturbed.

F. Resilient Floor Coverings: Remove floor coverings and adhesive according to recommendations in RFCI-WP and its Addendum. Vinyl asbestos tile will be removed by the Owner.
   1. Remove residual adhesive and prepare substrate for new floor coverings by one of the methods recommended by RFCI.

G. Carpet: Remove carpet and adhesive where indicated.

H. Roofing: Disturb no more existing roofing than can be patched the same day. Refer to applicable Division 07 Section "Single-Ply Membrane Roof Patching" for roof patching requirements.

3.6 BRACING

A. Locate bracing to clear columns, and other permanent work. If necessary to move a brace, install new bracing prior to removal of original brace.

B. Do not place bracing where it will be cast into or included in permanent work, except as otherwise acceptable to Architect.

C. Install internal bracing, if required, to prevent spreading or distortion to braced frames.

D. Maintain bracing until structural elements are rebraced by other bracing or until permanent construction is able to withstand pressures.

3.7 PATCHING AND REPAIRS

A. General: Promptly repair damage to adjacent construction caused by selective demolition operations.

B. Patching: Comply with this section and additional requirements in Division 01 Section "Cutting and Patching."

C. Work Exposed to View: Do not cut or patch in a manner that would, in the Architect's opinion, result in a lessening of the building's aesthetic qualities. Generally, cut from exposed side into concealed spaces to avoid unnecessary damage to finish. Do not cut and patch in a manner that would result in substantial visual evidence of cut and patch work. Restore exposed finishes of
patched areas in a manner, which eliminates evidence of patching and refinishing. For continuous surfaces, extend refinishing to nearest intersection, with a neat transition to adjacent surfaces.

D. Repairs: Where repairs to existing surfaces are required, patch to produce surfaces suitable for new materials.

E. Finishes: Restore exposed finishes of patched areas and extend restoration into adjoining construction in a manner that eliminates evidence of patching and refinishing.

F. Floors and Walls: Where walls or partitions that are demolished extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish color, texture, and appearance. Remove existing floor coverings and replace with new materials, if necessary, to achieve uniform color and appearance.
   1. Patch with durable seams that are as invisible as possible. Provide materials and comply with installation requirements specified in other Sections of these Specifications.
   2. Where patching occurs in a painted surface, apply primer and intermediate paint coats over patch and apply final paint coat over entire unbroken surface containing patch. Provide additional coats until patch blends with adjacent surfaces.
   3. Where feasible, test and inspect patched areas after completion to demonstrate integrity of installation.

G. Ceilings: Patch, repair, or rehang existing ceilings to remain as necessary to provide an even-plane surface of uniform appearance.
   1. Where suspended acoustical tile ceilings are indicated to be removed for mechanical or electrical work and re-installed upon completion of mechanical and electrical work, carefully remove acoustical tile and suspension system to prevent damage to components. Save, package and ceiling system components; identify areas where systems removed for re-installation. Protect ceiling tiles to prevent damage to edges.

3.8 DISPOSAL OF DEMOLISHED MATERIALS

A. General: Promptly dispose of demolished materials. Do not allow demolished materials to accumulate on-site. See Division 01 Section “Construction Waste Management and Disposal” for handling and processing of demolished materials and construction debris.

B. Burning: Do not burn demolished materials.

3.9 CLEANING

A. Sweep the building broom clean on completion of selective demolition operation.

END OF SECTION 024119
SECTION 042000 - UNIT MASONRY ASSEMBLIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes unit masonry assemblies consisting of the following:
   1. Face brick.
   2. Mortar and grout.
   3. Masonry joint reinforcement.
   4. Ties and anchors.
   5. Embedded flashing.
   6. Miscellaneous masonry accessories.
   7. Veneer-wall insulation.
   8. Cutting and patching.

B. Related Sections include the following:
   1. Division 07 Section “Metal Wall Panels” for installation of metal wall panels adjacent to
      masonry.
   2. Division 07 Section "Sheet Metal Flashing and Trim" for exposed sheet metal flashing.
   3. Division 07 Section "Joint Sealants" for sealing control and expansion joints in unit
      masonry.

C. Products installed, but not furnished, under this Section include the following:
   1. Steel lintels, and shelf angles for unit masonry, furnished under Division 05 Section
      "Metal Fabrications."

1.3 SUBMITTALS

A. General: Submit in accordance with Division 01 Section "Submittal Procedures."

B. Product Data: For each product specified.

C. Shop Drawings: For the following:
   1. Masonry Units: Show sizes, profiles, coursing, and locations of special shapes.
   2. Fabricated Flashing: Detail corner units, end-dam units, and other special applications.

D. Samples: For each type and color of the following:
   1. Decorative concrete masonry units.

E. Qualification Data: For firms and persons specified in "Quality Assurance" Article.

F. Submit samples of sand to an approved laboratory for tests. Submit test report for approval.
G. Cold-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with cold-weather requirements.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in performing the work of this Section with minimum: 5 years experience.

B. Source Limitations for Masonry Units: Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, through one source from a single manufacturer for each product required.

C. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from a single manufacturer for each cementitious component and from one source or producer for each aggregate.

D. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."
   1. Review procedures and installation requirements of flexible flashings. Parties that shall be present shall include the Contractor, Architect, air/vapor barrier applicator, masonry subcontractor’s field superintendent and field workers performing the actual application.
   2. Document proceedings, including corrective measures and actions required, and furnish copy of record to each participant.
   3. Provide 5 business days minimum advance notice to participants prior to convening preinstallation conference.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.

B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.

C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.

D. Deliver preblended, dry mortar mix in moisture-resistant containers designed for lifting and emptying into dispensing silo. Store preblended, dry mortar mix in delivery containers on elevated platforms, under cover, and in a dry location or in a metal dispensing silo with weatherproof cover.

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

F. Protect plastic insulation as follows:
   1. Do not expose to sunlight, except to extent necessary for period of installation and concealment.
   2. Protect against ignition at all times. Do not deliver plastic insulating materials to Project site before installation time.
3. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

1.6 PROJECT CONDITIONS

A. Protection of Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.
   1. Extend cover a minimum of 24 inches down both sides and hold cover securely in place.

B. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.
   1. Protect base of walls from rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface.
   2. Protect sills, ledges, and projections from mortar droppings.
   3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
   4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.

C. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602 and the following:
   1. Cold-Weather Construction: When the ambient temperature is within the limits indicated, use the following procedures:
      a. 40 to 32 deg F: Heat mixing water or sand to produce mortar temperatures between 40 and 120 deg F.
      b. 32 to 25 deg F: Heat mixing water and sand to produce mortar temperatures between 40 and 120 deg F. Heat grout materials to produce grout temperatures between 40 and 120 deg F. Maintain mortar and grout above freezing until used in masonry.
      c. 25 to 20 deg F: Heat mixing water and sand to produce mortar temperatures between 40 and 120 deg F. Heat grout materials to produce grout temperatures between 40 and 120 deg F. Maintain mortar and grout above freezing until used in masonry. Heat masonry units to 40 deg F if grouting. Use heat on both sides of walls under construction.
      d. 20 deg F and Below: Heat mixing water and sand to produce mortar temperatures between 40 and 120 deg F. Heat grout materials to produce grout temperatures between 40 and 120 deg F. Maintain mortar and grout above freezing until used in masonry. Heat masonry units to 40 deg F. Provide enclosures and use heat on both sides of walls under construction to maintain temperatures above 32 deg F within the enclosures.

   2. Cold-Weather Protection: When the mean daily temperature is within the limits indicated, provide the following protection, this is in addition to construction procedures specified above:
      a. 40 to 25 deg F: Cover masonry insulating blankets for 48 hours after construction.
      b. 25 deg F and Below: Provide enclosure and heat to maintain temperatures above 32 deg F within the enclosure for 72 hours after construction.
3. **Cold-Weather Cleaning:** Use liquid cleaning methods only when air temperature is 40 deg F and above and will remain so until masonry has dried, but not less than 7 days after completing cleaning.

D. **Hot-Weather Requirements:** Protect unit masonry work when temperature and humidity conditions produce excessive evaporation of water from mortar and grout. Provide artificial shade and wind breaks and use cooled materials as required.
1. When ambient temperature exceeds 100 deg F, or 90 deg F with a wind velocity greater than 8 mph, do not spread mortar beds more than 48 inches ahead of masonry. Set masonry units within one minute of spreading mortar.

**PART 2 - PRODUCTS**

2.1 **MANUFACTURERS**

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
1. **Products:** Subject to compliance with requirements, provide one of the products specified.
2. **Manufacturers:** Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 **MASONRY UNITS, GENERAL**

A. **Defective Units:** Referenced masonry unit standards may allow a certain percentage of units to exceed tolerances and to contain chips, cracks, or other defects exceeding limits stated in the standard. Do not use units where such defects, including dimensions that vary from specified dimensions by more than stated tolerances, will be exposed in the completed Work or will impair the quality of completed masonry.

2.3 **BRICK**

A. **General:** Provide shapes indicated and as follows:
1. For ends of sills and caps and for similar applications that would otherwise expose unfinished brick surfaces, provide units without cores or frogs and with exposed surfaces finished.
2. Provide special shapes for applications where stretcher units cannot accommodate special conditions, including those at corners, movement joints, bond beams, sashes, and lintels.
3. Provide special shapes for applications requiring brick of size, form, color, and texture on exposed surfaces that cannot be produced by sawing.
4. Provide special shapes for applications where shapes produced by sawing would result in sawed surfaces being exposed to view.

B. **Face Brick:** ASTM C 216, Grade SW, Type FBS.
1. **Unit Compressive Strength:** Provide units with minimum average net-area compressive strength of not less than 8000 psi.
2. **Initial Rate of Absorption:** Less than 18 g/30 sq. in. per minute when tested per ASTM C 67.
3. **Efflorescence:** Provide brick that has been tested according to ASTM C 67 and is rated "not effloresced."

4. **Size (Actual Dimensions):** 3-5/8 inches wide by 2-1/4 inches high by 7-5/8 inches long

5. **Application:** Use where brick is exposed, unless otherwise indicated.

6. **Product:** College Blend, Medium Range; Morin Brick Co.

### 2.4 MORTAR AND GROUT MATERIALS

**A. Portland Cement:** ASTM C 150, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.

**B. Hydrated Lime:** ASTM C 207, Type S.

**C. Portland Cement-Lime Mix:** Packaged blend of portland cement complying with ASTM C 150, Type I or Type III, and hydrated lime complying with ASTM C 207, Type S. Standard masonry cement is not acceptable. Provide one of the following portland cement-lime mix products:

1. Eaglebond; Lafarge North America Inc.
2. Portland and lime; Cement Quebec, Inc.

**D. Aggregate for Mortar:** ASTM C 144.

1. For mortar that is exposed to view, use washed aggregate consisting of natural sand or crushed stone.

**E. Aggregate for Grout:** ASTM C 404.

**F. Water-Repellent Admixture:** Liquid water-repellent mortar admixture intended for use with concrete masonry units, containing integral water repellent by same manufacturer.

1. Product: Grace Construction Products, a unit of W. R. Grace & Co. - Conn.; Dry-Block Mortar Admixture. Verify and match manufacturer used by the block manufacturer.

**G. Water:** Potable.

### 2.5 MASONRY JOINT REINFORCEMENT

**A. Masonry Joint Reinforcement for Ground-Face Concrete Masonry Veneers:** Continuous ladder type with 9 gage side rods and cross rods, 2 inch wide, ASTM A 153, Class B-2 hot-dip galvanized, carbon steel. Provide in lengths of not less than 10 feet, with prefabricated corner units.

1. Manufacturer: Hohmann & Barnard, Inc.

### 2.6 TIES AND ANCHORS

**A. Materials:** Provide ties and anchors specified in subsequent paragraphs that are made from materials that comply with eight subparagraphs below, unless otherwise indicated.

1. **Stainless-Steel Wire:** ASTM A 580/A 580M, Type 304 or 316.
2. **Stainless-Steel Sheet:** ASTM A 666, Type 304.
3. **Stainless Steel Bars:** ASTM A 276 or ASTM A 666, Type 304.

**B. Wire Ties, General:** Unless otherwise indicated, size wire ties to extend at least halfway through veneer but with at least 5/8-inch cover on outside face. Outer ends of wires are bent 90 degrees and extend 2 inches parallel to face of veneer.
C. **Adjustable Masonry-Veneer Anchors:**

1. **General:** Provide anchors that allow vertical adjustment but resist tension and compression forces perpendicular to plane of wall, for attachment over sheathing to wood or metal studs, and as follows:
   a. **Structural Performance Characteristics:** Capable of withstanding a 100-lbf load in both tension and compression without deforming or developing play in excess of 0.05 inch.
   b. Fabricate sheet metal anchor sections and other sheet metal parts from 0.078-inch-thick, stainless steel sheet.

2. **Screw-Attached, Masonry-Veneer Anchors with Weather-Resistant Gypsum Sheathing:** Units consisting of a wire tie and an adjustable metal anchor section.
   a. **Anchor Section:** Zinc-alloy barrel section with zinc alloy wing nut and metal backed neoprene washer, and corrosion-resistant, self-drilling screw. Barrel length to suit sheathing and insulation thickness.
   b. **Wire Ties:** Triangular-shaped wire ties fabricated from 0.188-inch-diameter, adjustable, stainless steel wire.
   c. **Product:** Heckmann Building Products Inc.; Wing-Nut Pos-I-Tie.

### 2.7 EMBEDDED FLASHING MATERIALS

A. **Metal Flashing:** Provide metal flashing, where flashing is exposed or partly exposed and where indicated, complying with SMACNA's "Architectural Sheet Metal Manual, Division 7 Section "Sheet Metal Flashing and Trim," and as follows:

1. **Tin-Zinc Alloy Coated Copper:** Temper H00 or H01, cold-rolled copper sheet, 16-oz./sq. ft. weight or 0.0216 inch thick, coated with tin-zinc alloy and a protective washcoat.
   a. **Product:** FreedomGray; Revere Copper Products, Inc.

2. **Fabrication:** Form metal flashing to required shape using sheet metal break.
   a. Fabricate metal flashing with drip edge. Fabricate by extending flashing 3/8 inch out from wall, with outer edge bent down 45 degrees.

B. **Flexible Flashing:** For flashing not exposed to the exterior, use the following, unless otherwise indicated:

1. **Rubberized-Asphalt Flashing:** Composite flashing product consisting of a pliable, adhesive rubberized-asphalt compound, bonded to a high-density, cross-laminated polyethylene film to produce an overall thickness of not less than 0.040 inch.
   a. **Products:**
      1) Carlisle Coatings & Waterproofing; CCW-705-TWF Thru-Wall Flashing.
      a) **Termination Mastic:** CCW-704 rubberized bitumen mastic. Coordinate mastic with manufacturer of air/vapor barrier system.
      a) **Termination Mastic:** Bituthene Mastic. Coordinate mastic with manufacturer of air/vapor barrier system.

C. **Adhesives, Primers, and Seam Tapes for Flashings:** Flashing manufacturer's standard products or products recommended by flashing manufacturer for bonding flashing sheets to each other and to substrates.
2.8 MISCELLANEOUS MASONRY ACCESSORIES

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

B. Preformed Control-Joint Gaskets: Made from styrene-butadiene-rubber compound, complying with ASTM D 2000, Designation M2AA-805 or PVC, complying with ASTM D 2287, Type PVC-65406 and designed to fit standard sash block and to maintain lateral stability in masonry wall; size and configuration as indicated.

C. Bond-Breaker Strips: Asphalt-saturated, organic roofing felt complying with ASTM D 226, Type I (No. 15 asphalt felt).

D. Weep/Vent Products: Use the following, unless otherwise indicated:
   1. Cellular Plastic Weep/Vent: One-piece, flexible extrusion made from UV-resistant polypropylene copolymer, full height and width of head joint and depth 1/8 inch less than depth of outer wythe, in color selected from manufacturer's standard.
      a. Products:
         1) Dayton Superior Corporation, Dur-O-Wal Division; Cell Vents.
         2) Hohmann & Barnard, Inc.; Quadro-Vent.
         3) Wire-Bond; Cell Vent.

E. Cavity Drainage Material: Free-draining mesh, made from nonabsorbent, polymer strands that will not degrade within the wall cavity.
   1. Configuration: Strips, full-depth of cavity and 10 inches wide, with dovetail shaped notches 7 inches deep that prevent mesh from being clogged with mortar droppings.
   3. Product: Mortar Net; Mortar Net USA, Ltd.

2.9 CAVITY-WALL INSULATION

A. Extruded-Polystyrene Board Insulation: ASTM C 578, Type IV, closed-cell product extruded with an integral skin, with a compressive strength of 15 psi in accordance with ASTM D 1621, tongue and groove edges, 48- by 96-inch sheets.
   1. Thickness: 2-inch, unless otherwise noted.
   2. Edge Treatment: Ship-lapped along long edges.
   3. Products:
      a. Styrofoam; Dow Chemical Company.
      b. Formular; U.C. Industries Inc.

B. Adhesive: Type recommended by insulation board manufacturer for application indicated.

C. Polyurethane Foam Insulation (Minimal Expansive): Single- or two-component, UL classified sealant, to insulate, seal, fill, and stop air infiltration.
   1. Density: 1.2 lbs./cu. ft.
   2. R-Value: Not less than 4.0 per inch of thickness.
   3. Fire-Test-Response Characteristics: ASTM E 84, as follows:
      b. Smoke Developed: 50.
4. Manufacturers:
   a. Insta-Foam Products Inc., Joliet, IL 60435, (800) 800-FOAM.
   c. Convenience Products, Fenton, MO 63026, (800) 325-6180.

2.10 MASONRY CLEANERS

A. Job-Mixed Detergent Solution: Solution of 1/2-cup dry measure tetrasodium polyphosphate (Spic and Span) and 1/2-cup dry measure laundry detergent dissolved in 1 gal. of water.

B. Proprietary Acidic Cleaner: Manufacturer's standard-strength cleaner designed for removing mortar/grout stains, efflorescence, and other new construction stains from new masonry without discoloring or damaging masonry surfaces. Use product expressly approved for intended use by cleaner manufacturer and manufacturer of masonry units being cleaned. Muriatic acid is not permitted.
   1. Cleaners for Brick:

2.11 MORTAR AND GROUT MIXES

A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures, unless otherwise indicated.
   1. Do not use calcium chloride in mortar or grout.
   2. Limit cementitious materials in mortar for exterior masonry to portland cement and lime.

B. Mortar for Unit Masonry: Comply with BIA Technical Notes 8A, Proportion Specification. Provide the following types of mortar for applications stated unless another type is indicated or needed to provide required compressive strength of masonry.
   1. For masonry below grade or in contact with earth, use Type M.
   2. For exterior veneer masonry, use Type N. Provide integral waterproofing for ground face concrete masonry units, same manufacturer that is contained in block.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.
   1. If unsatisfactory conditions are encountered, prepare written report, endorsed by Installer, listing conditions detrimental to performance of work.
   2. Examine wall framing, sheathing, weather barrier and air/vapor barrier. Verify that stud locations are suitable for spacing of veneer anchors and that installation will result in a weatherproof covering.
   3. Coordinate installation of cavity wall insulation with the installation of the weather barrier. Perimeter edges of blocking and plywood to be wrapped and tied into air/vapor barrier before the installation of the cavity insulation.
   4. Coordinate installation of cavity wall insulation with the installation of the windows.
B. Before installation, examine rough-in and built-in construction for piping and electrical systems to verify actual locations of piping and conduit connections.

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

3.2 INSTALLATION, GENERAL

A. Thickness: Build cavity walls and other masonry construction to full thickness shown.

B. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying. Install cut units with cut surfaces and, where possible, cut edges concealed.

C. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures.
   1. Mix units from several pallets or cubes as they are placed.

D. Comply with construction tolerances in ACI 530.1/ASCE 6/TMS 602 and with the following:
   1. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2 inch maximum.
   2. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 feet, or 1/2 inch maximum.
   3. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2 inch maximum.
   4. For exposed bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch, with a maximum thickness limited to 1/2 inch. Do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch.
   5. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch. Do not vary from adjacent bed-joint and head-joint thicknesses by more than 1/8 inch.
   6. For faces of adjacent exposed masonry units, do not vary from flush alignment by more than 1/16 inch except due to warpage of masonry units within tolerances specified for warpage of units.
   7. For exposed bed joints and head joints of stacked bond, do not vary from a straight line by more than 1/16 inch from one masonry unit to the next.

3.3 INSULATION INSTALLATION

A. Fit courses of cavity insulation firmly against air/vapor barrier membrane and sheathing or back-up wythe, with edges butted tightly both ways. Install with tongue edge up.

B. Fill cracks and open gaps in insulation with crack sealer compatible with insulation, air/vapor barrier membrane, masonry and gypsum sheathing.

C. At steel framed walls, screw masonry anchors through insulation, air/vapor barrier membrane, and gypsum sheathing into steel studs. Press insulation tight to substrate and tighten wing nut, holding insulation in place without gaps between back side of insulation and air/vapor barrier. If anchor misses stud, remove anchor and insulation, patch holes in air/vapor barrier membrane, and replace insulation with new insulation. Seal insulation joint gaps and gaps between
insulation and adjacent construction, including windows, z-furring and insulation supporting plywood and siding, and similar cavity insulation termination with minimal expanding foam insulation.

3.4 LAYING MASONRY WALLS

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

B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in running bond; do not use units with less than nominal 4-inch horizontal face dimensions at corners or jambs.

C. Stopping and Resuming Work: Stop work by racking back units in each course from those in course below; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar, remove loose masonry units and mortar, and wet brick if required before laying fresh masonry.

D. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.

3.5 MORTAR BEDDING AND JOINTING

A. Lay solid masonry units with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.

B. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness, unless otherwise indicated.

3.6 CAVITY WALLS

A. Keep cavities clean of mortar droppings and other materials during construction. Strike joints facing cavities flush.  
1. Use wood strips temporarily placed in cavity to collect mortar droppings. As work progresses, remove strips, clean off mortar droppings, and replace in cavity.
2. Place cavity drainage mat at the base flashing of all new masonry, providing a continuous drainage system at base of wall, at heads of windows, doors, and other horizontal interruptions in cavity. (Note: It is still intended to have mortar dropping minimized through proper placement, drag boards and other methods required to keep the cavity clear.)
3. Where masonry veneer goes below grade, fill cavity solid with no voids.

3.7 MASONRY JOINT REINFORCEMENT

A. General: Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8 inch on exterior side of walls, 1/2 inch elsewhere. Lap reinforcement a minimum of 6 inches.
1. Space reinforcement not more than 16 inches o.c.
2. Provide reinforcement not more than 12 inches above and below wall openings and extending 12 inches beyond openings.
   a. Reinforcement above is in addition to continuous reinforcement.
3. Provide continuous horizontal-joint reinforcement in block veneer. Space reinforcement not more than 24-inches o.c., starting reinforcement on top of the first block course.

B. Interrupt joint reinforcement at control and expansion joints, unless otherwise indicated.
C. Provide continuity at corners by using prefabricated L-shaped units.
D. Cut and bend reinforcing units as directed by manufacturer for continuity at corners, returns, offsets, and other special conditions.

3.8 ANCHORING MASONRY VENEERS

A. Anchor masonry veneers to wall framing and concrete backup with masonry-veneer anchors to comply with the following requirements:
   1. Fasten screw-attached anchors through insulation, air/vapor barrier, and sheathing to wall framing and to concrete backup with metal fasteners of type indicated. Use two fasteners unless anchor design only uses one fastener.
   2. Embed tie sections in masonry joints. Provide not less than 2 inches of air space between back of masonry veneer and face of insulation.
   3. Locate anchor sections to allow maximum vertical differential movement of ties up and down.
   4. Space anchors as indicated, but not more than 16 inches o.c. vertically and 16 inches o.c. horizontally, with not less than 1 anchor for each 1.77 sq. ft. of wall area. Install additional anchors within 12 inches of openings and at intervals, not exceeding 8 inches, around perimeter.
      a. Use care installing anchors so as to not strip threads engaging in metal studs.

3.9 CONTROL AND EXPANSION JOINTS

A. General: Install control joint materials in unit masonry as masonry progresses. Do not allow materials to span control joints without provision to allow for in-plane wall or partition movement.
   1. Where control joints are not shown, provide control joints at a maximum spacing of 30 feet; review proposed locations with Architect prior to installation.
B. Form expansion/control joints in masonry veneer as follows:
   1. Form open joint full depth of brick wythe and of width indicated, but not less than 3/8 inch for installation of sealant and backer rod specified in Division 07 Section “Joint Sealants.”

3.10 LINTELS

A. Install steel lintels where indicated.
B. Provide minimum bearing of 8 inches at each jamb, unless otherwise indicated.
3.11 FLASHING, WEEP HOLES, CAVITY DRAINAGE, AND VENTS

A. General: Install embedded flashing and weep holes in masonry at shelf angles, lintels, ledges, other obstructions to downward flow of water in wall, and where indicated. Install vents at shelf angles, ledges, and other obstructions to upward flow of air in cavities, and where indicated.

B. Install flashing as follows, unless otherwise indicated:
   1. Prepare masonry surfaces so they are smooth and free from projections that could puncture flashing. Where flashing is within mortar joint, place flashing on sloping bed of mortar and cover with mortar. Before covering with mortar, seal penetrations in flashing with adhesive, sealant, or tape as specified.
   2. Extend sheet metal flashing 3/8 inch beyond face of masonry at exterior and turn flashing down at 45 degrees to form a drip. Lap joints of metal flashing 3 inches, sealing between with full bed of asphalt mastic. Over the top of each joint, apply a 4-inch wide strip of rubberized asphalt sheet flashing to both horizontal and vertical legs.
   3. At masonry-veneer walls, extend flexible (rubberized-asphalt) flashing through veneer, across air space and insulation behind veneer, and up face of the air/vapor barrier system at least 12 inches, fully adhering to air/vapor barrier system, free of gaps and wrinkles, using roller to seal contact surfaces. Apply continuous bead of termination mastic along rubberized-asphalt flashing top edge, seams, cuts, and penetrations. Lap flexible flashing onto sheet metal drip flashing 3 inches, stopping flexible flashing minimum 1/2-inch back from face of brick, providing continuous watertight seal between. Where flexible flashing is unsupported, spanning across cavities greater than 1/4 inch, provide continuous sheet metal support.
   4. At lintels, shelf angles, and bearing plates, extend flashing a minimum of 8 inches into masonry at each end, turning up not less than 2 inches to form end dams with inside corners sealed. At heads and sills, extend flashing 6 inches at ends and turn up not less than 2 inches to form end dams with inside corners sealed.
   5. Metal flashing shall be one piece, full width of opening. Where opening width exceeds available sheet metal length, lap joints of metal flashing 3 inches, sealing between with full bed of asphalt mastic. Over the top of each joint, apply a 4-inch wide strip of rubberized asphalt sheet flashing to both the horizontal and vertical legs.

C. Install weep holes in head joints in exterior wythes of first course of masonry immediately above embedded flashing and as follows:
   1. Use specified weep/vent products to form weep holes.
   2. Space weep holes 24 inches o.c., unless otherwise indicated.
   3. Provide weep holes not more than 8 inches from end of lintels.

D. Place cavity drainage material in cavities to comply with configuration requirements for cavity drainage material in Part 2 "Miscellaneous Masonry Accessories" Article.

E. Install vents in head joints in exterior wythes at tops of walls at spacing indicated; if spacing not indicated, space vents 64 inches o.c. Use specified weep/vent products to form vents.

3.12 REPAIRING, POINTING, AND CLEANING

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

C. **In-Progress Cleaning:** Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.

D. **Final Cleaning:** After mortar is thoroughly set and cured, clean exposed masonry as follows:
1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
2. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.
3. Protect adjacent stone and nonmasonry surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
4. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
5. Clean brick by bucket-and-brush hand-cleaning method described in BIA Technical Notes 20 Revised, and manufacturer’s printed instructions using the following masonry cleaner:
   a. Proprietary masonry cleaning compound to clean brick and block. Allow mortar to cure minimum 7 days at a temperature above 45 degrees F before cleaning.

E. **Protection:** Provide final protection and maintain conditions that ensure unit masonry is without damage and deterioration at time of Substantial Completion.

3.13 **MASONRY WASTE DISPOSAL**

A. **Salvageable Materials:** Unless otherwise indicated, excess masonry materials are Contractor's property. At completion of unit masonry work, remove from Project site.

B. **Excess Masonry Waste:** Remove excess clean masonry waste and other masonry waste, and legally dispose of off Owner's property.

END OF SECTION 042000
SECTION 054000 - COLD-FORMED METAL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:
   1. Exterior non-load-bearing curtain-wall framing.
   2. Exterior soffit framing.
   3. Exterior gypsum sheathing.

B. Related Sections include the following:
   1. Division 06 Section "Rough Carpentry" for plywood wall and roof sheathing, metal furring, and thermal insulation.
   2. Division 07 Section "Self-Adhered Air/Vapor Barrier Membrane" for membrane on sheathing.
   3. Division 09 Section "Gypsum Board Assemblies" for interior non-load-bearing metal-stud framing, and ceiling-suspension assemblies.

1.3 DEFINITIONS

A. Minimum Uncoated Steel Thickness: Minimum uncoated thickness of cold-formed framing delivered to the Project site shall be not less than 95 percent of the thickness used in the cold-formed framing design. Lesser thicknesses shall be permitted at bends due to cold forming.

B. Producer: Entity that produces steel sheet coil fabricated into cold-formed members.

1.4 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide cold-formed metal framing capable of withstanding design loads within limits and under conditions indicated.
   1. Design Loads: As indicated on Structural Drawing S30.1.
   2. Deflection Limits: Design framing systems to withstand design loads without deflections greater than the following:
      a. Exterior Non-Load-Bearing Curtain-Wall Framing:
         1) Walls with Masonry Veneer Only and Walls with Masonry and Siding Cladding: Horizontal deflection of 1/600 of wall height.
      b. Exterior Soffit Framing: Vertical deflection of 1/360 of the span.
   3. Design framing systems to provide for movement of framing members without damage or overstressing, sheathing failure, connection failure, undue strain on fasteners and anchors, or other detrimental effects when subject to a maximum ambient temperature change of 120 deg F.
   4. Design framing system to maintain clearances at openings, to allow for construction tolerances, and to accommodate live load deflection of primary building structure as follows:
1.5 SUBMITTALS

A. General: Submit in accordance with Division 01 Section "Submittal Procedures."

B. Product Data: For each type of cold-formed metal framing product and accessory indicated.

C. Shop Drawings: Show layout, spacings, sizes, thicknesses, and types of cold-formed metal framing; fabrication; and fastening and anchorage details, including mechanical fasteners. Show reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachment to adjoining Work.
   
   1. Design Data: For cold-formed metal framing indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
      
      a. Gages indicated are minimum allowable uncoated gage. Verify load capacity of manufacturer's product being furnished for Project.
      
      b. Verify loading of architectural precast concrete anchor design.

D. Welding Certificates: Copies of certificates for welding procedures and personnel.

E. Qualification Data: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

F. Product Test Reports: From a qualified testing agency indicating that each of the following complies with requirements, based on comprehensive testing of current products:
   
   1. Expansion anchors.
   2. Power-actuated anchors.
   3. Mechanical fasteners.
   4. Vertical deflection clips.
   5. Miscellaneous structural clips and accessories.

G. Research/Evaluation Reports: Evidence of cold-formed metal framing's compliance with building code in effect for Project, from a model code organization acceptable to authorities having jurisdiction.

H. Installation Inspection Report: Submit report of completed work inspection, for each area that is completed and ready to turn over for application of the air/vapor barrier system.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An experienced Installer who has completed cold-formed metal framing similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.

B. Engineering Responsibility: Engage a qualified professional engineer to prepare design calculations, Shop Drawings, and other structural data.
C. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of cold-formed metal framing that are similar to those indicated for this Project in material, design, and extent.


E. AISI Specifications: Comply with AISI's "Specification for the Design of Cold-Formed Steel Structural Members" for calculating structural characteristics of cold-formed metal framing.


F. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination."

G. Installation Inspection: Contractor and Installer shall inspect completed cold-formed metal framing and sheathing installation for compliance with installation specifications and details and submit a report for each area that is completed and ready to turn over for application of the air/vapor barrier system. Report shall include the following:

1. All required framing and bracing is installed in exterior walls to receive sheathing, z-furring, and other components of the exterior skin of the building.
2. Verify proper attachment and spacing of anchors in top and bottom tracks to meet design loading requirements.
3. At deflection track locations, verify that studs are not screwed to track, permitting proper free sliding of studs in the track.
4. Sheathing has proper uniform gap at deflection tracks to permit full deflection. Verify sheathing edges are not screwed to the deflection track.
5. Verify sheathing attachment screw quantity and spacing per board is correct.
6. Verify screw head penetration is at the proper location to be in compliance with the sheathing manufacturer's requirements.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Protect cold-formed metal framing from corrosion, deformation, and other damage during delivery, storage, and handling.

B. Store cold-formed metal framing, protect with a waterproof covering, and ventilate to avoid condensation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cold Formed Metal Framing:
   a. Dietrich Industries, Inc.
   b. MarinoWare; Div. of Ware Industries, Inc.
   c. Unimast, Inc.
2. Glass-Mat Gypsum Sheathing Board:
   a. Dens-Glass Gold; Georgia-Pacific Corporation.
   b. GlasRoc Sheathing; CertainTeed Corporation.
   c. Expended Exposure Sheathing e²xp; National Gypsum Company.
   d. Securock Glass-Mat Sheathing; United States Gypsum Co.

2.2 MATERIALS

A. Steel Sheet: ASTM A 653/A 653M, structural steel, zinc coated, of grade and coating as follows:
   1. Grade: As required by structural performance.
   2. Coating: G90.
   3. Use for all framing.

2.3 CURTAIN-WALL FRAMING

A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, complying with ASTM C 955, and as follows:
   1. Minimum Uncoated-Steel Thickness: Not less than 0.0428 inch, 18 gage including cripple studs, short stud infill, and structural steel infill.
   2. Flange Width: 2 inches.
   3. Sizes: As required for specified design requirements, but not less than indicated on Drawings.

B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with unstiffened flanges, complying with ASTM C 955, and as follows:
   1. Minimum Uncoated-Steel Thickness: Not less than steel studs in material, gage, and finish.
   2. Flange Width: Not less than 1-1/4 inches.

C. Single Deflection Track: Manufacturer's single, deep-leg, U-shaped steel track; unpunched, with unstiffened flanges, of web depth to contain studs while allowing free vertical movement, with flanges designed to support horizontal and lateral loads, and as follows:
   1. Minimum Uncoated-Steel Thickness: Not less than steel studs in material, gage, and finish; gage as required to resist loading indicated.
   2. Flange Width: Not less than 3 inches to allow for 1-1/2 inches of deflection at roof levels.

D. Bridging:
   1. Minimum Uncoated-Steel Thickness: Not less than steel studs in material, gage, and finish.
   2. Shape: Cold-formed channel section.

E. Deflection Brackets:
   1. Product: VertiClip; Signature Industries; (919) 844-0789.
   2. Construction: Slotted galvanized steel angle with step bushing to prevent over tightening of fasteners.
   3. Vertical Deflection: 3-inches total travel at roof levels.
   4. Series: SL, SDL, SLB, AND SLS as required by attachment condition.
F. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.
   1. Minimum Base Metal Thickness: Not less than 0.0428 inch, 18 gage, unless indicated otherwise.

2.4 EXTERIOR SOFFIT (CEILING JOIST) FRAMING

A. Steel Soffit (Ceiling Joists) Framing: Manufacturer's standard C-shaped steel sections, of web depths indicated, unpunched, with stiffened flanges, complying with ASTM C 955, and as follows:
   1. Minimum Uncoated-Steel Thickness: Not less than 0.0329 inch, 20 gage.
   3. Sizes: Not less than indicated.

2.5 FRAMING ACCESSORIES

A. Miscellaneous Framing Components: Fabricate steel-framing accessories of the same material and finish used for framing members, with a minimum yield strength of 33,000 psi.

2.6 ANCHORS, CLIPS, AND FASTENERS

A. General: Provide required or indicated items; provide galvanized fasteners for assemblies having galvanized major steel components.

B. Power-Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 10 times design load, as determined by testing per ASTM E 1190 conducted by a qualified independent testing agency.

C. Welding Electrodes: Comply with AWS standards.

2.7 MISCELLANEOUS MATERIALS

A. Galvanizing Repair Paint: SSPC-Paint 20 or DOD-P-21035.

2.8 EXTERIOR SHEATHING

A. Glass-Mat Gypsum Sheathing Board: ASTM C 1177/C 1177M; water-resistant gypsum core with weather-resistant face, back and edges.
   1. Type and Thickness: Type X, 5/8 inch thick.

B. Gypsum Sheathing Fasteners for Metal Framing: Steel drill screws, ASTM C 954, in length recommended by sheathing manufacturer for thickness of sheathing board to be attached, with organic-polymer or other corrosion-protective coating having a salt-spray resistance of more than 800 hours according to ASTM B 117.
PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine supporting substrates and abutting structural framing, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Install cold-formed metal framing according to AISI's "Standard for Cold-Formed Steel Framing - General Provisions" and to manufacturer's written instructions unless more stringent requirements are indicated.

B. Install cold-formed metal framing and accessories plumb, square, and true to line, with lateral bracing and bridging, and with connections securely fastened, according to referenced standards, manufacturer's written recommendations and requirements in this Section.
   1. Cut framing members by sawing or shearing; do not torch cut.
   2. Fasten cold-formed metal framing members by welding or screw fastening, as standard with fabricator. Wire tying of framing members is not permitted.
      a. Comply with AWS D1.3 requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
      b. Locate mechanical fasteners and install according to Shop Drawings, with screw penetrating joined members by not less than three exposed screw threads. Use minimum of 2 self-tapping metal screws per connection, unless otherwise indicated.

C. Install framing members in one-piece lengths, unless splice connections are indicated for track or tension members. Splicing of load bearing components and curtain wall studs is prohibited.

D. Install temporary bracing and supports to secure framing and support loads comparable in intensity to those for which structure was designed. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to framing are secured.

E. Do not bridge building expansion and control joints with cold-formed metal framing. Independently frame both sides of joints.

F. Erection Tolerances: Install cold-formed metal framing level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet and as follows:
   1. Space individual framing members no more than plus or minus 1/8 inch from plan location and a maximum of 2 inches from abutting walls. Construct corners using minimum of three studs. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.
   2. Align top and bottom tracks; locate as indicated, and secure track to substrates at spacing required on engineered Shop Drawings, but not more than 24 inches on center, using fastening methods specified in manufacturer's printed installation instructions for Project substrate types.
   3. Install double studs at jambs of openings for doors, cased openings, and windows; install intermediate studs above and below openings to align with wall stud spacing.
4. Seat studs in track, square with track flange, with stud end maximum 1/16 inch from surface of track web.
5. Attach cross studs for attachment of fixtures; install framing between studs for attachment of mechanical and electrical items, and to prevent stud rotation.
6. Provide web stiffeners at locations indicated or required.

G. Install miscellaneous framing and connections, including supplementary framing, web stiffeners, clip angles, continuous angles, anchors, and fasteners, to provide a complete and stable wall-framing system.

3.3 CURTAIN-WALL INSTALLATION

A. Install continuous tracks sized to match studs. Align tracks accurately and securely anchor to supporting structure.

B. Fasten both flanges of studs to bottom track only, unless otherwise indicated. Do not fasten studs to deep-leg deflection tracks. Space studs as follows:
1. Stud Spacing: 16 inches, unless otherwise indicated.

C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar requirements.

D. Isolate non-load-bearing steel framing from building structure to prevent transfer of vertical loads while providing lateral support.
1. Install single deep-leg deflection tracks and anchor to building structure.

E. Install horizontal bridging in curtain-wall studs, spaced in rows indicated on Shop Drawings but not more than 54 inches apart. Fasten at each stud intersection.
1. Top Bridging for Single Deflection Track: Install row of horizontal bridging within 12 inches of single deflection track. Install a combination of flat, taut, steel sheet straps of width and thickness indicated and stud or stud-track solid blocking of width and thickness matching studs. Fasten flat straps to stud flanges and secure solid blocking to stud webs or flanges.
2. Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and stud-track solid blocking of width and thickness to match studs. Fasten flat straps to stud flanges and secure solid blocking to stud webs or flanges.

F. Install miscellaneous framing and connections, including stud kickers, web stiffeners, clip angles, continuous angles, anchors, fasteners, and stud girts, to provide a complete and stable curtain-wall-framing system.

3.4 INSTALLATION OF EXTERIOR SOFFIT FRAMING

A. Install perimeter soffit framing track sized to match soffit framing. Align and securely anchor or fasten track to supporting structure at corners, ends, and spacings indicated on Shop Drawings.

B. Install soffit framing bearing on supporting frame, level, straight, and plumb; adjust to final position, brace, and reinforce.
1. Install soffit framing over supporting frame with a minimum end bearing of 1-1/2 inches.
2. Reinforce ends and bearing points with web stiffeners, end clips, steel clip angles, or steel-stud sections as indicated on Shop Drawings.
C. Space soffit framing not more than 2 inches from abutting walls, and as follows:
   1. Soffit Framing Spacing: 16 inches.

D. Install bridging at each end of soffit framing and at intervals indicated on Shop Drawings. Fasten bridging at each joist intersection as follows:
   1. Soffit Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and joist-track solid blocking of width and thickness indicated.

3.5 EXTERIOR SHEATHING INSTALLATION

A. General: Install gypsum sheathing to comply with GA-253 and manufacturer's written instructions.

B. Cut boards at penetrations, edges, and other obstructions of the work; fit tightly against abutting construction, except provide a 3/8-inch setback where non-load-bearing construction abuts structural elements.

C. Coordinate sheathing installation with flashing and joint sealant installation so these materials are installed in the sequence and manner that prevent exterior moisture from passing through completed exterior wall assembly.

D. Apply fasteners so screw heads bear tight against but flush with surface of sheathing boards but do not cut into facing.

E. Do not bridge building expansion joints and deflection joints with sheathing; cut and space edges to match spacing of structural support elements. Do not screw edges of sheathing to deflection track.

F. Horizontal Installation: Abut ends of boards over centers of stud flanges and stagger end joints of adjacent boards not less than one stud spacing. Screw-attach boards at perimeter and within field of board to each steel stud at approximately 8 inches o.c. and set back a minimum of 3/8 inch from edges and ends of boards.

3.6 FIELD QUALITY CONTROL

A. Testing: Owner may engage a qualified independent testing agency to perform field quality-control testing.

B. Field and shop welds will be subject to inspection and testing.

C. Testing agency will report test results promptly and in writing to Contractor and Architect.

D. Remove and replace Work that does not comply with specified requirements.

E. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of corrected Work with specified requirements.

3.7 REPAIRS AND PROTECTION

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed metal framing with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.
B. Protect cutouts, corners, and joints in sheathing by filling with a flexible sealant or by applying tape recommended by sheathing manufacturer at time sheathing is applied.

C. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure cold-formed metal framing and sheathing are without damage or deterioration at time of Substantial Completion.

END OF SECTION 054000
SECTION 055000 - METAL FABRICATIONS

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, but is not limited to, the following:
   1. Ladders.
   2. Loose steel lintels.
   3. Steel framing and supports for the following:
      a. Roof and floor openings.
      b. Steel framing and supports for mechanical and electrical equipment.
      c. Steel framing and supports for floor hatch.
      d. Steel framing and supports for applications where framing and supports are not specified in other Sections.
   4. Miscellaneous fabrications:
      a. Steel closure caps.
   5. Rough hardware.

B. Products furnished, but not installed, under this Section include the following:
   1. Loose steel lintels.

C. Related Sections include the following:
   1. Division 04 Section "Unit Masonry Assemblies" for installing loose lintels and other items indicated to be built into unit masonry.

1.3 PERFORMANCE REQUIREMENTS

A. Structural Performance of Ladders: Provide ladders capable of withstanding the effects of loads and stresses within limits and under conditions specified in ANSI A14.3.

1.4 SUBMITTALS

A. General: Submit in accordance with Division 01 Section "Submittal Procedures."

B. Shop Drawings: Show fabrication and installation details for metal fabrications.
   1. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items.
   2. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld.
   3. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical high-strength bolted connections.

C. Welding Certificates: Signed by Contractor certifying that welders comply with requirements specified under the "Quality Assurance" Article.
1.5 QUALITY ASSURANCE

A. Fabricator Qualifications: Firm experienced in producing metal fabrications similar to those indicated for this Project with a record of successful in-service performance, and with sufficient production capacity to produce required units without delaying the Work.

B. Welding: Qualify procedures and personnel according to the following:
   1. AWS D1.1, "Structural Welding Code--Steel."
   2. AWS D1.3, "Structural Welding Code--Sheet Steel."
   3. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone re-certification.

PART 2 - PRODUCTS

2.1 METALS, GENERAL

A. Metal Surfaces, General: Provide materials with smooth, flat surfaces, unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

2.2 FERROUS METALS

A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
   1. Galvanized finish for exterior installations and where indicated.

B. Stainless-Steel Sheet, Strip, Plate, and Flat Bars: ASTM A 666, Type 304.

C. Rolled-Steel Floor Plate: ASTM A 786/A 786M, rolled from plate complying with ASTM A 36/A 36M or ASTM A 283/A 283M, Grade C or D.

2.3 FASTENERS

A. General: Unless otherwise indicated, provide Type 304 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633, Class Fe/Zn 5, at exterior walls. Provide stainless-steel fasteners for fastening aluminum. Select fasteners for type, grade, and class required.

B. High-Strength Bolts, Nuts, and Washers: ASTM A 325, Type 1, heavy hex steel structural bolts; ASTM A 563 heavy hex carbon-steel nuts; and ASTM F 436 hardened carbon-steel washers.

C. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307, Grade A; with hex nuts, ASTM A 563; and, where indicated, flat washers.

D. Stainless-Steel Bolts and Nuts: Regular hexagon-head annealed stainless steel bolts, nuts and, where indicated, flat washers; ASTM F 593 for bolts and ASTM F 594 for nuts, Alloy Group 1.

E. Anchor Bolts: ASTM F 1554, Grade 36.
   1. Provide hot-dip or mechanically deposited, zinc-coated anchor bolts where item being fastened is indicated to be galvanized.
F. Eyebolts: ASTM A 489.

G. Machine Screws: ASME B18.6.3.


I. Wood Screws: Flat head, ASME B18.6.1.


L. Expansion Anchors: Anchor bolt and sleeve assembly with capability to sustain, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.

M. Toggle Bolts: FS FF-B-588, tumble-wing type, class and style as required.

N. Chemical Anchors: Two-part epoxy systems with impacted bolt, rod or anchor as follows:
   1. Concrete Anchor: Epoxy capsule system similar to Hilti HVA Adhesive Anchor System, Ramset Chemset anchor system, or approved equal.
   2. Masonry Anchor: Epoxy injection system similar to Hilti HIT C-100 System.

2.4 MISCELLANEOUS MATERIALS

A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

B. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with performance requirements of FS TT-P-664, selected for good resistance to normal atmospheric corrosion, compatibility with finish paint system indicated, and capability to provide a sound foundation for field-applied topcoats despite prolonged exposure.


D. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

2.5 FABRICATION, GENERAL

A. Shop Assembly: Preassemble items in shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.

B. Form metal fabrications from materials of size, thickness, and shapes indicated but not less than needed to comply with performance requirements indicated. Work to dimensions indicated or
accepted on Shop Drawings, using proven details of fabrication and support. Use type of materials indicated or specified for various components of each metal fabrication.

C. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch, unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

D. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

E. Form exposed work true to line and level with accurate angles and surfaces and straight edges.

F. Weld corners and seams continuously to comply with the following:
   1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
   2. Obtain fusion without undercut or overlap.
   3. Remove welding flux immediately.
   4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

G. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) screws or bolts, unless otherwise indicated. Locate joints where least conspicuous.

H. Fabricate seams and other connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

I. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.

J. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.
   1. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors, 1/8 by 1-1/2 inches, with a minimum 6-inch embedment and 2-inch hook, not less than 8 inches from ends and corners of units and 24 inches o.c., unless otherwise indicated.

2.6 METAL LADDERS

A. General:
   1. Comply with ANSI A14.3, unless otherwise indicated.
   2. For elevator pit ladders, comply with ASME A17.1.
   3. Space siderails 18 inches apart, unless otherwise indicated.
   4. Support each ladder at top and bottom and not more than 60 inches o.c. with welded or bolted brackets, made from same metal as ladder.
      a. Size brackets to support design dead and live loads indicated and to hold centerline of ladder rungs clear of the wall surface by not less than 7 inches.
B. Steel Ladders:
1. Siderails: Continuous, steel channels, with eased edges, spaced 18 inches apart.
2. Rungs: 3/4-inch diameter steel bars, spaced 12 inches o.c.
3. Fit rungs in centerline of siderails; plug-weld and grind smooth on outer rail faces.
4. Provide nonslip surfaces on top of each rung, either by coating rung with aluminum-oxide granules set in epoxy-resin adhesive or by using a type of manufactured rung filled with aluminum-oxide grout.

2.7 LOOSE STEEL LINTELS

A. Fabricate loose structural steel lintels from steel angles and shapes of size indicated for openings and recesses in masonry walls and partitions at locations indicated.

B. Weld adjoining members together to form a single unit where indicated.

C. Size loose lintels for equal bearing of 1-inch per foot of clear span but not less than 8-inches bearing at each side of openings, unless otherwise indicated.

D. Galvanize loose steel lintels located in exterior walls.

2.8 MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Provide steel framing and supports for applications indicated that are not specified in other Sections as needed to complete the Work.

B. Fabricate units from steel shapes, plates, and bars of welded construction, unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction retained by framing and supports. Cut, drill, and tap units to receive hardware, hangers, and similar items.
   1. Equip units with integrally welded anchors for casting into concrete or building into masonry. Furnish inserts if units must be installed after concrete is placed.
      a. Except as otherwise indicated, space anchors 24 inches o.c. and provide minimum anchor units in the form of steel straps 1-1/4 inches wide by 1/4 inch thick by 8 inches long.
   2. Furnish inserts if units are installed after concrete is placed.

2.9 MISCELLANEOUS STEEL TRIM

A. Unless otherwise indicated, fabricate units from steel shapes, plates, and bars of profiles shown with continuously welded joints and smooth exposed edges. Miter corners and use concealed field splices where possible.

B. Provide cutouts, fittings, and anchorages as needed to coordinate assembly and installation with other work.
   1. Provide with integrally welded steel strap anchors for embedding in concrete or masonry construction.

2.10 MISCELLANEOUS FABRICATIONS

A. Sill Caps: Diamond plate formed to detail, 1/4-inch thick.
B. Installation Accessories: Trowelable leveling and patching compounds; latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by manufacturer for applications indicated.
   1. Product: Silpro Masco or equal.

2.11 ROUGH HARDWARE
A. Furnish bent, or otherwise custom-fabricated, bolts, plates, anchors, hangers, dowels, and other miscellaneous steel and iron shapes as required for framing and supporting woodwork, and for anchoring or securing woodwork to concrete or other structures.
B. Fabricate items to sizes, shapes, and dimensions required. Furnish malleable-iron washers for heads and nuts that bear on wood structural connections, and furnish steel washers elsewhere.

2.12 FINISHES, GENERAL
A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
B. Finish metal fabrications after assembly.

2.13 STEEL AND IRON FINISHES
A. Galvanizing: Provide coating for iron and steel fabrications applied by the hot-dip process, 0.05 - 0.09% nickel content, Duragalv by Duncan Galvanizing, or approved equal. Provide thickness of galvanizing specified in referenced standards. Hot-dip galvanize items as indicated to comply with applicable standard listed below:
   1. ASTM A 123/A 123M, for galvanizing both fabricated and unfabricated steel and iron products made of uncoated rolled, pressed, and forged shapes, plates, bars, and strip 0.0299 inch thick or thicker.
   2. ASTM A 153/A 153M, for galvanizing steel and iron hardware.
B. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with minimum requirements indicated below for SSPC surface preparation specifications and environmental exposure conditions of installed metal fabrications:
   1. Exteriors (SSPC Zone 1B): SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
   2. Interiors (SSPC Zone 1A): SSPC-SP 3, "Power Tool Cleaning."
C. Shop Priming: Apply shop primer to uncoated surfaces of metal fabrications, except those with galvanized finishes and those to be embedded in concrete, sprayed-on fireproofing, or masonry, unless otherwise indicated. Comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.
   1. Stripe paint corners, crevices, bolts, welds, and sharp edges.

PART 3 - EXECUTION

3.1 PREPARATION
A. Coordinate and furnish anchorages, setting drawings, diagrams, templates, instructions, and directions for installing anchorages, including concrete inserts, sleeves, anchor bolts, and
miscellaneous items having integral anchors that are to be embedded in concrete or masonry construction. Coordinate delivery of such items to Project site.

B. Set sleeves in concrete with tops flush with finish surface elevations. Protect sleeves from water and concrete entry.

3.2 INSTALLATION, GENERAL

A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.

B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are intended for bolted or screwed field connections.

C. Field Welding: Comply with the following requirements:
   1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
   2. Obtain fusion without undercut or overlap.
   3. Remove welding flux immediately.
   4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag bolts, wood screws, and other connectors.

E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

3.3 ADJUSTING AND CLEANING

A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
   1. Apply by brush or spray to provide a minimum 2.0-mil dry film thickness.

B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

END OF SECTION 055000
SECTION 061000 - ROUGH CARPENTRY

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. Wood blocking and nailers.

B. Related Sections include the following:
   1. Division 07 Section "Building Insulation" for rigid insulation.

1.3 DEFINITIONS

A. Rough Carpentry: Carpentry work not specified in other Sections and not exposed, unless otherwise indicated.

B. Dimension Lumber: Lumber of 2 inches nominal or greater but less than 5 inches nominal in least dimension.

C. Lumber grading agencies, and the abbreviations used to reference them, include the following:
   1. NELMA - Northeastern Lumber Manufacturers Association.
   2. NLGA - National Lumber Grades Authority.
   3. WCLIB - West Coast Lumber Inspection Bureau.
   4. WWPA - Western Wood Products Association.

1.4 SUBMITTALS

A. General: Submit in accordance with Division 01 Section "Submittal Procedures."

B. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.
   1. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Include physical properties of treated materials, both before and after exposure to elevated temperatures when tested according to ASTM D 5516.
   2. For fire-retardant treatments specified to be High-Temperature (HT) type, include physical properties of treated lumber both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency according to ASTM D 5664.
   3. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.
   4. Include copies of warranties from chemical treatment manufacturers for each type of treatment.
C. Research/Evaluation Reports: For the following, showing compliance with building code in effect for Project:
   1. Fire-retardant-treated wood and plywood.
   2. Power-driven fasteners.
   4. Expansion anchors.

1.5 QUALITY ASSURANCE

A. Source Limitations for Fire-Retardant-Treated Wood: Obtain each type of fire-retardant-treated wood product through one source from a single producer for both treatment and fire-retardant formulation.

B. Fire-Test-Response Characteristics: For assemblies with fire-resistance ratings, provide materials and construction identical to those of assemblies tested for fire resistance per ASTM E 119 by a testing and inspecting agency acceptable to authorities having jurisdiction.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Keep materials under cover and dry. Protect against exposure to weather and contact with damp or wet surfaces. Stack plywood and other panels flat. Place spacers between each bundle of lumber, plywood, and panel products to provide air circulation. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.
   2. Products: Subject to compliance with requirements, provide one of the products specified.

2.2 WOOD AND PANEL PRODUCTS, GENERAL

A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, provide lumber that complies with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Provide lumber graded by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.
   1. Factory mark each piece of lumber with grade stamp of grading agency.
   2. For exposed lumber indicated to receive a stained or natural finish, mark grade stamp on end or back of each piece.
   3. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry lumber.
   4. Provide dressed lumber, S4S, unless otherwise indicated.
5. Provide dry lumber with 19 percent maximum moisture content at time of dressing for 2-inch nominal thickness or less, unless otherwise indicated.

2.3 FIRE-RETARDANT-TREATED MATERIALS

A. General: Where fire-retardant-treated materials are indicated, provide materials that comply with performance requirements in AWPA C27 (plywood). Identify fire-retardant-treated wood with appropriate classification marking of UL, U.S. Testing, Timber Products Inspection, or another testing and inspecting agency acceptable to authorities having jurisdiction.
   1. Use treatment for which chemical manufacturer publishes physical properties of treated wood after exposure to elevated temperatures, when tested by a qualified independent testing agency according to ASTM D 5516, for plywood.
   2. Use treatment that does not promote corrosion of metal fasteners.
   3. Use Interior Type A High Temperature (HT), unless otherwise indicated.

B. Kiln-dry material after treatment to a maximum moisture content of 15 percent for plywood. Do not use material that is warped or does not comply with requirements for untreated material.

C. Application: Treat plywood backer boards receiving electrical panels, unless otherwise indicated.

2.4 FRAMING AND MISCELLANEOUS LUMBER

A. General: Provide lumber for support or attachment of other construction, including the following:
   1. Blocking.
   2. Nailers.

B. For items of dimension lumber size, provide Construction, Stud, or No. 2 grade lumber with 19 percent maximum moisture content and any of the following species:
   1. Spruce-pine-fir; NLGA.
   2. Spruce-pine-fir (south); NeLMA, WCLIB, or WWPA.

C. For concealed boards, provide lumber with 19 percent maximum moisture content and the following species and grades:
   1. Spruce-pine-fir (south) or Spruce-pine-fir, Standard or 3 Common grade; NeLMA, NLGA, WCLIB, or WWPA.

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

2.5 FASTENERS

A. General: Provide fasteners of size and type indicated that comply with requirements specified in this Article for material and manufacture.
   1. Where rough carpentry is exposed to weather, in ground contact, in roof area, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M.
   2. For roof and wall sheathing, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M.
B. Nails, Brads, and Staples: ASTM F 1667.


D. Wood Screws: ASME B18.6.1.

E. Lag Bolts: ASME B18.2.1.

F. Bolts: Steel bolts complying with ASTM A 307, Grade A; with ASTM A 563 hex nuts and, where indicated, flat washers.

G. Expansion Anchors: Anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to 6 times the load imposed when installed in unit masonry assemblies and equal to 4 times the load imposed when installed in concrete as determined by testing per ASTM E 488 conducted by a qualified independent testing and inspecting agency.
   2. Material: Stainless steel with bolts and nuts complying with ASTM F 593 and ASTM F 594, Alloy Group 1 or 2.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry to other construction; scribe and cope as needed for accurate fit. Locate nailers, blocking, and similar supports to comply with requirements for attaching other construction.

B. Framing Standard: Comply with AF&PA's "Details for Conventional Wood Frame Construction," unless otherwise indicated.

C. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.

D. Sort and select lumber so that natural characteristics will not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of member or pieces that are too small to use with minimum number of joints or optimum joint arrangement.

E. Do not use panel materials with defects that impair quality of sheathing or pieces that are too small to use with minimum number of joints or optimum joint arrangement.

F. Cut panels at penetrations, edges, and other obstructions of work; fit tightly against abutting construction, unless otherwise indicated.

G. Securely attach rough carpentry and panel work to substrate by anchoring and fastening as indicated, complying with the following:
   1. NES NER-272 for power-driven fasteners.
3. National Evaluation Report No. NER-272 for pneumatic or mechanical driven staples, 
P-Nails, and allied fasteners.

H. Use common wire nails, unless otherwise indicated. Select fasteners of size that will not fully 
penetrate members where opposite side will be exposed to view or will receive finish materials. 
Make tight connections between members. Install fasteners without splitting wood; predrill as 
required.

3.2 WOOD BLOCKING AND NAILER INSTALLATION

A. Install where indicated and where required for attaching other work. Install wood blocking, 
nailers, sleepers to support fixtures, equipment services, heavy trim, grab bars, toilet 
accessories, casework, furnishings, or similar construction. Form to shapes indicated and cut as 
required for true line and level of attached work. Coordinate locations with other work 
involved.

B. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces, 
unless otherwise indicated. Build anchor bolts into masonry during installation of masonry 
work. Where possible, secure anchor bolts to formwork before concrete placement.

C. Roofing Nailers: Install wood nailers of same total thickness as insulation. Anchor perimeter 
nailers to substrate in a manner to resist a force of 75 pounds per linear foot in any direction. 
Top nailer shall be fastened through the lower layers and into metal deck.

3.3 Z-FURRING AND RIGID INSULATION INSTALLATION

A. Fasten Z-furring members securely through gypsum sheathing into cold-formed steel framing. 
Fasteners shall be spaced no greater than 12 inches on center.

B. Install J-shaped furring at the base of walls, over windows and similar terminations, concealing 
edges of rigid insulation, and providing plywood sheathing edge support.

C. Install rigid insulation provided under Division 07 "Building Insulation" horizontally and hold 
in place with Z-furring members spaced 24 inches o.c. vertically. Butt edges and ends tightly. 
Butt insulation to window units and blocking.

D. Fill cracks and open gaps in insulation with minimal expanding foam crack sealer.

END OF SECTION 061000
SECTION 062000 - FINISH CARPENTRY

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. Exterior hardboard soffits.
   2. Window trim.

B. Related Sections include the following:
   1. Division 09 Section "Painting" for priming and back-priming of finish carpentry.

1.3 DEFINITIONS

A. Inspection agencies, and the abbreviations used to reference them, include the following:
   1. NHLA - National Hardwood Lumber Association.

1.4 SUBMITTALS

A. General: Submit in accordance with Division 01 Section "Submittal Procedures."

B. Product Data: For each product. Include construction details, material descriptions, dimensions of individual components and profiles, textures, and colors.

1.5 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install interior finish carpentry until building is enclosed and weatherproof, wet work in space is completed and nominally dry, and provisions are made to maintain temperature and relative humidity at occupancy levels during the remainder of the construction period.

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

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

A. Lumber: DOC PS 20 and applicable grading rules of inspection agencies certified by the American Lumber Standards' Committee Board of Review.
1. Factory mark each piece of lumber with grade stamp of inspection agency indicating grade, species, moisture content at time of surfacing, and mill.
2. For exposed lumber, mark grade stamp on end or back of each piece.

B. Hardwood Plywood: HPVA HP-1, "Interim Voluntary Standard for Hardwood and Decorative Plywood", 7 ply core, no voids, Grade A veneers.

2.2 EXTERIOR SOFFITS

A. Hardboard Soffits: Primed hardboard, complying with AHA A135.6, with panel manufacturer's standard exterior enamel primer.

B. Type: 1/2-inch- thick (or as required to match existing) flat panels, smooth.

2.3 WINDOW TRIM

A. Window Sills (Stools): Fabricate to Custom Grade, from hardwood veneer plywood edged with solid hardwood, in profile and thickness indicated, for opaque finish.

2.4 MISCELLANEOUS MATERIALS

A. Fasteners for Exterior Finish Carpentry: Provide nails or screws of the following materials, in sufficient length to penetrate minimum of 1-1/2 inches into substrate, unless otherwise recommended by manufacturer:
   1. Stainless steel.
   2. Hot-dip galvanized steel.
   4. Prefinished aluminum in color to match stain, where face fastening of material to receive stain is unavoidable.

B. Fasteners for Interior Finish Carpentry: Nails, screws, and other anchoring devices of type, size, material, and finish required for application indicated to provide secure attachment, concealed where possible.
   1. Where finish carpentry materials are exposed in areas of high humidity, provide fasteners and anchorages with hot-dip galvanized coating complying with ASTM A 153/A 153M.

C. Sealants: Comply with requirements in Division 07 Section "Joint Sealants" for materials required for sealing siding work.

2.5 FABRICATION

A. Quality Standards: Unless otherwise indicated, comply with AWI's "Architectural Woodwork Quality Standards" for grades, construction, finishes, and other requirements as follows:
   1. Standing and Running Trim: Section 300, Custom Grade.

B. Wood Moisture Content: Comply with requirements of specified inspection agencies and with manufacturer's written recommendations for moisture content of finish carpentry at relative humidity conditions existing during time of fabrication and in installation areas.

C. Ease edges of lumber less than 1 inch in nominal thickness to 1/16-inch radius and edges of lumber 1 inch or more in nominal thickness to 1/8-inch radius.
PART 3 - EXECUTION

3.1 EXAMINATION

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

B. Examine finish carpentry materials before installation. Reject materials that are wet, moisture damaged, and mold damaged.

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

3.2 PREPARATION

A. Clean substrates of projections and substances detrimental to application.

B. Before installing interior finish carpentry, condition materials to average prevailing humidity in installation areas for a minimum of 24 hours, unless longer conditioning is recommended by manufacturer.

3.3 INSTALLATION, GENERAL

A. Do not use materials that are unsound, warped, improperly treated or finished, inadequately seasoned, or too small to fabricate with proper jointing arrangements.
   1. Do not use manufactured units with defective surfaces, sizes, or patterns.

B. Install finish carpentry level, plumb, true, and aligned with adjacent materials. Use concealed shims where necessary for alignment.
   1. Scribe and cut finish carpentry to fit adjoining work. Refinish and seal cuts as recommended by manufacturer.
   2. Countersink fasteners, fill surface flush, and sand where face fastening is unavoidable.
   3. Install to tolerance of 1/8 inch in 96 inches for level and plumb. Install adjoining finish carpentry with 1/32-inch maximum offset for flush installation and 1/16-inch maximum offset for reveal installation.
   4. Coordinate finish carpentry with materials and systems in or adjacent to it. Provide cutouts for mechanical and electrical items that penetrate exposed surfaces of finish carpentry.
   5. Refer to Division 09 Section "Painting" for final finishing of finish carpentry.

3.4 INTERIOR STANDING AND RUNNING TRIM

A. Install with minimum number of joints practical, using full-length pieces from maximum lengths of lumber available. Do not use pieces less than 24 inches long, except where necessary. Stagger joints in adjacent and related standing and running trim. Cope at returns and miter at corners to produce tight-fitting joints with full-surface contact throughout length of joint. Use scarf joints for end-to-end joints. Plane backs of casings to provide uniform thickness across joints where necessary for alignment.
   1. Install trim after gypsum board joint finishing operations are completed.
   2. Drill pilot holes in hardwood before fastening to prevent splitting. Fasten to prevent movement or warping. Countersink fastener heads on exposed carpentry work and fill holes.
3.5 ADJUSTING

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

3.6 CLEANING

A. Clean finish carpentry on exposed and semiexposed surfaces. Touch up factory-applied finishes to restore damaged or soiled areas.

END OF SECTION 062000
SECTION 072100 - BUILDING 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. This Section includes the following:
   1. Adjust list below to suit Project. Delete applications such as cavity wall and safing insulation that are specified in other Sections.
   2. Concealed building insulation.
   3. Foam-in-place insulation sealant.
   4. Insulation in louver frame.

B. Related Sections include the following:
   1. Division 07 Section "Single-Ply Membrane Roof Patching" for insulation specified as part of roofing construction.
   2. Division 09 Section "Gypsum Board Assemblies" for provision of interior acoustical insulation in metal-framed assemblies.
   3. Division 22 and 23 Sections insulation on pipes, ducts, and mechanical equipment.

C. Products furnished, but not installed, under this Section include the following:
   1. Rigid insulation installed in z-furring at exterior walls, installed under Division 06 Section "Rough Carpentry."

1.3 DEFINITIONS

A. Thermal Resistivity: Where the thermal resistivity of insulation products are designated by "r-values," they represent the reciprocal of thermal conductivity (k-values). Thermal conductivity is the rate of heat flow through a homogenous material exactly 1 inch thick. Thermal resistivities are expressed by the temperature difference in degrees F between the two exposed faces required to cause one BTU to flow through one square foot per hour at mean temperatures indicated.

1.4 SUBMITTALS

A. General: Submit in accordance with Division 01 Section "Submittal Procedures."

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

1.5 DELIVERY, STORAGE, AND HANDLING

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

PART 2 - PRODUCTS

2.1 MANUFACTURERS

   A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.
   2. Products: Subject to compliance with requirements, provide one of the products specified.

2.2 INSULATING MATERIALS

   A. General: Provide insulating materials that comply with requirements and with referenced standards.
   1. Preformed Units: Sizes to fit applications indicated; selected from manufacturer's standard thicknesses, widths, and lengths.

   B. Rigid Insulation: Extruded-polystyrene board insulation, ASTM C 578, Type IV, 1.60 lb./cu. ft., unless otherwise indicated, with maximum flame-spread and smoke-developed indices of 75 and 450, respectively:
   1. Thickness: 2 inch, unless otherwise noted.
   2. Edges of rigid insulation shall be square edges for insulation installed in z-furring.
   3. Products:
      a. Styrofoam; Dow Chemical Company.
      b. Foamular 250; Owens Corning.
      c. GreenGuard; Pactiv Building Products (formerly Tenneco Building Products).

   C. Unfaced, Glass-Fiber Blanket (Batt) Insulation: ASTM C 665, Type I (blankets without membrane facing); consisting of fibers manufactured from inorganic glass bonded with thermosetting resin; with maximum flame-spread and smoke-developed indices of 25 and 50, respectively; passing ASTM E 136 for combustion characteristics.
   1. Full Depth of cavity. Where cavity requires insulation that is thicker than standard size, install next larger size and compress into cavity.
   2. Manufacturers:
      a. CertainTeed Corporation.
      b. Owens Corning.

   D. Foam-In-Place Insulation Sealant: On-site foam-in-place insulation sealant shall be Class 1 foam.
   1. Products:
2.3 INSULATION FASTENERS

A. Insulation Support Anchor: 25 gage, galvanized continuous metal support strip with pre-punched tabs at 8 inches on center.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for Sections in which substrates and related work are specified and other conditions affecting performance.

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

3.2 PREPARATION

A. Clean substrates of substances harmful to insulations or vapor retarders, including removing projections capable of puncturing vapor retarders or of interfering with insulation attachment.

3.3 INSTALLATION, GENERAL

A. Comply with insulation manufacturer's written instructions applicable to products and application indicated.

B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed at any time to ice and snow.

C. Extend insulation in thickness indicated to envelop entire area to be insulated. Cut and fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.

D. Apply single layer of insulation to produce thickness indicated, unless multiple layers are otherwise shown or required to make up total thickness.

3.4 INSTALLATION OF GENERAL BUILDING INSULATION

A. Apply insulation units to substrates by method indicated, complying with manufacturer's written instructions. If no specific method is indicated, bond units to substrate with adhesive or use mechanical anchorage to provide permanent placement and support of units. Fill voids in thermal envelope not covered by the work of other sections.

B. See Division 06 Section "Rough Carpentry" for rigid insulation installed with Z-furring installation.

C. Install glass-fiber blankets in cavities formed by framing members according to the following requirements:
1. Use blanket widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill cavity, provide lengths that will produce a snug fit between ends.

2. Place blankets in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.

3. For metal-framed wall cavities where cavity heights exceed 96 inches, support unfaced blankets mechanically and support faced blankets by taping stapling flanges to flanges of metal studs.

4. Install insulation support anchors at top of cavity and spaced 5 feet on center full length of each cavity.

D. Stuff mineral-fiber insulation into miscellaneous voids and cavity spaces where shown.

3.5 INSTALLATION OF FOAM-IN-PLACE INSULATION

A. Install foam-in-place insulation sealant to a minimum depth of 1 inch, sealing construction cracks and gaps where outside air and cold can infiltrate, providing an airtight building envelope.

3.6 INSULATION OF LOUVER FRAMES

A. Exterior Louver Frames: Louver frames in exterior walls shall be filled with insulation. Cut rigid insulation slab the full width of frame throat and insert continuous slab into frame head, jambs and sills before frame is installed. After frame is installed, fill remaining gap between rigid insulation and air/vapor barrier with foam-in-place insulation.

3.7 PROTECTION

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

END OF SECTION 072100
SECTION 072500 - WEATHER BARRIERS

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. Weather barrier membrane.
   2. Seam tape.
   3. Flexible flashing membrane.
   4. Fasteners.

B. Related Sections include the following:
   1. Division 06 Section "Rough Carpentry" for wall sheathing.

1.3 REFERENCES

A. ASTM International
   2. ASTM E 84; Test Method for Surface Burning Characteristics of Building Materials
   3. ASTM E 96; Test Method for Water Vapor Transmission of Materials

B. AATCC - American Association of Textile Chemists & Colorists
   1. Test Method 127 Water Resistance: Hydrostatic Pressure Test

1.4 SUBMITTALS

A. General: Submit in accordance with Division 01 Section "Submittal Procedures."

B. Product Data: Submit manufacturer's current technical literature for each component. Include manufacturer's installation instructions showing the recommended procedures and sequence of installation of weather barrier.

C. Shop Drawings: Submit manufacturer installation details for terminations, attachment and sealing to adjacent construction, including aluminum entrances, and flanged aluminum windows.

D. Manufacturer's Field Service: Manufacturer's Representative shall be present at the following times for review of installations:
   1. Preinstallation conference.
   2. Commencement of Work: Manufacturer's Representative shall be present for the window flashing installation for the first ten windows.
   3. Review of installation areas, including window installation and tie-in with air/vapor barrier, before covering work of this Section with exterior finishes.
E. Manufacturer's Field Service Reports: Provide site reports from authorized field service representative, indicating observation of weather barrier assembly installation.

1.5 QUALITY ASSURANCE

A. Installer Qualifications:
   1. Installer shall have experience with installation of specified weather barrier assemblies under similar conditions.
   2. Installation shall be in accordance with weather barrier manufacturer's installation guidelines and recommendations.

B. Source Limitations: Provide weather barrier and accessory materials produced by single manufacturer.

C. Mockup: Build mockup to set quality standards for materials and execution.
   1. Prepare mockups for review at Preinstallation Conference.
   2. Build mockup of typical exterior wall area in metal wall panels at Type A installed in the weather barrier and Type B windows installed flexible flashing membrane at locations as directed by Architect.
   3. Install mockup using approved weather barrier assembly including fasteners, flashing, tape and related accessories per manufacturer's current printed instructions and recommendations. Include sample of flashing and sealing around window flanges, and sample tie-in to air/vapor barrier.
   4. Manufacturer's representative of the weather barrier shall be present for preparation of mockup.
   5. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups, unless such deviations are specifically approved by Architect in writing.
   6. Contact manufacturer's designated representative prior to weather barrier assembly installation, to perform required mockup visual inspection and analysis as required for warranty.
   7. Approved mockup may become part of the work.

D. Preinstallation Conference: Conduct conference at Project site two weeks prior to start of weather barrier installation. Comply with requirements in Division 01 Section "Project Management and Coordination." Review methods and procedures related to roofing system including, but not limited to, the following:
   1. Meet with Owner, Architect, weather barrier Installer, weather barrier manufacturer's designated representative, sheathing Installer, air/vapor barrier membrane Installer, and installers whose work interfaces with or affects weather barrier including installers of metal wall panels, aluminum entrance doors, windows, and glazed aluminum curtain wall.
   2. Review all related project requirements and submittals, status of substrate work and preparation, temporary weather protection, forecasted weather conditions, areas of potential conflict and interface, availability of weather barrier assembly materials and components, and coordinate methods, procedures and sequencing requirements for full and proper installation, integration and protection.
   3. Review interface and compatibility of flashings tapes with air/vapor barrier membrane system.
   4. Review mock-up.
5. Document proceedings, including corrective measures and actions required, and furnish copy of record to each participant.
6. Provide 5 business days minimum advance notice to participants prior to convening preinstallation conference.

1.6 DELIVERY, STORAGE AND HANDLING

A. Deliver weather barrier materials and components in manufacturer's original, unopened, undamaged containers with identification labels intact.

B. Store weather barrier materials as recommended by weather barrier manufacturer.

1.7 SCHEDULING

A. Review requirements for sequencing of installation of weather barrier assembly with installation of metal wall panels, windows, aluminum entrance doors, glazed aluminum curtain walls, and trim flashings to provide a weather-tight barrier assembly.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Weather Barrier: Wall Shield; VaproShield LLC; manufacturer's representative: Robert McEarhern, InterSource Roofing Sales, LLC, Hampstead, NH; phone: (603) 494-3757. Spun bonded, high-density polypropylene underlayment having the following properties:
   1. Thickness and Weight: 0.023 inches thick and 5.161 oz./sq. yd.
   2. Tensile Strength: ASTM D 882, pass.
      a. Permeance: 212 perms.
      b. Permeability: 595 perm inches.
   5. Low Temperature Bend: AC38, Pass.
      a. Flame Spread Index: Class A.
      b. Smoke-Developed Index: Class A.

B. Flexible Flashing Membrane: Composite, self-adhesive, flashing product consisting of a pliable, butyl rubber based compound, bonded to a high-density, cross-laminated polyethylene film to produce an overall thickness of not less than 0.030 inch. (Note the specified weather barrier requires butyl rubber based sheet to assure proper adhesion. Rubberized asphalt sheet is not acceptable. Cut membrane into required flashing widths.)
   1. Products:
      a. Carlisle Coatings & Waterproofing; Dri-Start HR.
   2. Locations:
      a. Perimeter of weather barrier tying into air/vapor barrier system.
      b. Flexible flashing membrane covering plywood sheathing and tying into air/vapor barrier system for Type B windows and for Type A windows with small area of plywood and siding above and below window units within masonry.
3. Termination Mastic: Two part, elastomeric, cold-applied, trowel grade material designed for use with self-adhered membranes and tapes.

2.2 ACCESSORIES

A. Weather Barrier Flashing Tapes: For use to secure weather barrier to itself and to substrates.
   2. Double-Sided Sealing Tape: VaproTape (Double-Sided), 30 mil thick, 1 inch wide.

B. Weather Barrier Fasteners for Wood Sheathing: Minimum No. 12 gage, corrosion-resistant, steel or stainless steel nails having a minimum 3/8-inch diameter head.

C. Caulks and Sealants: As recommended by weather barrier manufacturer to maintain watertight conditions.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and surface conditions, with Installer present, to verify that surfaces are sound, dry, even, and free of oil, grease, dirt, other contaminants that are detrimental to the adhesion of flexible flashing membrane, and for compliance with requirements and other conditions affecting performance of weather barrier.
   1. Plywood Sheathing: Verify that boards are sufficiently attached with appropriate screws at proper spacing.

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

3.2 INSTALLATION OF WEATHER BARRIER AND FLEXIBLE FLASHING MEMBRANE

A. General: Install weather barrier and flexible flashing membrane over exterior face of exterior wall substrate in accordance with manufacturer's recommendations.
   1. Apply materials within manufacturer's requirements for substrate and ambient temperatures and for weather conditions.
   2. Do not apply to wet or frozen substrates.
   3. Install membrane in tight intimate contact with substrate, without wrinkles and fishmouths.
   4. Roll entire surface of flexible flashing membrane firmly to assure full adhesion to substrates.
   5. Roll flashings tapes firmly to assure full adhesion to substrates.

B. Install weather barrier in a horizontal manner starting at lower portion of wall surface with subsequent layers installed in a shingling manner to overlap lower layers. Lap vertically a minimum of 6 inches with taped joints. Do not place vertical laps above openings. Mechanically fasten top and bottom 24 inches o.c. Maintain weather barrier, smooth, plumb and level.
   1. Install weather barrier after windows have been installed in accordance with manufacturer's requirements as detailed for retrofit window flashing.
      a. Install 9 inch wide Vaproflashing strip at sill, extending 9 inches beyond jambs and adhere to flange with continuous double-sided tape.
b. Install retrofit corner membrane at each end of sill and adhere with double-sided tape.
c. Install 9 inch wide Vaproflashing strip at jambs, and adhere to flange and wall sheathing with continuous double-sided tape.
d. Install retrofit corner membrane at each top corner of window and adhere to flange and wall sheathing with continuous double-sided tape.
e. Install 9 inch wide Vaproflashing strip across head of window, extending 9 inches beyond jambs and adhere to flange and wall sheathing with continuous double-sided tape.
f. Apply weather barrier to wall, running top edge under sill Vaproflashing strip.
g. Apply weather barrier to wall in shingle fashion, extending barrier to edge of window jambs. Seal edge with continuous double-sided tape.
h. Apply weather barrier to wall in shingle fashion above window, extending barrier to edge of window jambs. Seal edge with continuous double-sided tape.

2. Where weather barrier terminates at perimeter of plywood, stop weather barrier at edge of plywood and seal edge to sheathing with continuous double-sided tape. Nail edge 12 inches on center through the barrier and tape.
a. Apply flexible flashing membrane to seal edge of plywood and insulation, making a watertight connection. Lap flexible flashing on to face of air/vapor barrier a minimum of 4 inches and seal edge with termination mastic. Lap flexible flashing on to face of air/vapor barrier a minimum of 4 inches and seal edge with termination mastic.

C. Install flexible flashing membrane in tight intimate contact with substrate without stretching. Bend membrane to fit tightly into inside corners, without gaps and without stretching membrane.
1. Apply and firmly adhere flexible flashing membrane sheets in a "shingle" fashion, working from base of wall upwards, so laps shed water naturally without interception by a sheet edge, unless that edge is sealed with permanently flexible termination mastic.
2. Accurately align sheets and maintain uniform overlap seams not less than 2-1/2 inches at edges and not less than 4 inches at ends; stagger end laps. Overlap and seal seams to ensure water tight installation. Roll sheets firmly to enhance adhesion to substrate.
3. Lap membrane to perimeter of window with not less than 1 inch of full contact on to flange. At corners of windows where membrane strips overlap, roll corners in intimate contact with flanges. Apply termination mastic at each corner, filling ay gaps and sealing membrane edges to window nailing fin.
4. Apply flexible flashing membrane to seal edge of plywood and insulation, making a watertight connection. Lap flexible flashing on to face of air/vapor barrier a minimum of 4 inches and seal edge with termination mastic. Lap flexible flashing on to face of air/vapor barrier a minimum of 4 inches and seal edge with termination mastic.

3.3 FIELD QUALITY CONTROL

A. Notify manufacturer's designated representative to obtain required periodic observations of weather barrier assembly installation.

3.4 PROTECTION

A. Protect installed weather barrier from damage.

END OF SECTION 072500
SECTION 072713 - SELF-ADHERING SHEET AIR/VAPOR BARRIERS

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 self-adhering, vapor-retarding, modified bituminous sheet air/vapor barriers on glass-mat gypsum sheathing board.

1.3 PERFORMANCE REQUIREMENTS

A. Air/Vapor Barrier: Shall be designed and constructed as a continuous air barrier to control air leakage into, or out of the conditioned space, and to act as a watertight barrier to discharge to the outside any incidental condensation or water penetration. Air/vapor barrier membrane shall accommodate movements of building materials by providing expansion and control joints as required, with appropriate air seal materials at such locations, changes in substrate and perimeter conditions. Barrier shall be continuous with all joints made air-tight and shall have the following characteristics:

1. Air Barrier Assembly Air Leakage: Shall not exceed 0.04 cfm/sq. ft. of surface area at 1.57 lbf/sq. ft.; ASTM E 283.

2. Water Vapor Permeance for Self-Adhering Sheet Membrane: ASTM E 96, Water Method; not exceeding 0.05 perms.

3. Water Vapor Permeance for Fluid-Applied Membrane: Shall not exceed 0.05 perms for 40-mil dry coating grams/ft²/hr in Hg when tested in accordance with ASTM E 96.

4. Liquid Water Absorption: ASTM D 570; less than 0.12 percent weight-gain maximum after 48-hour immersion at 70 deg F.

5. Shall be capable of withstanding positive and negative combined design wind, fan and stack pressures on envelope without damage or displacement; shall transfer load to structure; and shall not displace adjacent materials under full load.

6. Shall be joined in an airtight, flexible manner to the air/vapor barrier surface/material of adjacent systems, allowing for relative movement of systems due to thermal and moisture variations or creep. Air/vapor barrier shall be connected to the following system components:
   a. Windows penetrating exterior walls.
   b. Different wall systems.
   c. Wall and soffit intersections.

B. Air/Vapor Barrier Penetrations: All penetrations of the air/vapor barrier system and paths of air infiltration or exfiltration shall be made airtight to not less than the rating of the air/vapor barrier system.

1.4 SUBMITTALS

A. General: Submit in accordance with Division 01 Section "Submittal Procedures."
B. Complete Shop Drawings and Product Data shall be submitted to the Architect at least 21 days before the Preinstallation Conference. No Preinstallation Conference will be held and no material shall be applied until submittals are complete and released for construction.

C. Product Data: For each type of product indicated. Include technical data; certified test results; manufacturer's printed instructions for evaluating, preparing and treating substrate; and installation instructions, including temperature and other limitations of installation.

D. Shop Drawings: Show locations and extent of air/vapor barrier. Include details of intersections with other envelope systems and materials; details of membrane counter-flashings; details for substrate joints and cracks, counterflashing strip, and penetrations; details for inside and outside corners; details showing how expansion and control joints will be bridged; details for terminations, and tie-ins with adjoining construction. Identify materials, primers, sealers, support materials and other items detailed, including manufacturer's product names. Show relationship to adjacent materials, sequence of installation and materials, and methods for sealing penetrations. Shop Drawings shall include connection details between the air/vapor barrier and for the following exterior envelope components as applicable to the Project:

1. Windows.
2. Wall and soffit assemblies.
3. Wall penetrations by pipes, ducts and conduits.
4. Typical gypsum based sheathing joint treatment, outside corner, inside corner.
5. Square tube, steel angle, channels, knife plates, structural WF beam and tube shape penetration sealing as applicable.
6. Detailing a penetration where gypsum sheathing has a wide gap from the penetration.
7. Corner and edge damage preparation of gypsum based sheathing (sheet metal cover plate adhered to board) to receive A/V barrier membrane.
8. Horizontal deflection joint and vertical control joint details in gypsum based sheathing, as applicable.
9. Mechanical louvers and vent penetrations.

E. Product Certificates: For air/vapor barrier system, certifying compatibility of air/vapor barrier system and accessory materials with Project materials that connect to or that come in contact with air/vapor barrier system; signed by product manufacturer.

F. Qualification Data: For Applicator signed by manufacturer certifying that Applicators comply with requirements.

G. Product Test Reports: From a qualified independent testing agency indicating and interpreting test results of air/vapor barrier system for compliance with requirements, based on comprehensive testing of current air/vapor barrier system in accordance with ASTM E 2178.

H. Daily Reports: Installer shall maintain daily reports at the Project site. Copies of reports shall be submitted weekly.

1.5 QUALITY ASSURANCE

A. Applicator Qualifications: A firm experienced in applying air/vapor barrier materials similar in material, design, and extent to those indicated for this Project, whose work has resulted in applications with a record of successful in-service performance and is approved in writing by air/vapor barrier membrane manufacturer.
B. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination." Review methods and procedures related to air/vapor barrier membrane installation.

1. Complete Shop Drawings and Product Data shall be submitted to the Architect at least 21 days before the Preinstallation Conference.
2. Meet with Owner, Architect, air/vapor barrier membrane Installer, air/vapor barrier membrane system manufacturer's representative, testing agency representative and installers whose work interfaces with or affects air/vapor barrier membrane including, but not limited to, installers of exterior sheathing, exterior wall assemblies, window assemblies, storefronts and aluminum-framed entrances, and flashings and trim.
3. Review air/vapor barrier requirements including surface preparation, substrate condition and pretreatment, minimum substrate curing period, forecasted weather conditions, special details and sheet flashings, mockups, installation procedures, sequence of installation, testing and inspecting procedures, and protection and repairs.
4. Review approved submittals.
5. Review cold formed metal framing and sheathing installation report.
6. Review methods and procedures related to air/vapor barrier membrane installation, including manufacturer's written instructions, including surface preparation and substrate condition and pretreatment, if applicable.
7. Review compatibility of air/vapor barrier materials with building envelope materials.
8. Review and coordinate sequence of installation with adjacent materials.
9. Review interface of flashings and trim with air/vapor barrier system.
10. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
11. Review cold formed metal framing and sheathing installation report.
12. Review procedures for quality assurance, testing, and corrective procedures.
13. Review daily report requirements.
14. Review construction schedule for subsequent work covering air/vapor barrier.
15. Review coordination of inspection of exterior air/vapor barrier before covering.
16. Review coordination of inspection of interior side of sheathing for holes before interior finishes are applied.
17. Review procedures for correcting holes made by screws missing framing during application of z-furring and other applicable wall attachments.
18. Review requirements for exterior insulation being in place before heating of building interior.
19. Document proceedings, including corrective measures and actions required, and furnish copy of record to each participant.
20. Provide 5 business days minimum advance notice to participants prior to convening preinstallation conference.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store liquid materials in their original undamaged packages in a clean, dry, protected location and within temperature range required by air/vapor barrier manufacturer. Packages shall be labeled with manufacturer's name, product brand name and type, date of manufacture, and shelf life.

B. Remove and replace liquid materials that cannot be applied within their stated shelf life.

C. Store rolls according to manufacturer's written instructions.
D. Protect stored materials from direct sunlight.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Apply air/vapor barrier within the range of ambient and substrate temperatures recommended by air/vapor barrier manufacturer. Protect substrates from environmental conditions that affect performance of air/vapor barrier. Do not apply air/vapor barrier to a damp or wet substrate or during snow, rain, fog, or mist.

1.8 DAILY REPORTS

A. Installer shall maintain daily reports of all air/vapor barrier installation activity. As a minimum, report shall contain the following:
1. Weather conditions, temperature.
2. Substrate condition, defects and corrective action.
3. Identify area of building where application took place.
4. List of certified installers at the site.
5. Temperature at time of application and cure time of primers before application of membrane.
6. Temperature at time of application of membrane.
7. Photo of installed area.

1.9 CONTRACTOR FIELD TESTING

A. Air Leakage: Conduct daily qualitative air leak test of installed air/vapor barrier system. Test system at various locations to provide a representative sample of the work installed that day.
2. Test site locations shall include the following:
   a. Sheathing joints.
   b. Edges and intersections of transition membranes.
   c. Corners of windows.
   d. Penetrations.

1.10 WARRANTY

A. General: Special warranty specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

B. Manufacturer's System Warranty: Written system warranty, signed by air/vapor barrier membrane manufacturer agreeing to replace air/vapor barrier system materials and accessories which fail to achieve specified air tightness and vapor seal, exhibit loss of adhesion or cohesion, or do not cure within specified warranty period.
1. Warranty Period: Manufacturer's standard warranty, not less than five years from date of Substantial Completion.
PART 2 - PRODUCTS

2.1 SELF-ADHERING SHEET AIR/VAPOR BARRIER

A. Modified Bituminous Sheet: 40-mil-thick, self-adhering sheet consisting of 36 mils of rubberized asphalt laminated to a 4-mil-thick, polyethylene film with release liner on adhesive side and formulated for application with primer that complies with VOC limits of authorities having jurisdiction.

1. Products: Subject to compliance with requirements, provide one of the following:
   a. Carlisle Coatings & Waterproofing; CCW-705 Air & Vapor Barrier.

2. Physical and Performance Properties:
   a. Membrane Air Permeance: Not to exceed 0.004 cfm/sq. ft. of surface area at 1.57-lbf/sq. ft. pressure difference; ASTM E 2178.
   b. Tensile Strength: 500 psi minimum; ASTM D 412, Die C, modified.
   e. Puncture Resistance: 40 lbf minimum; ASTM E 154.
   f. Water Absorption: 0.12 percent weight-gain maximum after 48-hour immersion at 70 deg F; ASTM D 570.
   g. Vapor Permeance: 0.05 perms; ASTM E 96, Water Method.

2.2 AUXILIARY MATERIALS

A. General: Auxiliary materials recommended by air/vapor barrier manufacturer for intended use and compatible with air/vapor barrier. Liquid-type auxiliary materials shall comply with VOC limits of authorities having jurisdiction.

B. Primer: Liquid waterborne primer recommended for substrate by manufacturer of air/vapor barrier material.

C. Counterflashing Strip: Modified bituminous 40-mil-thick, self-adhering sheet consisting of 32 mils of rubberized asphalt laminated to an 8-mil-thick, crosslaminated polyethylene film with release liner backing.

1. Products:
   a. CCW-705-TWF; Carlisle Coatings & Waterproofing, Inc.
   b. Perm-A-Barrier Wall Flashing; Grace Construction Products.

D. Modified Bituminous Strip: Vapor-retarding, 40-mil-thick, smooth-surfaces, self-adhering; consisting of 36 mils of rubberized asphalt laminated to a 4-mil-thick polyethylene film with release liner backing.

E. Termination Mastic: Cold fluid-applied elastomeric liquid; trowel grade.

F. Substrate Patching Membrane: Manufacturer's standard trowel-grade substrate filler.

G. Adhesive and Tape: Air/vapor barrier manufacturer's standard adhesive and pressure-sensitive adhesive tape.

H. Stainless-Steel Sheet: ASTM A 240/A 240M, Type 304, 0.0187 inch thick, and Series 300 stainless-steel fasteners.
I. Sprayed Polyurethane Foam Sealant: 1- or 2-component, foamed-in-place, polyurethane foam sealant, 1.5 to 2.0 lb/cu. ft. density; flame spread index of 25 or less according to ASTM E 162; initial R-Value (at 1 inch) of not less than 7; with primer and noncorrosive substrate cleaner recommended by foam sealant manufacturer.

J. Modified Bituminous Transition Strip: Vapor-retarding, 40-mil- thick, smooth-surfaced, self-adhering; consisting of 36 mils of rubberized asphalt laminated to a 4-mil- thick polyethylene film with release liner backing.

K. Joint Sealant: ASTM C 920, single-component, neutral-curing silicone; Class 100/50 (low-modulus), Grade NS, Use NT related to exposure, and, as applicable to joint substrates indicated, Use O. Comply with Division 07 Section "Joint Sealants."

L. Detailing Metal: 0.032 inch thick aluminum sheet.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions as each area is completed for air/vapor barrier system application, with Applicator present, to verify that surfaces are sound, dry, even, and free of oil, grease, dirt, excess mortar or other contaminants that are detrimental to the adhesion of air/vapor barrier system materials.

1. Gypsum Sheathing: Verify that boards are sufficiently stabilized with corners and edges fastened with appropriate screws at proper spacing. Verify sheathing edges are not screwed to deflection tracks.

2. If unacceptable conditions are encountered, prepare written report, endorsed by Applicator, listing conditions detrimental to performance of work.

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

3.2 SURFACE PREPARATION

A. Clean, prepare, and treat substrate according to manufacturer's written instructions. Provide clean, dust-free, and dry substrate for air/vapor barrier application.

B. Remove grease, oil, bitumen, form-release agents, paints, curing compounds, and other penetrating contaminants or film-forming coatings from concrete.

C. Remove fins, ridges, mortar, and other projections and fill honeycomb, aggregate pockets, holes, and other voids in concrete with substrate-patching membrane.

D. Prepare, fill, prime, and treat joints and cracks in substrates. Remove dust and dirt from joints and cracks according to ASTM D 4258.

1. Install modified bituminous strips and center over treated construction and contraction joints and cracks exceeding a width of 1/16 inch.

E. Fill gaps between different substrate systems to form a smooth transition from one plane to another; fill gaps between substrates and window, and storefront systems; and miscellaneous penetrations in substrates with sealant.

1. Apply foam sealant in gaps up to 2 inches wide.
2. Apply insulation foam sealant in gaps greater than 2 inches wide.
3. Cover foam sealants with adhesively applied aluminum sheet metal or other substrate material approved by the air/vapor barrier manufacturer, providing a permanent air/vapor barrier transition attachment.
4. Apply sealant within recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.

F. Bridge and cover isolation joints, and expansion joints with overlapping modified bituminous strips.
   1. Invert and loosely lay first sheet strip over center of joint. Firmly adhere second sheet strip to first and overlap to substrate.

G. At changes in substrate plane, apply sealant or termination mastic beads at sharp corners and edges to form a smooth transition from one plane to another.

H. Cover gaps in substrate plane and form a smooth transition from one substrate plane to another with stainless steel or aluminum sheet mechanically fastened to structural framing to provide continuous support for air/vapor barrier.

I. Gypsum Sheathing Panels: Prime glass-fiber surfaced gypsum sheathing with an adequate number of coats to achieve required bond to membranes, with adequate drying time between coats. Limit priming to areas that will be covered by air/vapor barrier membrane in same day. Reprime areas exposed for more than 24 hours.

3.3 INSTALLATION

A. Install modified bituminous sheets according to air/vapor barrier manufacturer's written instructions and according to recommendations in ASTM D 6135.
   1. When ambient and substrate temperatures range between 25 and 40 deg F, install self-adhering, modified bituminous air/vapor barrier sheets produced for low-temperature application. Do not use low-temperature sheets if ambient or substrate temperature is higher than 60 deg F.
   2. Do not apply to wet or frozen substrates.
   3. Do not allow contamination with dust or dirt.
   4. Seal completely at edges, perimeter and penetrations.
   5. Wrap membrane around perimeter of window openings, so the window systems can be caulked around the interior perimeter of opening, sealing between edge of window and air/vapor barrier membrane.
   6. Install membrane in tight intimate contact with substrate without stretching. Bend membrane to fit tightly into inside corners, without gaps and without stretching membrane.

B. Corners: Prepare, prime, and treat inside and outside corners according to ASTM D 6135.
   1. Install modified bituminous strips centered over vertical inside corners. Install 3/4-inch fillets of termination mastic on horizontal inside corners.

C. Prepare, treat, and seal vertical and horizontal surfaces at terminations and penetrations with termination mastic and according to ASTM D 6135.

D. Apply primer to substrates at required rate and allow to dry thoroughly. Adjust time for drying, based upon ambient temperature, humidity and weather conditions. Limit priming to areas that
will be covered by air/vapor barrier sheet in same day. Reprime areas exposed for more than 24 hours.
1. Prime glass-fiber-surfaced gypsum sheathing with number of prime coats needed to achieve required bond, with adequate drying time between coats.

E. Apply and firmly adhere modified bituminous sheets horizontally over area to receive air/vapor barrier sheets. Accurately align sheets and maintain a uniform 2-1/2-inch- minimum lap widths and end laps. Overlap and seal seams and stagger end laps to ensure airtight installation.
1. Apply sheets in a shingled manner to shed water without interception by any exposed sheet edges.
2. Roll sheets firmly to enhance adhesion to substrate.

F. Apply continuous modified bituminous sheets over modified bituminous strips bridging substrate cracks, construction, and contraction joints.

G. Seal top of through-wall flashings to air/vapor barrier sheet with an additional 6-inch- wide, counterflashing strip. Seal exposed top edge of counterflashing strip with bead of mastic as recommended by air/vapor barrier manufacturer.

H. Seal exposed edges of sheets at seams, cuts, penetrations, and terminations not concealed by metal counterflashings or ending in reglets with termination mastic.

I. Install air/vapor barrier sheets and auxiliary materials to form a seal with adjacent construction and to maintain a continuous air/vapor barrier.

J. Connect and seal exterior wall air/vapor barrier membrane continuously to floor-to-floor construction, exterior glazing and window systems, storefront systems, exterior louvers, exterior door framing, and other construction used in exterior wall openings using accessory materials as indicated.

K. Wall Openings: Prime concealed perimeter frame surfaces of windows, storefront, louvers, and doors. Apply modified bituminous transition strip so that a minimum of 3 inches of coverage is achieved over both substrates. Maintain 3 inches of full contact over firm bearing to perimeter frames with not less than 1 inch of full contact.
1. Modified Bituminous Transition Strip: Roll firmly to enhance adhesion.

L. Fill gaps in perimeter frame surfaces of windows, storefronts, louvers, doors, and miscellaneous penetrations of air/vapor barrier membrane with foam sealant.

M. At end or each working day, seal top edge of membrane to substrate with termination mastic.

N. Apply joint sealants forming part of air/vapor barrier assembly within manufacturer's recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.

O. Repair punctures, voids, and deficient lapped seams in air/vapor barrier. Slit and flatten fishmouths and blisters. Patch with air/vapor barrier sheet extending 6 inches beyond repaired areas in all directions.

P. Post-Installation Inspections: Do not cover air/vapor barrier until the following inspections have been completed:
1. Manufacturer's representative has inspected installation.
2. Owner’s testing agency, if directed by Owner, has inspected installation.
3. Owner’s representative has inspected and photo documented all walls, all transitions (wall to foundation, wall to roof, and similar transitions), and all penetrations through air/vapor barrier.

Q. Correct deficiencies in or remove air/vapor barrier that does not comply with requirements; repair substrates and reapply air/vapor barrier components.

3.4 FIELD QUALITY CONTROL

A. Third Party Testing Agency: Owner may engage a qualified, independent testing and inspecting agency to perform field tests and inspections and to prepare test reports. Allow inspectors access to scaffolding and work areas, as needed to perform inspections and tests.

B. Inspections: Air/vapor barrier materials and installation are subject to inspection for compliance with requirements. Inspections may include the following:
   1. Continuity of air/vapor barrier system has been achieved throughout the building envelope with no gaps or holes.
   2. Continuous structural support of air/vapor barrier system has been provided.
   3. Site conditions for application temperature and dryness of substrates have been maintained.
   4. Maximum exposure time of materials to UV deterioration has not been exceeded.
   5. Surfaces have been primed.
   6. Laps in sheet materials have complied with the minimum requirements and have been shingled in the correct direction (or mastic applied on exposed edges), with no fishmouths.
   7. Termination mastic has been applied on cut edges.
   8. Air/vapor barrier has been firmly adhered to substrate.
   9. Compatible materials have been used.
  10. Transitions at changes in direction and structural support at gaps have been provided.
  11. Connections between assemblies (membrane and sealants) have complied with requirements for cleanliness, preparation and priming of surfaces, structural support, integrity, and continuity of seal.
  12. All penetrations have been sealed.

C. Remove and replace applications of air/vapor barrier membrane where test results indicate that it does not comply with specified requirements.

D. Additional testing and inspecting, at Contractor’s expense, will be performed to determine compliance of replaced or additional work with specified requirements.

E. Do not cover air/vapor barrier membrane until field quality control testing has been completed.

3.5 CLEANING AND PROTECTION

A. Protect air/vapor barrier system from damage during application and remainder of construction period, according to manufacturer's written instructions.
   1. Protect air/vapor barrier from exposure to UV light and harmful weather exposure as required by manufacturer. Remove and replace air/vapor barrier exposed to these conditions for more than 30 days.
B. Clean spills, stains, and soiling from adjacent construction that would be exposed in the completed work using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION 072713
SECTION 074213 - METAL WALL PANELS

PART 1 - GENERAL

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

1.2 SUMMARY
   A. This Section includes the following:
      1. Factory-formed and field-assembled, concealed-fastener metal wall panels.
      2. Formed sheet metal flashing and trim.
      3. Weather resistant sheathing (building) paper.
   B. Related Sections include the following:
      1. Division 06 Section "Rough Carpentry" for z-furring and supporting plywood sheathing.
      2. Division 07 Section "Joint Sealants" for field-applied sealants not otherwise specified in this Section.

1.3 DEFINITION
   A. Metal Wall Panel Assembly: Metal wall panels, attachment system components, miscellaneous metal flashing, trim, and accessories necessary for a complete weathertight system.

1.4 SUBMITTALS
   A. General: Submit in accordance with Division 01 Section “Submital Procedures”.
   B. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of metal wall panel and accessory.
   C. Shop Drawings: Show fabrication and installation layouts of metal wall panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures, and accessories; and special details. Distinguish between factory- and field-assembled work. Details shall be at a scale not less than 1-1/2 inches per 12 inches.
      1. Accessories: Include details of flashing and trim, at a scale of not less than 3 inches per 12 inches.
   D. Samples: For each type of exposed finish required, prepared on Samples of size indicated below.
      1. Metal Wall Panels: 12 inches long by actual panel width. Include fasteners, closures, and other metal wall panel accessories.
      2. Trim and Closures: 12 inches long. Include fasteners and other exposed accessories.
   E. Maintenance Data: For metal wall panels to include in maintenance manuals.
   F. Warranties: Special warranties specified in this Section.
1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain each type of metal wall panel through one source from a single manufacturer.
   1. Obtain metal for shop-formed trim from metal wall panel manufacturer to assure match to metal wall panel.

B. Product Options: Drawings indicate size, profiles, and dimensional requirements of metal wall panels and trim.
   1. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.

C. Fabricated Sheet Metal Standard: Comply with SMACNA's "Architectural Sheet Metal Manual." Conform to dimensions and profiles shown, unless more stringent requirements are indicated.

D. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination." Review methods and procedures related to metal wall panel assemblies including, but not limited to, the following:
   1. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
   2. Review methods and procedures related to metal wall panel installation, including manufacturer's written instructions.
   3. Examine support conditions for compliance with requirements, including alignment between and attachment to structural members.
   4. Review flashings, special siding details, wall penetrations, openings, and condition of other construction that will affect metal wall panels.
   5. Review governing regulations and requirements for insurance, certificates, and testing and inspecting if applicable.
   6. Review temporary protection requirements for metal wall panel assemblies during and after installation.
   7. Review wall panel observation and repair procedures after metal wall panel installation.
   8. Document proceedings, including corrective measures and actions required, and furnish copy of record to each participant.
   9. Provide 5 business days minimum advance notice to participants prior to convening preinstallation conference.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver components, sheets, metal wall panels, and other manufactured items so as not to be damaged or deformed. Package metal panels for protection from damage, dirt, road grime, and similar soiling and weather affects during transportation and handling.

B. Handling: Unload, store, and erect metal wall panels in a manner to prevent bending, warping, twisting, and surface damage. Cover fork truck tines and use protected rigging lifting devices to protect panels from marring and damage.

C. Stack metal wall panels horizontally on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal panels to ensure dryness, with positive slope for drainage
of water. Do not store metal panels in contact with other materials that might cause staining, denting, or other surface damage.

D. Protect strippable protective covering on metal wall panels from exposure to sunlight and high humidity, except to extent necessary for period of metal wall panel installation.

E. Flashing and Trim: Unload, store, and install sheet metal flashing materials and fabrications in a manner to prevent bending, warping, twisting, and surface damage. Stack materials on platforms or pallets, covered with suitable weathertight and ventilated covering. Do not store sheet metal flashing and trim materials in contact with other materials that might cause staining, denting, or other surface damage.

1.7 PROJECT CONDITIONS

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

1.8 COORDINATION

A. Coordinate installation of rigid insulation installed with z-furring supporting plywood sheathing installed in Division 6 Section "Rough Carpentry".

B. Coordinate metal wall panel assemblies and flashing and trim work of this Section with flashing, trim, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.9 WARRANTY

A. General: Special warranty specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.

B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal wall panels that show evidence of deterioration of factory-applied finishes within specified warranty period.
   1. Fluoropolymer Finish: Deterioration includes, but is not limited to, the following:
      a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
      b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
      c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
   2. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply for product selection:
   1. Products: Subject to compliance with requirements, provide one of the products specified.
2.2 PANEL MATERIALS

A. Aluminum Sheet: Coil-coated sheet, ASTM B 209, [alloy as standard with manufacturer, with temper as required to suit forming operations and structural performance required.
   1. Surface: Smooth, flat finish.
   2. Exposed Finishes: Apply the following coating, as specified or indicated on Drawings.
      a. High-Performance Organic Finish: AA-C12C42R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: acid-chromate-fluoride-phosphate conversion coating; Organic Coating: as specified below). Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
      1) Fluoropolymer Two-Coat System: Manufacturer's standard two-coat, thermocured system consisting of specially formulated inhibitive primer and fluoropolymer color topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight; complying with AAMA 2605.
   3. Concealed Finish: Apply pretreatment and manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil.

B. Panel Sealants:
   1. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch wide and 1/8 inch thick.
   2. Joint Sealant: ASTM C 920; elastomeric polyurethane, polysulfide, or silicone sealant; of type, grade, class, and use classifications required to seal joints in metal wall panels and remain weathertight; and as recommended in writing by metal wall panel manufacturer.

2.3 WEATHER-RESISTANT SHEATHING (BUILDING) PAPER

A. Weather-Resistant Sheathing (Building) Paper: Spun bonded polypropylene underlayment having the following properties:
   1. Air Barrier: ASTM E 1677, Type I air retarder and ASTM E 283 at 75 Pa less than 0.020 L/sq. m.
   2. Thickness and Weight: 0.023 inches thick and 5.161 oz./ sq. yd.
   3. Water Vapor Transmission: 50 perms per ASTM E 96-00, Method B (as tested by CNRC).
   5. Surface Burning Characteristics: ASTM E 84, flame-spread and smoke-developed indexes of less than 25 and 450, respectively.

B. Accessories: Provide the following for use with weather-resistant sheathing paper:
   1. Single-Sided Sealing Tape: 3 inch VaproTape (Seam-Seal) for use to secure WrapShield to itself and to substrates; distributed by VaproShield L.L.C/Manufactured by Eternabond.
   2. Double-Side Sealing Tape: 1 inch VaproTape (Double-Sided) for use to secure WrapShield to itself and to substrates; distributed by VaproShield L.L.C/Manufactured by Eternabond.
2.4 MISCELLANEOUS MATERIALS

A. Panel Fasteners: Self-tapping screws, and other suitable fasteners designed to withstand design loads. Provide exposed fasteners with heads matching color of metal wall panels by means of plastic caps or factory-applied coating. Provide EPDM, PVC, or neoprene sealing washers.

1. Fasteners for Flashing and Trim: Blind fasteners or self-drilling screws with hex washer head.


2.5 CONCEALED-FASTENER METAL (SIDING) WALL PANELS

A. General: Provide factory-formed metal wall panels designed to be field assembled by lapping and interconnecting side edges of adjacent panels and mechanically attaching through panel to supports using concealed fasteners in side laps. Include accessories required for weathertight installation.

B. Prefinished Metal Siding: Factory-formed with vertical panel edges and flat pan between panel edges; with flush joint between panels.

1. Product: Designwall 500; Kingspan metal panels.
2. Material: Aluminum sheet, 0.040 inch thick minimum.
   b. Color: To match existing on site materials.
4. Panel Height: 1 1/8-inch.

2.6 ACCESSORIES

A. Wall Panel Accessories: Provide components required for a complete metal wall panel assembly including trim, flashing, mullions, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal wall panels, unless otherwise indicated.

1. Closures: Provide closures at tops and bottoms of panels.
2. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer/fabricator.
3. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch thick, flexible closure strips; cut or premolded to match metal wall panel profile. Provide closure strips at ends of panels, and where indicated or necessary to ensure weathertight construction.

B. Flashing and Trim: Formed from 0.040 inch thick, aluminum sheet prepainted with coil coating. Provide flashing and trim as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, base drips, sills, jambs, decorative trim, transition drips, Z-flashing, J-channels, box trims, soffit trim, H-trims, clips, corners, endwalls, framed openings, reveals, and fillers. Flashing and trim colors as indicated.

1. Trim Color: Colors as indicated.
2.7 FACTORY- FABRICATION

A. General: Fabricate and finish metal wall panels and accessories at the factory to greatest extent possible, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.

B. Provide metal wall panels in one-piece, full-length sections without transverse seams, unless otherwise indicated.

C. Fabricate metal wall panels in a manner that eliminates condensation on interior side of panel and with joints between panels designed to form weathertight seals.

D. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel.

E. Sheet Metal Accessories: Fabricate flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to the design, dimensions, metal, and other characteristics of item indicated.
   1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
   2. Seams: Fabricate nonmoving seams in accessories with flat-lock seams.
   3. Sealed Joints: Form nonexpansion but movable joints in metal to accommodate elastomeric sealant to comply with SMACNA standards.
   4. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.

2.8 CUSTOM-FABRICATION OF TRIM

A. Custom Fabrication, General: Custom fabricate sheet metal trim, flashing, and accessories to comply with the details shown, the recommendations in SMACNA's "Architectural Sheet Metal Manual,5th Edition" and the recommendations of the metal manufacturer regarding design, dimensions, geometry, metal thickness, and other characteristics of installation indicated.
   1. Sheet Metal Accessories:
      a. Flashing and trim shall be fabricated in 8 to 10 foot lengths.
      b. Hem edges of all metal accessories, concealing raw edges and back of sheets.
      c. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
      d. Seams: Fabricate nonmoving seams in accessories with flat-lock seams.
      e. Sealed Joints: Form nonexpansion but movable joints in metal to accommodate elastomeric sealant to comply with SMACNA standards.
      f. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.
      g. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal recommended by metal stock manufacturer.

B. Fabricate sheet metal wall trim and flashing to allow for expansion in running work sufficient to prevent buckling, damage, and deterioration of the Work. Form exposed sheet metal work to fit
over substructure without excessive oil canning, buckling, and tool marks, true to line and levels indicated.

C. Expansion Provisions: Where lapped or bayonet-type expansion provisions in the Work cannot be used, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with non-acidic sealant (concealed within joints).

D. Formed Sheet Metal Trim and Flashing: Flashing shall be fabricated from prefinished, aluminum sheet obtained from manufacturer of metal wall panels.
   1. Ledge Sill Flashing: Shop formed to detail with continuous edge clip; joint detail per Table 3-1, joint style J-10 and edge style E1; continuous barrier strip over wood blocking, turned up wall and turned down face of blocking, lapping over foundation; face of ledge flashing to lap foundation, 1 inch minimum; slope flashing to drain.

2.9 FINISHES, GENERAL

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

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

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal wall panel supports, and other conditions affecting performance of work.
   1. Examine solid wall sheathing to verify that sheathing joints are supported by framing or blocking, that installation is within flatness tolerances required by metal wall panel manufacturer, and building paper is continuous to shed water to the exterior.
   2. If unacceptable conditions are encountered, prepare written report, endorsed by Installer, listing conditions detrimental to performance of work.

B. Examine roughing-in for components and systems penetrating metal wall panels to verify actual locations of penetrations relative to seam locations of metal wall panels before metal wall panel installation.

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

3.2 PREPARATION

A. Clean substrates of substances harmful to insulation, including removing projections capable of interfering with insulation attachment.
B. Install flashings and other sheet metal to comply with requirements specified in Division 7 Section "Sheet Metal Flashing and Trim."
   1. Install sheet metal flashing and trim with minimum number of joints practical, using shop fabricated full-length pieces. Provide one piece flashing and trim using full-length pieces without joints where run is less than the 8 to 10 foot fabricated lengths. Do not use pieces less than 24 inches long.
      a. Flashing and Trim: Provide one piece flashing, full width of opening except where opening exceeds available fabricated lengths. Sill flashings and horizontal trims shall turn up on backside. Tape the top of horizontal trim to direct water to the exterior.

3.3 WEATHER-RESISTANT SHEATHING (BUILDING) PAPER APPLICATION

A. Install weather-resistant sheathing paper in accordance with manufacturer’s written instructions.

B. Install building wrap, orange side out, starting from low to high in shingle fashion to shed water, overlapping edges 6 inches minimum and ends 6 inches. Attach with non-corrosive fasteners to hold in place. Seal end and side laps with seam tape. Lap building wrap over metal flashings and seal with continuous double-sided seam tape to form a watertight barrier. Materials shall not be left exposed for longer than 8 months. Seal top, bottom end termination, setting building wrap in bead of sealant.

C. Tape top of horizontal trims to direct water to the exterior.

3.4 METAL WALL PANEL INSTALLATION, GENERAL

A. General: Install metal wall panels in orientation, sizes, and locations indicated on Drawings. Anchor metal wall panels and other components of the Work securely in place, with provisions for thermal and structural movement.
   1. Field cutting of metal panels by torch is not permitted.
   2. Shim or otherwise plumb substrates receiving metal wall panels.
   3. Rigidly fasten metal wall panels and allow end free movement due to thermal expansion and contraction.
   4. Flash and seal metal wall panels with weather closures at base and at perimeter of all openings. Fasten with self-tapping screws. Do not begin installation until flashings that will be concealed by metal wall panels are installed.
   5. Install screw fasteners in predrilled holes.
   6. Locate and space fastenings in uniform vertical and horizontal alignment.
   7. Install flashing and trim as metal wall panel work proceeds.
   8. Fasten flashings and trim around openings and similar elements with concealed self-tapping screws.

B. Fasteners for Steel Wall Panels: Use stainless steel fasteners.

C. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating, by applying rubberized-asphalt underlayment to each contact surface, or by other permanent separation as recommended by metal wall panel manufacturer or fabricator.
3.5 FIELD-ASSEMBLED METAL WALL PANEL INSTALLATION

A. Concealed-Fastener Wall Panels: Fasten metal wall panels to supports with fasteners at each lapped joint at location and spacing recommended by manufacturer.
1. Apply panels and associated items for neat and weathertight enclosure. Avoid "panel creep" or application not true to line.
2. Install screw fasteners with power tools having controlled torque adjusted to compress washer tightly without damage to washer, screw threads, or panels. Install screws in predrilled holes.

3.6 ACCESSORY INSTALLATION

A. General: Install accessories with positive anchorage to building and weathertight mounting and provide for thermal expansion. Coordinate installation with flashings and other components.
1. Install components required for a complete metal wall panel assembly including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items.

B. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, SMACNA's "Architectural Sheet Metal Manual," and approved Shop Drawings. Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.
1. Install exposed flashing and trim that is without excessive oil canning, buckling, and tool marks and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and to result in waterproof and weather-resistant performance.
2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped or bayonet-type expansion provisions cannot be used or would not be sufficiently weather resistant and waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with mastic sealant (concealed within joints).
3. Exposed fasteners shall match color and finish of material being secured.

3.7 INSTALLATION OF CUSTOM FABRICATED FLASHING AND TRIM

A. General: Except as otherwise indicated, install custom sheet metal flashing and trim to comply with fabricator's installation instructions, performance requirements, and SMACNA "Architectural Sheet Metal Manual." Anchor units of work securely in place by methods indicated, providing for thermal expansion of metal units; conceal fasteners where possible; and set units true to line and level as indicated. All edge strips shall be neatly folded; external and internal corners shall be mitered, and sealed in full bed of water cut off mastic for prefinished metal. Install work with laps, joints, and seams that will be permanently watertight and weatherproof.

B. Back-Up Plates: Where specified, set flashing ends in full bed of water cut-off mastic, allowing 1/4-inch between sections.

C. Install flashing and sheet metal with concealed fasteners, unless indicated otherwise. Metal edge flashing shall be installed to resist wind blow-off and prevent flutter and vibration. Allow
for expansion and contraction, making square, straight corners and tight overlaps, free of gaps and openings, properly sealed to be watertight.

1. Where exposed fasteners are unavoidable, fasteners shall match color and finish of material being secured.

D. Electrolytic Action: Where two dissimilar metals adjoin or lap each other (example: galvanized metal ducts and copper cap flashing), an approved separating strip or other insulating material shall be installed.

E. Bed flanges of work in water cut off mastic where required for waterproof performance.

3.8 ERECTION TOLERANCES

A. Installation Tolerances: Shim and align metal wall panel units within installed tolerance of 1/4 inch in 20 feet, nonaccumulative, on level, plumb, and location lines as indicated and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

3.9 CLEANING AND PROTECTION

A. Remove temporary protective coverings and strippable films, if any, as metal wall panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of metal wall panel installation, clean finished surfaces as recommended by metal wall panel manufacturer. Maintain in a clean condition during construction.

B. After metal wall panel installation, clear weep holes and drainage channels of obstructions, dirt, and sealant.

C. Replace metal wall panels and custom fabricated trims that have been damaged or have deteriorated beyond successful repair as determined by Architect by finish touchup or similar minor repair procedures.

END OF SECTION 074213
SECTION 075410 - SINGLE-PLY MEMBRANE ROOF PATCHING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:
   1. Alterations and patching to the existing TPO roofing system.
   2. Roof insulation infill.

B. Related Sections:
   1. Division 06 Section "Rough Carpentry" for wood blocking and nailers.

1.2 REFERENCES

A. NRCA: National Roofing Contractors Association
B. SPRI: Single Ply Roofing Industry
C. Membrane Manufacturers Installation Manual

1.3 DEFINITIONS

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

1.4 SUBMITTALS FOR APPROVAL

A. General: Submit in accordance with Division 01 Section "Submittal Procedures."
B. Product Data: For each type of product indicated.
C. Shop Drawings: Submit shop drawings showing roof modification locations, sheet layout, seam locations, colors (as applicable), penetration and flashing details and special conditions.
D. Installer Verification Letter:
   1. A corporate officer or designated representative of the manufacturer shall sign letter. Letter from local or regional distributor is not acceptable.
   2. Addressed to Owner, referencing this project, and certifying that Installer is approved, authorized, or licensed by manufacturer to install the roofing system.
   3. Acknowledging that the existing manufacturer's Warranty will continue in effect upon completion of work.
E. List of not less than five previous TPO installation projects of similar area completed over the three year period prior to beginning work.
F. Warranties: Continuation of existing roof warranty and special warranties noted in this Section.
1.5 QUALITY ASSURANCE

A. Installer Qualifications: A qualified firm that is approved, authorized, or licensed by roofing system manufacturer to install manufacturer's product.

B. Source Limitations: Obtain single-ply membrane roofing from original manufacturer. Provide secondary materials by same manufacturer or as recommended in writing by manufacturer of primary materials.

C. Coordinate alterations to existing roofing with original manufacturer to maintain warranty, if warranty has not expired. The results of the warranty inspection by the system manufacturer shall be submitted in writing to Owner for their review and records.

1.6 SEQUENCING

A. Coordinate roofing work with phasing or schedule of work. Provide weather tight closure around new penetrations as necessary to allow the work to proceed. Do not begin roof membrane installation until all penetrations have been extended to the proper height above roof deck and other trades no longer require access to the roof area.

B. Monitor roof mounted equipment and curb installation to maintain weatherproof conditions until complete membrane can be installed.

1.7 WARRANTY

A. Manufacturer's Warranty:
   1. Continuation of existing warranty.
      a. Knox Building roof was replaced in 2009 with a TPO roofing system.

B. Roofing Installer's Warranty: On form at end of this Section, signed by Installer.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Same manufacturer as existing roof system.

2.2 MATERIALS

A. TPO Sheet: Uniform, flexible sheet formed from a thermoplastic polyolefin, internally fabric or polyester scrim reinforced, and as follows:
   1. Thickness: 0.060 inches, nominal.
   2. Exposed Face Color: White.

2.3 COMPONENTS

A. General: Auxiliary materials recommended by roofing system manufacturer for intended use and compatible with membrane roofing.
   1. Liquid-type auxiliary materials shall meet VOC limits of authorities having jurisdiction.
B. Sheet Flashing: Manufacturer's standard sheet flashing of same material, thickness, type, reinforcement, and color as TPO sheet membrane.

C. Bonding Adhesive: Manufacturer's standard bonding adhesive for TPO membrane, and solvent-based bonding adhesive for base flashings.

D. Metal Flashing Termination Bars: Manufacturer's standard predrilled stainless steel or aluminum bars, approximately 1 by 1/8 inch thick; with anchors. Supplied by membrane manufacturer to be used on vertical wall applications between roof deck surface and wall coping detail. Bar to be placed at maximum 48 inches on center. Fasten bar to wall as recommended by membrane manufacturer.

E. Fasteners: Factory-coated steel fasteners and metal or plastic plates meeting corrosion-resistance provisions in FMG 4470, designed for fastening membrane to substrate, and acceptable to membrane roofing system manufacturer. Fasteners into masonry or concrete shall penetrate minimum of 1-1/2 inches and a minimum 1-inch diameter washer or termination bar to support membrane.

F. Miscellaneous Accessories: Provide pourable sealers, preformed cone flashings, preformed inside and outside corner sheet flashings, T-joint covers, termination reglets, cover strips, and other accessories. Provide manufacturer’s standard premolded accessories.

2.4 ACCESSORIES

A. Sheet Metal Cap: Zinc-Coated Steel; Commercial quality with 0.20 percent copper, ASTM A 526 except ASTM A 527 for lock-forming, G90 hot-dip galvanized, 22 gauge. Form to detail, providing weather tight cap.
   1. Comply with SMACNA fabrication and installation requirements.

B. Insulation Board for Infill: To match existing in type and thickness.

C. Insulation Accessories
   1. Roof insulation accessories recommended by insulation manufacturer for intended use and compatible with membrane roofing.
   2. Fasteners: Factory-coated steel fasteners and metal or plastic plates meeting corrosion-resistance provisions in FMG 4470, designed for fastening roof insulation to substrate, and acceptable to roofing system manufacturer.

PART 3 - EXECUTION

3.2 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with the following requirements and other conditions affecting performance of roofing system:
   1. Verify that roof openings and penetrations are in place and set.
   2. Verify that wood blocking, curbs, and nailers are securely anchored to roof deck at penetrations and terminations and that nailers match thicknesses of insulation.
   3. Proceed with installation only after unsatisfactory conditions have been corrected.
3.3 PREPARATION

A. Clean substrate of dust, debris, moisture, and other substances detrimental to roofing installation according to roofing system manufacturer's written instructions in manner that will not create or contribute to environmental hazard. Remove sharp projections, nails, screws or metal pieces.

B. Prevent materials from entering and clogging roof drains and conductors and from spilling or migrating onto surfaces of other construction.

C. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system at the end of the workday or when rain is forecast. Remove and discard temporary seals before beginning work on adjoining roofing.

3.4 INSULATION INSTALLATION

A. Coordinate installing membrane roofing system components so insulation is not exposed to precipitation or left exposed at the end of the workday.

B. Comply with membrane roofing system manufacturer's written instructions for installing roof insulation.
   1. Install two layers of insulation under area of roofing to achieve required thickness
   2. Fill gaps exceeding 1/4 inch with insulation.
      a. Cut and fit insulation within 1/4 inch of nailers, projections, and penetrations.
   3. Secure insulation to deck using mechanical fasteners.

3.5 ROOFING MEMBRANE INSTALLATION

A. Install roofing membrane over area to receive roofing according to roofing system manufacturer's written instructions.

B. Accurately align roofing membranes and maintain uniform side and end laps of minimum dimensions required by manufacturer.

C. Fasteners shall be of sufficient length to penetrate all layers of insulation and minimum of 3/4 inch beyond structural deck.

D. Mechanically fasten roofing membrane securely at terminations, penetrations, and perimeter of roofing.

E. Apply roofing membrane with side laps shingled with slope of roof deck where possible.

F. Seams: Clean seam areas with manufacturers recommended cleaning solution, overlap roofing membrane and seam tape side and end laps of roofing membrane according to manufacturer's written instructions to ensure a watertight seam installation.
   1. Repair tears, voids, and lapped seams in roofing membrane that does not meet requirements.

G. Install roofing membrane and auxiliary materials to tie in to existing roofing.
3.6 FLASHING INSTALLATION
   A. Install sheet flashings and preformed flashing accessories and adhere to substrates according to membrane roofing system manufacturer's written instructions.
   B. Apply bonding adhesive to substrate and underside of sheet flashing at required rate and allow to dry until tacky-to-dry to the touch. Do not apply bonding adhesive to seam area of flashing.
   C. Flash penetrations and field-formed inside and outside corners with sheet flashing.
   D. Clean seam areas and overlap and firmly roll sheet flashings into the adhesive. Adhere side and end laps to ensure a watertight seam installation.
   E. Terminate and seal top of sheet flashings and mechanically anchor to substrate through termination bars.
   F. Screw attach sheet metal cap to curb, providing air tight, weather tight seal.

3.7 PROTECTING AND CLEANING
   A. Protect membrane roofing system from damage and wear during remainder of construction period. When remaining construction will not affect or endanger roofing, inspect roofing for deterioration and damage, describing its nature and extent in a written report, with copies to Architect and Owner.
   B. Correct deficiencies in or remove membrane roofing system that does not comply with requirements, repair substrates, and repair or reinstall membrane roofing system to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.

3.8 ROOFING INSTALLER'S WARRANTY (FOR ROOF THAT DOES NOT CARRY A CURRENT MANUFACTURER’S WARRANTY)
   A. WHEREAS <Insert name> of <Insert address>, herein called the "Roofing Installer," has performed roofing and associated work ("work") on the following project:
      1. Owner: <Insert name of Owner.>
      2. Address: <Insert address.>
      3. Building Name/Type: <Insert information.>
      4. Address: <Insert address.>
      5. Area of Work: <Insert information.>
      6. Acceptance Date: <Insert date.>
      7. Warranty Period: <Insert time.>
      8. Expiration Date: <Insert date.>
   B. AND WHEREAS Roofing Installer has contracted (either directly with Owner or indirectly as a subcontractor) to warrant said work against leaks and faulty or defective materials and workmanship for designated Warranty Period,
   C. NOW THEREFORE Roofing Installer hereby warrants, subject to terms and conditions herein set forth, that during Warranty Period he will, at his own cost and expense, make or cause to
be made such repairs to or replacements of said work as are necessary to correct faulty and defective work and as are necessary to maintain said work in a watertight condition.

D. This Warranty is made subject to the following terms and conditions:
1. Specifically excluded from this Warranty are damages to work and other parts of the building, and to building contents, caused by:
   a. Lightning;
   b. Peak gust wind speed exceeding 55 mph;
   c. Fire;
   d. Failure of roofing system substrate, including cracking, settlement, excessive deflection, deterioration, and decomposition;
   e. Faulty construction of parapet walls, copings, chimneys, skylights, vents, equipment supports, and other edge conditions and penetrations of the work;
   f. Vapor condensation on bottom of roofing; and
   g. Activity on roofing by others, including construction contractors, maintenance personnel, other persons, and animals, whether authorized or unauthorized by Owner.
2. When work has been damaged by any of foregoing causes, Warranty shall be null and void until such damage has been repaired by Roofing Installer and until cost and expense thereof have been paid by Owner or by another responsible party so designated.
3. Roofing Installer is responsible for damage to work covered by this Warranty but is not liable for consequential damages to building or building contents resulting from leaks or faults or defects of work.
4. During Warranty Period, if Owner allows alteration of work by anyone other than Roofing Installer, including cutting, patching, and maintenance in connection with penetrations, attachment of other work, and positioning of anything on roof, this Warranty shall become null and void on date of said alterations, but only to the extent said alterations affect work covered by this Warranty. If Owner engages Roofing Installer to perform said alterations, Warranty shall not become null and void unless Roofing Installer, before starting said work, shall have notified Owner in writing, showing reasonable cause for claim, that said alterations would likely damage or deteriorate work, thereby reasonably justifying a limitation or termination of this Warranty.
5. During Warranty Period, if original use of roof is changed and it becomes used for, but was not originally specified for, a promenade, work deck, spray-cooled surface, flooded basin, or other use or service more severe than originally specified, this Warranty shall become null and void on date of said change, but only to the extent said change affects work covered by this Warranty.
6. Owner shall promptly notify Roofing Installer of observed, known, or suspected leaks, defects, or deterioration and shall afford reasonable opportunity for Roofing Installer to inspect work and to examine evidence of such leaks, defects, or deterioration.
7. This Warranty is recognized to be the only warranty of Roofing Installer on said work and shall not operate to restrict or cut off Owner from other remedies and resources lawfully available to Owner in cases of roofing failure. Specifically, this Warranty shall not operate to relieve Roofing Installer of responsibility for performance of original work according to requirements of the Contract Documents, regardless of whether Contract was a contract directly with Owner or a subcontract with Owner's General Contractor.
E. IN WITNESS THEREOF, this instrument has been duly executed this <Insert day> day of <Insert month>, <Insert year>.
   1. Authorized Signature: <Insert signature>.
   2. Name: <Insert name>.
   3. Title: <Insert title>.

END OF SECTION 075410
SECTION 076200 - SHEET METAL FLASHING AND TRIM

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. Manufactured through-wall flashing with counterflashing.
   2. Formed wall sheet metal fabrications.
   3. Formed equipment support flashing.
   4. Formed overhead-piping safety pans.

B. Related Requirements:
   1. Section 061000 "Rough Carpentry" for wood nailers, curbs, and blocking.
   2. Section 074213 "Metal Wall Panels" for sheet metal flashing and trim integral with metal wall panels.
   3. Section 077200 "Roof Accessories" for set-on-type curbs, equipment supports, and other manufactured roof accessory units.

1.3 COORDINATION

A. Coordinate sheet metal flashing and trim layout and seams with sizes and locations of penetrations to be flashed, and joints and seams in adjacent materials.

B. Coordinate sheet metal flashing and trim installation with adjoining roofing and wall materials, joints, and seams to provide leakproof, secure, and noncorrosive installation.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.
   1. Review construction schedule. Verify availability of materials, Installer’s personnel, equipment, and facilities needed to make progress and avoid delays.
   2. Review special roof details, roof drainage, roof-penetration flashing, equipment curbs, and condition of other construction that affect sheet metal flashing and trim.
   3. Review requirements for insurance and certificates if applicable.
   4. Review sheet metal flashing observation and repair procedures after flashing installation.

1.5 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 each manufactured product and accessory.

B. Shop Drawings: For sheet metal flashing and trim.
   1. Include plans, elevations, sections, and attachment details.
2. Detail fabrication and installation layouts, expansion-joint locations, and keyed details. Distinguish between shop- and field-assembled work.
3. Include identification of material, thickness, weight, and finish for each item and location in Project.
4. Include details for forming, including profiles, shapes, seams, and dimensions.
5. Include details for joining, supporting, and securing, including layout and spacing of fasteners, cleats, clips, and other attachments. Include pattern of seams.
6. Include details of termination points and assemblies.
7. Include details of roof-penetration flashing.
8. Include details of edge conditions, including counterflashings as applicable.
9. Include details of special conditions.
10. Include details of connections to adjoining work.
11. Detail formed flashing and trim at scale of not less than 1-1/2 inches per 12 inches.

C. Samples for Initial Selection: For each type of sheet metal and accessory indicated with factory-applied finishes.

D. Samples for Verification: For each type of exposed finish.
1. Sheet Metal Flashing: 12 inches (300 mm) long by actual width of unit, including finished seam and in required profile. Include fasteners, cleats, clips, closures, and other attachments.
2. Trim, Metal Closures, Expansion Joints, Joint Intersections, and Miscellaneous Fabrications: 12 inches (300 mm) long and in required profile. Include fasteners and other exposed accessories.
3. Unit-Type Accessories and Miscellaneous Materials: Full-size Sample.
4. Anodized Aluminum Samples: Samples to show full range to be expected for each color required.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For fabricator.
B. Product Certificates: For each type of coping and roof edge flashing that is SPRI ES-1 tested.
C. Product Test Reports: For each product, for tests performed by a qualified testing agency.
D. Sample Warranty: For special warranty.

1.7 CLOSEOUT SUBMITTALS

A. Maintenance Data: For sheet metal flashing and trim, and its accessories, to include in maintenance manuals.

1.8 QUALITY ASSURANCE

A. Fabricator Qualifications: Employs skilled workers who custom fabricate sheet metal flashing and trim similar to that required for this Project and whose products have a record of successful in-service performance.
1. For copings and roof edge flashings that are SPRI ES-1 tested, shop shall be listed as able to fabricate required details as tested and approved.
B. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for fabrication and installation.
   1. Build mockup of typical window sill flashing, approximately 8 feet long, including supporting construction cleats, seams, attachments, and accessories.
   2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
   3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Do not store sheet metal flashing and trim materials in contact with other materials that might cause staining, denting, or other surface damage. Store sheet metal flashing and trim materials away from uncured concrete and masonry.

B. Protect strippable protective covering on sheet metal flashing and trim from exposure to sunlight and high humidity, except to extent necessary for period of sheet metal flashing and trim installation.

1.10 WARRANTY

A. Special Warranty on Finishes: Manufacturer agrees to repair finish or replace sheet metal flashing and trim that shows evidence of deterioration of factory-applied finishes within specified warranty period.
   1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:
      a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
      b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
      c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
   2. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. General: Sheet metal flashing and trim assemblies shall withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Completed sheet metal flashing and trim shall not rattle, leak, or loosen, and shall remain watertight.

B. Sheet Metal Standard for Flashing and Trim: Comply with NRCA's "The NRCA Roofing Manual" and SMACNA's "Architectural Sheet Metal Manual" requirements for dimensions and profiles shown unless more stringent requirements are indicated.

2.2 SHEET METALS

A. General: Protect mechanical and other finishes on exposed surfaces from damage by applying strippable, temporary protective film before shipping.

B. Copper Sheet: ASTM B 370, cold-rolled copper sheet, H00 or H01 temper.
1. **Manufacturers:** Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Hussey Copper Ltd.
   b. Revere Copper Products, Inc.


C. Aluminum Sheet: ASTM B 209, alloy as standard with manufacturer for finish required, with temper as required to suit forming operations and performance required; with smooth, flat surface.
   1. Clear Anodic Finish, Coil Coated: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.

2.3 UNDERLAYMENT MATERIALS

A. Felt: ASTM D 226/D 226M, Type II (No. 30), asphalt-saturated organic felt; nonperforated.

B. Slip Sheet: Rosin-sized building paper, 3 lb/100 sq. ft. minimum.

2.4 MISCELLANEOUS MATERIALS

A. General: Provide materials and types of fasteners, protective coatings, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation and as recommended by manufacturer of primary sheet metal or manufactured item unless otherwise indicated.

B. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads and recommended by manufacturer of primary sheet metal or manufactured item.
   1. General: Blind fasteners or self-drilling screws, gasketed, with hex-washer head.
      a. Exposed Fasteners: Heads matching color of sheet metal using plastic caps or factory-applied coating.
      b. Blind Fasteners: High-strength aluminum or stainless-steel rivets suitable for metal being fastened.
      c. Spikes and Ferrules: Same material as gutter; with spike with ferrule matching internal gutter width.
   2. Fasteners for Aluminum Sheet: Aluminum or Series 300 stainless steel.

C. Sealant Tape: Pressure-sensitive, 100 percent solids, polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch (13 mm) wide and 1/8 inch (3 mm) thick.

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

E. Bituminous Coating: Cold-applied asphalt emulsion according to ASTM D 1187.
2.5 MANUFACTURED SHEET METAL FLASHING AND TRIM

A. Through-Wall, Ribbed, Sheet Metal Flashing: Manufacture through-wall sheet metal flashing for embedment in masonry, with ribs at 3-inch (75-mm) intervals along length of flashing to provide integral mortar bond.

1. Copper: 10-oz. (0.34-mm-thick) minimum for fully concealed flashing; 16 oz. (0.55 mm thick) elsewhere.
   a. **Products:** Subject to compliance with requirements, provide one of the following:
      1) [Cheney Flashing Company](http://www.cheneyflash.com); Cheney Flashing.
      2) [Hohmann & Barnard, Inc.](http://www.hohmannandbarnard.com); STF Sawtooth Flashing.
      4) [Sandell Manufacturing](http://www.sandell-manufacturing.com); Pre-Formed Metal Flashing.

2.6 FABRICATION, GENERAL

A. General: Custom fabricate sheet metal flashing and trim to comply with details shown and recommendations in cited sheet metal standard that apply to design, dimensions, geometry, metal thickness, and other characteristics of item required. Fabricate sheet metal flashing and trim in shop to greatest extent possible.

1. Fabricate sheet metal flashing and trim in thickness or weight needed to comply with performance requirements, but not less than that specified for each application and metal.
2. Obtain field measurements for accurate fit before shop fabrication.
3. Form sheet metal flashing and trim to fit substrates without excessive oil canning, buckling, and tool marks; true to line, levels, and slopes; and with exposed edges folded back to form hems.
4. Conceal fasteners and expansion provisions where possible. Do not use exposed fasteners on faces exposed to view.

B. Fabrication Tolerances: Fabricate sheet metal flashing and trim that is capable of installation to a tolerance of 1/4 inch in 20 feet (6 mm in 6 m) on slope and location lines indicated on Drawings and within 1/8-inch (3-mm) offset of adjoining faces and of alignment of matching profiles.

C. Fabrication Tolerances: Fabricate sheet metal flashing and trim that is capable of installation to tolerances specified in MCA's "Guide Specification for Residential Metal Roofing."

D. Expansion Provisions: Form metal for thermal expansion of exposed flashing and trim.

1. Form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with butyl sealant concealed within joints.
2. Use lapped expansion joints only where indicated on Drawings.

E. Sealant Joints: Where movable, nonexpansion-type joints are required, form metal to provide for proper installation of elastomeric sealant according to cited sheet metal standard.

F. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.

G. Fabricate cleats and attachment devices of sizes as recommended by cited sheet metal standard for application, but not less than thickness of metal being secured.
H. Seams: Fabricate nonmoving seams with flat-lock seams. Tin edges to be seamed, form seams, and solder.

I. Seams: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with elastomeric sealant unless otherwise recommended by sealant manufacturer for intended use. Rivet joints where necessary for strength.

J. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints where necessary for strength.

K. Do not use graphite pencils to mark metal surfaces.

2.7 WALL SHEET METAL FABRICATIONS

A. Through-Wall Flashing: Fabricate continuous flashings in minimum 96-inch- (2400-mm-) long, but not exceeding 12-foot- (3.6-m-) long, sections, under copings, and at shelf angles. Fabricate discontinuous lintel, sill, and similar flashings to extend 6 inches (150 mm) beyond each side of wall openings; and form with 2-inch- (50-mm-) high, end dams. Fabricate from the following materials:
   1. Copper: 16 oz./sq. ft. (0.55 mm thick).

B. Opening Flashings in Frame Construction: Fabricate head, sill, jamb, and similar flashings to extend 4 inches (100 mm) beyond wall openings. Form head and sill flashing with 2-inch- (50-mm-) high, end dams. Fabricate from the following materials:
   1. Aluminum: 0.032 inch (0.81 mm) thick.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, substrate, and other conditions affecting performance of the Work.
   1. Verify compliance with requirements for installation tolerances of substrates.
   2. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
   3. Verify that air- or water-resistant barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.

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

3.2 UNDERLAYMENT INSTALLATION

A. Felt Underlayment: Install felt underlayment, wrinkle free, using adhesive to minimize use of mechanical fasteners under sheet metal flashing and trim. Apply in shingle fashion to shed water, with lapped joints of not less than 2 inches (50 mm).

B. Synthetic Underlayment: Install synthetic underlayment, wrinkle free, according to manufacturers' written instructions, and using adhesive where possible to minimize use of mechanical fasteners under sheet metal.
C. Self-Adhering Sheet Underlayment: Install self-adhering sheet underlayment, wrinkle free. Prime substrate if recommended by underlayment manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation; use primer for installing underlayment at low temperatures. Apply in shingle fashion to shed water, with end laps of not less than 6 inches (150 mm) staggered 24 inches (600 mm) between courses. Overlap side edges not less than 3-1/2 inches (90 mm). Roll laps and edges with roller. Cover underlayment within 14 days.

3.3 INSTALLATION, GENERAL

A. General: Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement. Use fasteners, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.
1. Install sheet metal flashing and trim true to line, levels, and slopes. Provide uniform, neat seams with minimum exposure of solder, welds, and sealant.
2. Install sheet metal flashing and trim to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.
3. Space cleats not more than 12 inches (300 mm) apart. Attach each cleat with at least two fasteners. Bend tabs over fasteners.
4. Install exposed sheet metal flashing and trim with limited oil canning, and free of buckling and tool marks.
5. Torch cutting of sheet metal flashing and trim is not permitted.
6. Do not use graphite pencils to mark metal surfaces.

B. Metal Protection: Where dissimilar metals contact each other, or where metal contacts pressure-treated wood or other corrosive substrates, protect against galvanic action or corrosion by painting contact surfaces with bituminous coating or by other permanent separation as recommended by sheet metal manufacturer or cited sheet metal standard.
1. Coat concealed side of uncoated-aluminum sheet metal flashing and trim with bituminous coating where flashing and trim contact wood, ferrous metal, or cementitious construction.
2. Underlayment: Where installing sheet metal flashing and trim directly on cementitious or wood substrates, install underlayment and cover with slip sheet.

C. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at maximum of 10 feet (3 m) with no joints within 24 inches (600 mm) of corner or intersection.
1. Form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with sealant concealed within joints.
2. Use lapped expansion joints only where indicated on Drawings.

D. Fasteners: Use fastener sizes that penetrate wood blocking or sheathing not less than 1-1/4 inches (32 mm) for nails and not less than 3/4 inch (19 mm) for wood screws.

E. Conceal fasteners and expansion provisions where possible in exposed work and locate to minimize possibility of leakage. Cover and seal fasteners and anchors as required for a tight installation.
F. Seal joints as required for watertight construction.
   1. Use sealant-filled joints unless otherwise indicated. Embed hooked flanges of joint
      members not less than 1 inch (25 mm) into sealant. Form joints to completely conceal
      sealant. When ambient temperature at time of installation is between 40 and 70 deg F (4
      and 21 deg C), set joint members for 50 percent movement each way. Adjust setting
      proportionately for installation at higher ambient temperatures. Do not install sealant-type
      joints at temperatures below 40 deg F (4 deg C).
   2. Prepare joints and apply sealants to comply with requirements in Section 079200 "Joint
      Sealants."

3.4 ROOF FLASHING INSTALLATION

A. General: Install sheet metal flashing and trim to comply with performance requirements and
   cited sheet metal standard. Provide concealed fasteners where possible, and set units true to line,
   levels, and slopes. Install work with laps, joints, and seams that are permanently watertight and
   weather resistant.

B. Pipe or Post Counterflashing: Install counterflashing umbrella with close-fitting collar with top
   edge flared for elastomeric sealant, extending minimum of 4 inches (100 mm) over base
   flashing. Install stainless-steel draw band and tighten.

C. Counterflashing: Coordinate installation of counterflashing with installation of base flashing.
   Insert counterflashing in reglets or receivers and fit tightly to base flashing. Extend
   counterflashing 4 inches (100 mm) over base flashing. Lap counterflashing joints minimum of 4
   inches (100 mm). Secure in waterproof manner.

D. Roof-Penetration Flashing: Coordinate installation of roof-penetration flashing with installation
   of roofing and other items penetrating roof. Seal with elastomeric sealant and clamp flashing to
   pipes that penetrate roof.

3.5 WALL FLASHING INSTALLATION

A. General: Install sheet metal wall flashing to intercept and exclude penetrating moisture
   according to cited sheet metal standard unless otherwise indicated. Coordinate installation of
   wall flashing with installation of wall-opening components such as windows, doors, and
   louvers.

B. Through-Wall Flashing: Installation of through-wall flashing is specified in Section 042000
   "Unit Masonry."

C. Opening Flashings in Frame Construction: Install continuous head, sill, jamb, and similar
   flashings to extend 4 inches (100 mm) beyond wall openings.

3.6 MISCELLANEOUS FLASHING INSTALLATION

A. Equipment Support Flashing: Coordinate installation of equipment support flashing with
   installation of roofing and equipment. Weld or seal flashing with elastomeric sealant to
   equipment support member.
B. Overhead-Piping Safety Pans: Suspend pans from structure above, independent of other overhead items such as equipment, piping, and conduit, unless otherwise indicated on Drawings. Pipe and install drain line to plumbing waste or drainage system.

3.7 ERECTION TOLERANCES

A. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerance of 1/4 inch in 20 feet (6 mm in 6 m) on slope and location lines indicated on Drawings and within 1/8-inch (3-mm) offset of adjoining faces and of alignment of matching profiles.

B. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerances specified in MCA’s "Guide Specification for Residential Metal Roofing."

3.8 CLEANING AND PROTECTION

A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.

B. Clean and neutralize flux materials. Clean off excess solder.

C. Clean off excess sealants.

D. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed unless otherwise indicated in manufacturer's written installation instructions. On completion of sheet metal flashing and trim installation, remove unused materials and clean finished surfaces as recommended by sheet metal flashing and trim manufacturer. Maintain sheet metal flashing and trim in clean condition during construction.

E. Replace sheet metal flashing and trim that have been damaged or that have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 076200
SECTION 077200 - ROOF 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. Roof curbs.
   2. Equipment supports.
   3. Pipe supports.
   4. Preformed flashing sleeves.

B. Related Sections:
   1. Section 055000 "Metal Fabrications" for metal vertical ladders, ships' ladders, and stairs for access to roof hatches.
   2. Section 055213 "Pipe and Tube Railings" for safety railing systems not attached to roof-hatch curbs.

1.3 PERFORMANCE REQUIREMENTS

A. General Performance: Roof accessories shall withstand exposure to weather and resist thermally induced movement without failure, rattling, leaking, or fastener disengagement due to defective manufacture, fabrication, installation, or other defects in construction.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of roof accessory indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Shop Drawings: For roof accessories. Include plans, elevations, keyed details, and attachments to other work. Indicate dimensions, loadings, and special conditions. Distinguish between plant- and field-assembled work.

C. Samples: For each exposed product and for each color and texture specified, prepared on Samples of size to adequately show color.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Roof plans, drawn to scale, and coordinating penetrations and roof-mounted items. Show the following:
   1. Size and location of roof accessories specified in this Section.
   2. Method of attaching roof accessories to roof or building structure.
3. Other roof-mounted items including mechanical and electrical equipment, ductwork, piping, and conduit.
4. Required clearances.

B. Warranty: Sample of special warranty.

1.6 CLOSEOUT SUBMITTALS
A. Operation and Maintenance Data: For roof accessories to include in operation and maintenance manuals.

1.7 COORDINATION
A. Coordinate layout and installation of roof accessories with roofing membrane and base flashing and interfacing and adjoining construction to provide a leakproof, weathertight, secure, and noncorrosive installation.

B. Coordinate dimensions with rough-in information or Shop Drawings of equipment to be supported.

PART 2 - PRODUCTS

2.1 METAL MATERIALS
A. Zinc-Coated (Galvanized) Steel Sheet: ASTM A 653/A 653M, G90 (Z275) coating designation.
1. Factory Prime Coating: Where field painting is indicated, apply pretreatment and white or light-colored, factory-applied, baked-on epoxy primer coat, with a minimum dry film thickness of 0.2 mil (0.005 mm).

B. Copper Sheet: ASTM B 370, manufacturer's standard temper.

C. Steel Shapes: ASTM A 36/A 36M, hot-dip galvanized according to ASTM A 123/A 123M unless otherwise indicated.

D. Steel Tube: ASTM A 500, round tube.

E. Galvanized-Steel Tube: ASTM A 500, round tube, hot-dip galvanized according to ASTM A 123/A 123M.


2.2 MISCELLANEOUS MATERIALS
A. General: Provide materials and types of fasteners, protective coatings, sealants, and other miscellaneous items required by manufacturer for a complete installation.

B. Acrylic Glazing: ASTM D 4802, thermoformable, monolithic sheet, manufacturer's standard, Type UVA (formulated with UV absorber), Finish 1 (smooth or polished).

C. Polycarbonate Glazing: Thermoformable, monolithic polycarbonate sheets manufactured by extrusion process, burglar-resistance rated according to UL 972 with an average impact strength
of 12 to 16 ft-lbf/in. (640 to 854 J/m) of width when tested according to ASTM D 256, Method A (Izod).

D. Cellulosic-Fiber Board Insulation: ASTM C 208, Type II, Grade 1, thickness as indicated.

E. Glass-Fiber Board Insulation: ASTM C 726, thickness as indicated.

F. Polyisocyanurate Board Insulation: ASTM C 1289, thickness as indicated.

G. Wood Nailers: Softwood lumber, pressure treated with waterborne preservatives for aboveground use, acceptable to authorities having jurisdiction, containing no arsenic or chromium, and complying with AWPA C2; not less than 1-1/2 inches (38 mm) thick.

H. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D 1187.

I. Underlayment:
   1. Felt: ASTM D 226, Type II (No. 30), asphalt-saturated organic felt, nonperforated.
   2. Polyethylene Sheet: 6-mil- (0.15-mm-) thick polyethylene sheet complying with ASTM D 4397.
   3. Slip Sheet: Building paper, 3-lb/100 sq. ft. (0.16-kg/sq. m) minimum, rosin sized.

J. Fasteners: Roof accessory manufacturer's recommended fasteners suitable for application and metals being fastened. Match finish of exposed fasteners with finish of material being fastened. Provide nonremovable fastener heads to exterior exposed fasteners. Furnish the following unless otherwise indicated:
   1. Fasteners for Zinc-Coated or Aluminum-Zinc Alloy-Coated Steel: Series 300 stainless steel or hot-dip zinc-coated steel according to ASTM A 153/A 153M or ASTM F 2329.
   2. Fasteners for Aluminum Sheet: Aluminum or Series 300 stainless steel.
   3. Fasteners for Copper Sheet: Copper, hardware bronze, or passivated Series 300 stainless steel.
   4. Fasteners for Stainless-Steel Sheet: Series 300 stainless steel.

K. Gaskets: Manufacturer's standard tubular or fingered design of neoprene, EPDM, PVC, or silicone or a flat design of foam rubber, sponge neoprene, or cork.

L. Elastomeric Sealant: ASTM C 920, elastomeric polymer sealant as recommended by roof accessory manufacturer for installation indicated; low modulus; of type, grade, class, and use classifications required to seal joints and remain watertight.

M. Butyl Sealant: ASTM C 1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for expansion joints with limited movement.


2.3 ROOF CURBS

A. Roof Curbs: Internally reinforced roof-curb units capable of supporting superimposed live and dead loads, including equipment loads and other construction indicated on Drawings; with welded or mechanically fastened and sealed corner joints, and integrally formed deck-mounting flange at perimeter bottom.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. AES Industries, Inc.
   b. Curbs Plus, Inc.
   c. Custom Solution Roof and Metal Products.
   d. Greenheck Fan Corporation.
   e. LM Curbs.
   f. Metallic Products Corp.
   g. Milcor Inc.; Commercial Products Group of Hart & Cooley, Inc.
   h. Pate Company (The).
   i. Roof Products, Inc.
   j. Safe Air of Illinois.
   k. Thybar Corporation.
   l. Vent Products Co., Inc.

B. Size: Coordinate dimensions with roughing-in information or Shop Drawings of equipment to be supported.

C. Material: Zinc-coated (galvanized) steel sheet, 0.052 inch (1.32 mm) thick.
   1. Finish: Mill phosphatized.

D. Construction:
   1. Insulation: Factory insulated with 1-1/2-inch- (38-mm-) thick glass-fiber board insulation.
   2. Liner: Same material as curb, of manufacturer's standard thickness and finish.
   3. Factory-installed wood nailer at top of curb, continuous around curb perimeter.
   4. On ribbed or fluted metal roofs, form deck-mounting flange at perimeter bottom to conform to roof profile.
   5. Fabricate curbs to minimum height of 12 inches (300 mm) unless otherwise indicated.
   6. Top Surface: Level around perimeter with roof slope accommodated by sloping the deck-mounting flange.
   7. Sloping Roofs: Where roof slope exceeds 1:48, fabricate curb with perimeter curb height tapered to accommodate roof slope so that top surface of perimeter curb is level. Equip unit with water diverter or cricket on side that obstructs water flow.

2.4 EQUIPMENT SUPPORTS

A. Equipment Supports: Internally reinforced metal equipment supports capable of supporting superimposed live and dead loads, including equipment loads and other construction indicated on Drawings; with welded or mechanically fastened and sealed corner joints, and integrally formed deck-mounting flange at perimeter bottom.
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      a. AES Industries, Inc.
      b. Curbs Plus, Inc.
      c. Custom Solution Roof and Metal Products.
B. Size: Coordinate dimensions with roughing-in information or Shop Drawings of equipment to be supported

C. Material: Zinc-coated (galvanized) steel sheet, 0.052 inch (1.32 mm) thick.
   1. Finish: Mill phosphatized.

D. Construction:
   1. Insulation: Factory insulated with 1-1/2-inch- (38-mm-) thick glass-fiber board insulation.
   2. Liner: Same material as equipment support, of manufacturer's standard thickness and finish.
   3. Factory-installed continuous wood nailers 3-1/2 inches (90 mm) wide at tops of equipment supports.
   4. Metal Counterflashing: Manufacturer's standard, removable, fabricated of same metal and finish as equipment support.
   5. On ribbed or fluted metal roofs, form deck-mounting flange at perimeter bottom to conform to roof profile.
   6. Fabricate equipment supports to minimum height of 12 inches (300 mm) unless otherwise indicated.
   7. Sloping Roofs: Where roof slope exceeds 1:48, fabricate each support with height to accommodate roof slope so that tops of supports are level with each other. Equip supports with water diverters or crickets on sides that obstruct water flow.

2.5 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

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

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions, and other conditions affecting performance of the Work.

B. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
C. Verify dimensions of roof openings for roof accessories.

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

3.2 INSTALLATION

A. General: Install roof accessories according to manufacturer's written instructions.
   1. Install roof accessories level, plumb, true to line and elevation, and without warping, jogs in alignment, excessive oil canning, buckling, or tool marks.
   2. Anchor roof accessories securely in place so they are capable of resisting indicated loads.
   3. Use fasteners, separators, sealants, and other miscellaneous items as required to complete installation of roof accessories and fit them to substrates.
   4. Install roof accessories to resist exposure to weather without failing, rattling, leaking, or loosening of fasteners and seals.

B. Metal Protection: Protect metals against galvanic action by separating dissimilar metals from contact with each other or with corrosive substrates by painting contact surfaces with bituminous coating or by other permanent separation as recommended by manufacturer.
   1. Coat concealed side of uncoated aluminum roof accessories with bituminous coating where in contact with wood, ferrous metal, or cementitious construction.
   2. Underlayment: Where installing roof accessories directly on cementitious or wood substrates, install a course of felt underlayment and cover with a slip sheet, or install a course of polyethylene sheet.

C. Roof Curb Installation: Install each roof curb so top surface is level.

D. Equipment Support Installation: Install equipment supports so top surfaces are level with each other.

E. Pipe Support Installation: Install pipe supports so top surfaces are in contact with and provide equally distributed support along length of supported item.

F. Security Grilles: Weld bar intersections and ends of bars to structural frame or primary curb walls.

G. Roof Walkway Installation:
   1. Verify that locations of access and servicing points for roof-mounted equipment are served by locations of roof walkways.
   2. Install roof walkway support pads prior to placement of roof walkway support stands onto low-slope roofing.

H. Preformed Flashing-Sleeve Installation: Secure flashing sleeve to roof membrane according to flashing-sleeve manufacturer's written instructions.

I. Seal joints with elastomeric sealant as required by roof accessory manufacturer.
3.3 REPAIR AND CLEANING

A. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing according to ASTM A 780.

B. Clean exposed surfaces according to manufacturer's written instructions.

C. Clean off excess sealants.

D. Replace roof accessories that have been damaged or that cannot be successfully repaired by finish touchup or similar minor repair procedures.

END OF SECTION 077200
SECTION 078413 - THROUGH-PENETRATION FIRESTOP SYSTEMS

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. Penetrations in fire-resistance-rated walls.
   2. Penetrations in horizontal assemblies.
   3. Penetrations in smoke barriers.

B. Related Sections:
   1. Division 07 Section "Joint Sealants" for non-fire-resistant joint sealants.
   2. Division 09 Section "Gypsum Board Assemblies" for firestopping where fire rated gypsum board assemblies butt adjacent construction including masonry, steel deck, joists, beams, floors, roofs and structural members.
   3. Division 22 and 23 Sections specifying duct and piping penetrations.
   4. Division 26 Section specifying cable and conduit penetrations.

1.3 SUBMITTALS

A. General: Submit in accordance with Division 01 Section "Submittal Procedures."

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

C. Shop Drawings: For each through-penetration firestop system, show each kind of construction condition penetrated, relationships to adjoining construction, and kind of penetrating item. Include firestop design designation of testing and inspecting agency acceptable to authorities having jurisdiction that evidences compliance with requirements for each condition required.
   1. Submit documentation, including illustrations applicable to each through-penetration firestop system configuration for construction and penetrating items.

D. Product Schedule: For each penetration firestopping system. Include location and design designation of qualified testing and inspecting agency.
   1. Where Project conditions require modification to a qualified testing and inspecting agency’s illustration for a particular penetration firestopping condition, submit illustration, with modifications marked, approved by penetration firestopping manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly.

E. Qualification Data: For qualified Installer.

F. Installer Certificates: From Installer indicating penetration firestopping has been installed in compliance with requirements and manufacturer's written recommendations.
G. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified, independent testing agency, for penetration firestopping.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: A firm experienced in installing penetration firestopping similar in material, design, and extent to that required for this Project, whose work has resulted in construction with a record of successful performance. Qualifications include having the necessary experience, staff, and training to install manufacturer's products per specified requirements. Manufacturer's willingness to sell its penetration firestopping products to Contractor or to Installer engaged by Contractor does not in itself confer qualification on buyer.

B. Installation Responsibility: Assign installation of through-penetration firestop systems and fire-resistant joint systems in Project to a single qualified installer.

C. Fire-Test-Response Characteristics: Penetration firestopping shall comply with the following requirements:
   1. Penetration firestopping tests are performed by a qualified testing agency acceptable to authorities having jurisdiction.
   2. Penetration firestopping is identical to those tested per testing standard referenced in "Penetration Firestopping" Article. Provide rated systems complying with the following requirements:
      a. Penetration firestopping products bear classification marking of qualified testing and inspecting agency.
      b. Classification markings on penetration firestopping correspond to designations listed by the following:
         1) UL in its "Fire Resistance Directory."
         2) Intertek ETL SEMKO in its "Directory of Listed Building Products."
         3) FM Global in its "Building Materials Approval Guide."

D. Provide through-penetration firestop system products containing no detectable asbestos as determined by the method specified in 40 CFR Part 763, subpart F, Appendix A, Section 1, "Polarized Light Microscopy."

E. Preinstallation Conference: Conduct conference at Project site.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver through-penetration firestop system products to Project site in original, unopened containers or packages with intact and legible manufacturers' labels identifying product and manufacturer; date of manufacture; lot number; shelf life, if applicable; qualified testing and inspecting agency's classification marking applicable to Project; curing time; and mixing instructions for multicomponent materials.

B. Store and handle materials for through-penetration firestop systems to prevent their deterioration or damage due to moisture, temperature changes, contaminants, or other causes.
1.6 PROJECT CONDITIONS

A. Environmental Limitations: Do not install penetration firestopping when ambient or substrate temperatures are outside limits permitted by penetration firestopping manufacturers or when substrates are wet because of rain, frost, condensation, or other causes.

B. Install and cure penetration firestopping per manufacturer's written instructions using natural means of ventilations or, where this is inadequate, forced-air circulation.

1.7 COORDINATION

A. Coordinate Work of this Section with the work of other trades to assure the proper sequencing of each installation and to provide a fire- and smoke-resistant installation.

B. Coordinate construction of openings and penetrating items to ensure that penetration firestopping is installed according to specified requirements.

C. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate penetration firestopping.

D. Notify Owner's testing agency at least seven days in advance of penetration firestopping installations; confirm dates and times on day preceding each series of installations.

E. Do not cover up through-penetration firestop system installations that will become concealed behind other construction until each installation has been examined by Owner's inspecting agency and building inspector, if required by authorities having jurisdiction.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   2. Grace Construction Products.
   3. Hilti, Inc.
   6. NUCO Inc.
   8. RectorSeal Corporation.
   9. Specified Technologies Inc.
   10. 3M Fire Protection Products.
   12. USG Corporation.

2.2 PENETRATION FIRESTOPPING

A. Provide penetration firestopping that is produced and installed to resist spread of fire according to requirements required, resist passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated. Penetration firestopping systems shall be
compatible with one another, with the substrates forming openings, and with penetrating items if any.
1. Provide paintable through-penetration firestop products at locations exposed to view in public spaces. Mechanical, electrical and elevator machine rooms are not considered public spaces.

B. Penetrations in Fire-Resistance-Rated Walls: Provide penetration firestopping with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg.
   1. Fire-resistance-rated walls include fire-barrier walls, smoke-barrier walls and fire partitions.
   2. F-Rating: Not less than the fire-resistance rating of constructions penetrated.

C. Penetrations in Horizontal Assemblies: Provide penetration firestopping with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg.
   1. Horizontal assemblies include floors and floor/ceiling assemblies.
   2. F-Rating: At least 1 hour, but not less than the fire-resistance rating of constructions penetrated.

D. Penetrations in Smoke Barriers: Provide penetration firestopping with ratings determined per UL 1479.
   1. L-Rating: Not exceeding 5.0 cfm/sq. ft. of penetration opening at 0.30-inch wg at both ambient and elevated temperatures.

E. Exposed Penetration Firestopping: Provide products with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.

F. VOC Content: Provide penetration firestopping that complies with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
   1. Architectural Sealants: 250 g/L.
   2. Sealant Primers for Nonporous Substrates: 250 g/L.
   3. Sealant Primers for Porous Substrates: 775 g/L.

G. Accessories: Provide components for each penetration firestopping system that are needed to install fill materials and to maintain ratings required. Use only those components specified by penetration firestopping manufacturer and approved by qualified testing and inspecting agency for firestopping indicated.
   1. Permanent forming/damming/backing materials, including the following:
      a. Slag-wool-fiber or rock-wool-fiber insulation.
      b. Sealants used in combination with other forming/damming/backing materials to prevent leakage of fill materials in liquid state.
      c. Fire-rated form board.
      d. Fillers for sealants.
   2. Temporary forming materials.
   5. Steel sleeves.
2.3 FILL MATERIALS

A. Cast-in-Place Firestop Devices: Factory-assembled devices for use in cast-in-place concrete floors and consisting of an outer metallic sleeve lined with an intumescent strip, a radial extended flange attached to one end of the sleeve for fastening to concrete formwork, and a neoprene gasket.

B. Latex Sealants: Single-component latex formulations that do not re-emulsify after cure during exposure to moisture.

C. Firestop Devices: Factory-assembled collars formed from galvanized steel and lined with intumescent material sized to fit specific diameter of penetrant.

D. Intumescent Composite Sheets: Rigid panels consisting of aluminum-foil-faced elastomeric sheet bonded to galvanized-steel sheet.

E. Intumescent Putties: Nonhardening dielectric, water-resistant putties containing no solvents, inorganic fibers, or silicone compounds.

F. Intumescent Wrap Strips: Single-component intumescent elastomeric sheets with aluminum foil on one side.

G. Mortars: Prepackaged dry mixes consisting of a blend of inorganic binders, hydraulic cement, fillers, and lightweight aggregate formulated for mixing with water at Project site to form a nonshrinking, homogeneous mortar.

H. Pillows/Bags: Reusable heat-expanding pillows/bags consisting of glass-fiber cloth cases filled with a combination of mineral-fiber, water-insoluble expansion agents, and fire-retardant additives. Where exposed, cover openings with steel-reinforcing wire mesh to protect pillows/bags from being easily removed.

I. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

J. 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, and nonsag formulation for openings in vertical and sloped surfaces, unless indicated firestopping limits use of nonsag grade for both opening conditions.

2.4 MIXING

A. For those products requiring mixing before application, comply with penetration firestopping manufacturer's written instructions for accurate proportioning of materials, water (if required), type of mixing equipment, selection of mixer speeds, mixing containers, mixing time, and other items or procedures needed to produce products of uniform quality with optimum performance characteristics for application required.
PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance of the Work.

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

3.2 PREPARATION

A. Surface Cleaning: Clean out openings immediately before installing penetration firestopping to comply with manufacturer's written instructions and with the following requirements:
   1. Remove from surfaces of opening substrates and from penetrating items foreign materials that could interfere with adhesion of penetration firestopping.
   2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with penetration firestopping. Remove loose particles remaining from cleaning operation.
   3. Remove laitance and form-release agents from concrete.

B. Priming: Prime substrates where recommended in writing by manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

C. Masking Tape: Use masking tape to prevent penetration firestopping from contacting adjoining surfaces that will remain exposed on completion of the Work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove stains. Remove tape as soon as possible without disturbing firestopping's seal with substrates.

3.3 INSTALLATION

A. General: Install penetration firestopping to comply with manufacturer's written installation instructions and published drawings for products and applications indicated.

B. Install forming materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.
   1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not indicated as permanent components of firestopping.

C. Install fill materials for firestopping by proven techniques to produce the following results:
   1. Fill voids and cavities formed by openings, forming materials, accessories, and penetrating items as required to achieve fire-resistance ratings indicated.
   2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
   3. For fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.
3.4 IDENTIFICATION

A. Identify penetration firestopping with preprinted metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches of firestopping edge so labels will be visible to anyone seeking to remove penetrating items or firestopping. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:
   1. The words "Warning - Penetration Firestopping - Do Not Disturb. Notify Building Management of Any Damage."
   2. Contractor's name, address, and phone number.
   3. Designation of applicable testing and inspecting agency.
   4. Date of installation.
   5. Manufacturer's name.
   6. Installer's name.

3.5 FIELD QUALITY CONTROL

A. Owner may engage a qualified testing agency to perform tests and inspections.

B. Allow for 3 random samples of each type of firestopping system to be inspected. Reinstall disturbed samples to comply with requirements.

C. Where deficiencies are found or penetration firestopping is damaged or removed because of testing, repair or replace penetration firestopping to comply with requirements.
   1. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

D. Proceed with enclosing penetration firestopping with other construction only after inspection reports are issued and installations comply with requirements.

3.6 CLEANING AND PROTECTION

A. Clean off excess fill materials adjacent to openings as the Work progresses by methods and with cleaning materials that are approved in writing by penetration firestopping manufacturers and that do not damage materials in which openings occur.

B. Provide final protection and maintain conditions during and after installation that ensure that penetration firestopping is without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, immediately cut out and remove damaged or deteriorated penetration firestopping and install new materials to produce systems complying with specified requirements.

END OF SECTION 078413
SECTION 078446 - FIRE-RESISTIVE JOINT SYSTEMS

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 fire-resistive joint systems for the following:
   1. Floor-to-wall joints.
   2. Head-of-wall joints.
   3. Wall-to-wall joints.
   4. Wall-to-adjacent structure and supports.

B. Related Sections include the following:
   1. Division 07 Section "Through-Penetration Firestop Systems" for systems installed in openings in walls and floors with and without penetrating items.
   2. Division 07 Section "Joint Sealants" for non-fire-resistive joint sealants.
   3. Division 09 Section "Gypsum Board Assemblies" for firestopping where fire rated gypsum board assemblies butting adjacent construction including masonry, steel deck, joists, beams, floors, roofs and structural members.

1.3 PERFORMANCE REQUIREMENTS
A. General: Provide fire-resistive joint systems that are produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of assembly in which fire-resistive joint systems are installed.

B. Joint Systems in and between Fire-Resistance-Rated Constructions: Provide systems with assembly ratings equaling or exceeding the fire-resistance ratings of construction that they join, and with movement capabilities and L-ratings indicated as determined by UL 2079.
   1. Load-bearing capabilities as determined by evaluation during the time of test.
   2. For fire-resistance systems with movement capabilities, allow for the following movement.
      a. Floors: 3/4-inch deflection.
      b. Roofs: 1 1/2-inch deflection.
   3. Provide systems with L-rating where walls and partitions also are smoke barriers. Where a fire-resistive joint system is not available with the ability to resist smoke, provide smoke sealant material to one side of wall to stop the passage of smoke.

C. For fire-resistive systems exposed to view, provide products with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.
   1. For fire-resistive systems exposed to view, provide products that are paintable.

1.4 SUBMITTALS
A. General: Submit in accordance with Division 01 Section "Submittal Procedures."
B. **Product Data:** For each type of product proposed for use. List product characteristics, typical uses, performance and limitation criteria, test data, and installation instructions.

C. **Shop Drawings:** For each fire-resistant joint system, show each kind of construction condition in which joints are installed; also show relationships to adjoining construction. Include fire-resistant joint system design designation of testing and inspecting agency acceptable to authorities having jurisdiction that demonstrates compliance with requirements for each condition indicated.
   1. Submit documentation, including illustrations, from a qualified testing and inspecting agency that is applicable to each fire-resistant joint system configuration for construction and penetrating items.
   2. For those firestop applications that exist for which no UL tested system is available through a manufacturer, a manufacturer's engineering judgment derived from a similar UL system design or other tests shall be submitted to local authorities having jurisdiction for their review and approval prior to installation. Manufacturer's engineering judgment shall follow requirements set forth by the International Firestop Council.

D. **Product Certificates:** For each type of fire-resistant joint system, signed by product manufacturer.

E. **Qualification Data:** For Installer.

F. **Field quality-control test reports.**

1.5 **QUALITY ASSURANCE**

A. **Installer Qualifications:** A firm experienced in installing fire-resistant joint systems similar in material, design, and extent to that required for this Project, whose work has resulted in construction with a record of successful performance. Qualifications include having the necessary experience, staff, and training to install manufacturer's products per specified requirements. Manufacturer's willingness to sell its fire-resistant joint system products to Contractor or to Installer engaged by Contractor does not in itself confer qualification on buyer.

B. **Installation Responsibility:** Assign installation of through-penetration firestop systems and fire-resistant joint systems in Project to a single qualified installer.

C. **Source Limitations:** Obtain fire-resistant joint systems, for each kind of joint and construction condition indicated, through one source from a single manufacturer.

D. **Fire-Test-Response Characteristics:** Provide fire-resistant joint systems that comply with the following requirements and those specified in Part 1 "Performance Requirements" Article:
   1. Fire-resistance tests are performed by a qualified testing and inspecting agency. A qualified testing and inspecting agency is UL, OPL or another agency performing testing and follow-up inspection services for fire-resistant joint systems acceptable to authorities having jurisdiction.
   2. Fire-resistant joint systems are identical to those tested per methods indicated in Part 1 "Performance Requirements” Article and comply with the following:
      a. Fire-resistant joint system products bear classification marking of qualified testing and inspecting agency.
      b. Fire-resistant joint systems correspond to those indicated by referencing system designsations of the qualified testing and inspecting agency.
1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver fire-resistive joint system products to Project site in original, unopened containers or packages with qualified testing and inspecting agency's classification marking applicable to Project and with intact and legible manufacturers' labels identifying product and manufacturer, date of manufacture, lot number, shelf life, curing time, and mixing instructions for multicomponent materials.

B. Store and handle materials for fire-resistive joint systems to prevent their deterioration or damage due to moisture, temperature changes, contaminants, or other causes.

C. Remove and replace materials, at no cost to Owner, that cannot be applied within their stated shelf life.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Do not install fire-resistive joint systems when ambient or substrate temperatures are outside limits permitted by fire-resistive joint system manufacturers or when substrates are wet due to rain, frost, condensation, or other causes.

B. Ventilate fire-resistive joint systems per manufacturer's written instructions by natural means or, if this is inadequate, forced-air circulation.

1.8 COORDINATION

A. Coordinate construction of joints to ensure that fire-resistive joint systems are installed according to specified requirements.

B. Coordinate sizing of joints to accommodate fire-resistive joint systems.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Products: Subject to compliance with requirements, provide products by one of the following:
   3. Hilti Construction Chemicals, Inc.
   5. Nelson Firestop Products
   6. NUCO Inc.
   7. RectorSeal Corporation (The)
   8. Specified Technologies Inc.
   9. 3M Fire Protection Products
   10. Tremco Sealant/Weatherproofing Division
2.2 FIRE-RESISTIVE JOINT SYSTEMS

A. Compatibility: Provide fire-resistive joint systems that are compatible with joint substrates, under conditions of service and application, as demonstrated by fire-resistive joint system manufacturer based on testing and field experience.

B. Fire-resistive joint systems surfaces that will remain exposed in public spaces upon completion of Work shall be paintable.
   1. Mechanical, electrical and elevator machine rooms are not considered public spaces.

C. Accessories: Provide components of fire-resistive joint systems, including primers and forming materials, that are needed to install fill materials and to comply with Part 1 "Performance Requirements" Article. Use only components specified by fire-resistive joint system manufacturer and approved by the qualified testing and inspecting agency for systems submitted.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for joint configurations, substrates, and other conditions affecting performance of work.

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

3.2 PREPARATION

A. Surface Cleaning: Clean joints immediately before installing fire-resistive joint systems to comply with fire-resistive joint system manufacturer's written instructions and the following requirements:
   1. Remove from surfaces of joint substrates foreign materials that could interfere with adhesion of fill materials.
   2. Clean joint substrates to produce clean, sound surfaces capable of developing optimum bond with fill materials. Remove loose particles remaining from cleaning operation.
   3. Remove laitance and form-release agents from concrete.

B. Priming: Prime substrates where recommended in writing by fire-resistive joint system manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

C. Masking Tape: Use masking tape to prevent fill materials of fire-resistive joint system from contacting adjoining surfaces that will remain exposed on completion of Work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove smears of fire-resistive joint system materials from adjoining surfaces. Remove tape as soon as possible without disturbing fire-resistive joint system's seal with substrates or damaging adjoining surfaces.
3.3 INSTALLATION

A. General: Install fire-resistive joint systems to comply with Part 1 "Performance Requirements" Article and fire-resistive joint system manufacturer's written installation instructions for products and applications used.

B. Install forming/packing/backing materials and other accessories of types required to support fill materials during their application and in position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.

C. Install fill materials for fire-resistive joint systems by proven techniques to produce the following results:
   1. Fill voids and cavities formed by openings and forming/packing/backing materials as required to achieve fire-resistance ratings indicated.
   2. Apply fill materials so they contact and adhere to substrates formed by joints.
   3. For fill materials that will remain exposed after completing Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 FIELD QUALITY CONTROL

A. Inspecting Agency: Owner may engage a qualified independent inspecting agency to inspect fire-resistive joint systems and prepare inspection reports.

B. Before installation of ceilings and adjacent construction that would conceal firestopping, inspect joints to verify complete installation of firestopping materials.

C. Remove and replace fire-resistive joint systems where inspections indicate that they do not comply with specified requirements.

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

E. Proceed with enclosing fire-resistive joint systems with other construction only after inspection reports are issued and fire-resistive joint systems comply with requirements.

3.5 CLEANING AND PROTECTING

A. Clean off excess fill materials adjacent to joints as Work progresses by methods and with cleaning materials that are approved in writing by fire-resistive joint system manufacturers and substrate manufacturers that do not damage materials in which openings occur.

B. Provide final protection and maintain conditions during and after installation that ensure fire-resistive joint systems are without damage or deterioration at time of Substantial Completion. If damage or deterioration occurs despite such protection, cut out and remove damaged or deteriorated fire-resistive joint systems immediately and install new materials to produce fire-resistive joint systems complying with specified requirements.

END OF SECTION 078446
SECTION 079200 - JOINT SEALANTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes joint sealants for the following applications, including those specified by reference to this Section:
   1. Interior joints in the following vertical surfaces and horizontal nontraffic surfaces:
      a. Perimeter joints of exterior openings where indicated.
      b. Perimeter joints between interior wall surfaces and frames of interior doors, and windows.
      c. Other joints as indicated.
   B. Related Sections include the following:
      1. Division 07 Section "Through-Penetration Firestop Systems" for sealing penetrations in fire-resistance-rated construction.
      2. Division 07 Section "Fire-Resistive Joint Systems" for sealing joints in fire-resistance-rated construction.
      3. Division 09 Section "Gypsum Board Assemblies" for sealing perimeter joints of gypsum board partitions to reduce smoke transmission.
      4. Divisions 22, 23, and 26 for sealing of perimeter joints of plumbing, HVAC systems, automatic fire protection systems, and electrical systems.

1.3 PERFORMANCE REQUIREMENTS

A. Provide joint sealants that have been produced and installed to establish and to maintain watertight and airtight continuous seals without causing staining or deterioration of joint substrates.

B. Provide joint sealants for interior applications that establish and maintain airtight and water-resistant continuous joint seals without staining or deteriorating joint substrates.

1.4 SUBMITTALS

A. General: Submit in accordance with Division 01 Section "Submittal Procedures."

B. Product Data: For each joint-sealant product indicated.

C. Samples for Selection: Manufacturer’s color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.

D. Qualification Data: For Installer.
1.5 QUALITY ASSURANCE
   
   A. Installer Qualifications: Engage an experienced Installer who has completed joint sealant applications similar in materials, design, and extent to that indicated for Project that have resulted in construction with a record of successful in-service performance.

   B. Source Limitations: Obtain each type of joint sealant through one source from a single manufacturer.

1.6 PROJECT CONDITIONS

   A. Environmental Conditions: 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. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
      3. Contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

   B. Joint Width Conditions: Do not proceed with installation of joint sealants where joint widths are less than allowed by joint sealant manufacturer for application indicated.

   C. Joint Substrate Conditions: Do not proceed with installation of joint sealants until contaminants capable of interfering with their adhesion are removed from joint substrates.

1.7 SEQUENCING AND SCHEDULING

   A. Coordinate Work of this Section with interfacing and adjoining Work for proper sequencing of each installation to ensure a weathertight installation.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

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

   B. Stain-Test-Response Characteristics: Where sealants are specified to be nonstaining to porous substrates, provide products that have undergone testing according to ASTM C 1248 and have not stained porous joint substrates indicated for Project.

   C. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

2.2 JOINT SEALANTS

   A. Type 1 - General Purpose Exterior Sealant: Polyurethane; ASTM C920, Type S, Grade NS, Class 25; single component.
      1. Sonolastic NP-1; Sonneborn, Division of ChemRex Inc.
      2. Dymonic; Tremco.
3. Sikaflex-1a; Sika Corporation, Inc.
4. Dynatrol 1; Pecora Corporation.
5. Vulkem 116; Tremco.
6. Chem-Calk 900; Bostik Findley.

B. Type 2 - General Purpose Exterior Sealant: Polyurethane; ASTM C920, Type M, Grade NS, Class 25; two-component.
1. Sonolastic NP-2; Sonneborn, Division of ChemRex Inc.
2. Dymeric 240/240FC; Tremco.
3. Sikaflex-2c, NS; Sika Corporation, Inc.
4. Dynatrol 2; Pecora Corporation.
5. Vulkem 922; Tremco.
6. Chem-Calk 500; Bostik Findley.

C. Type 3 - General Purpose Interior Sealant: Acrylic emulsion latex; ASTM C834, single component, paintable.
1. Tremco Acrylic Latex; Tremco.
2. AC-20; Pecora Corporation.
3. Chem-Calk 600; Bostik Findley.

2.3 JOINT-SEALANT BACKING

A. General: Provide sealant backings (backer rods) 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. Plastic Foam Joint Fillers (Backer Rods): Preformed, compressible, resilient, nonstaining, nonwaxing, nonextruding strips of flexible plastic foam of material indicated below and of size, shape, and density to control sealant depth and otherwise contribute to producing optimum sealant performance:
1. Closed-cell polyethylene foam, nonabsorbent to liquid water and gas, nonoutgassing in unruptured state.

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.

2.4 MISCELLANEOUS MATERIALS

A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.

B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.

C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and 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 concrete, masonry, unglazed surfaces of ceramic tile, and similar 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.
   3. Remove laitance and form-release agents from concrete.
   4. Clean metal, glass, porcelain enamel, glazed surfaces of ceramic tile, and other 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.

B. Joint Priming: Prime joint substrates, where indicated or 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. Installation of Sealant Backings (Backer Rods): Install sealant backings to comply with the following requirements:
   1. Install sealant backings of type indicated to provide support of 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.
a. Do not leave gaps between ends of sealant backings.
b. Do not stretch, twist, puncture, or tear sealant backings.

2. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and joint fillers or backs of joints.

D. Installation of Sealants: Install sealants using proven techniques that result in sealants directly contacting and fully wetting joint substrates, completely filling recesses provided for each joint configuration, and providing uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability. Install sealants at the same time sealant backings are installed.

E. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.
   1. Remove excess 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. Exterior Joints: Type 2; colors as selected.

B. Concealed Interior Perimeter Joints of Exterior Openings: Type 1.

C. Exposed Interior Perimeter Joints of Exterior Openings: Type 3; colors as selected.

D. Interior Joints for Which No Other Sealant is Indicated: Type 3; colors as selected.

END OF SECTION 079200
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:
   1. Steel doors.
   2. Steel frames.
   3. Door hardware for steel doors.

B. Related Sections include the following:
   1. Division 09 painting Sections for field painting steel frames.

1.3 DEFINITIONS

A. Minimum Steel Sheet Thickness: Minimum thickness of base metal without coatings.

1.4 SUBMITTALS

A. General: Submit in accordance with Division 01 Section "Submittal Procedures."

B. Product Data: Include door designation, type, level and model, construction details, material descriptions, core descriptions, label compliance, and finishes for each type of door and frame specified. Submit data for each type of hardware.

C. Shop Drawings: In addition to requirements below, provide a schedule of steel doors and frames using same reference numbers for details and openings as those on Drawings:
   1. Elevations of each door design.
   2. Details of doors, including vertical and horizontal edge details.
   3. Frame details for each frame type, including dimensioned profiles.
   4. Details and locations of reinforcement and preparations for hardware.
   5. Details of each different wall opening condition.
   6. Details of anchorages, accessories, joints, and connections.
   7. Details of glazing frames and stops showing glazing.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver doors and frames wrapped, or crated to provide protection during transit and Project-site storage. Do not use non-vented 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. Inspect doors and frames on delivery for damage; notify shipper and supplier if damage is found. Minor damages may be repaired provided refinished items match new work and are acceptable to Architect. Remove and replace damaged items that cannot be repaired as directed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Steel Door and Frame Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Ceco Door Products; an ASSA ABLOY Group Company.
   2. CURRIES Company; an ASSA ABLOY Group Company.
   4. JR Frames.

2.2 MATERIALS

A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.

B. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with minimum A40 zinc-iron-alloy (galvannealed) coating designation.

C. 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 steel door frames of type indicated.

2.3 STEEL FRAMES

A. General: Comply with ANSI A250.8 and with details indicated for type and profile.

B. Hardware Reinforcement: Fabricate reinforcement plates of sufficient strength from same material as frames to support hardware without through bolting and to comply with the following minimum sizes:
   1. Hinges: Minimum 0.123 inch thick (10 gage) 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 (14 gage).
   3. All Other Surface-Mounted Hardware: Minimum 0.067 inch thick (14 gage).
   4. Locate hardware as indicated on Shop Drawings or, if not indicated, according to ANSI A250.8.

C. Supports and Anchors: Fabricated from not less than 0.042-inch thick (18 gage) electrolytic zinc-coated or metallic-coated steel sheet.

D. Jamb Anchors:
   1. Post-installed Expansion Type for Existing 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.
E. Floor Anchors: Formed from same material as frames, not less than 0.042 inch thick (18 gage), and as follows:
   1. Monolithic Concrete Slabs: Clip-type anchors, with two holes to receive fasteners.

F. Fabricate concealed stiffeners and hardware reinforcement from either cold- or hot-rolled steel sheet.

2.4 DOOR HARDWARE

A. Provide the following hardware:

Doors 100, 102
Each pair of doors shall have:

3 (ea.) Hinges: 4.5 x 4.5; Ballbearing NRP; US26D

Door Closers: ANSI A156.4 Grade one; Aluminum Finish

1(ea pair) Cylindrical Lockset: Grade 1, lever handle; Newport lever, match existing keying; 2-3/4 backset; ANSI curved lip strike; US26D

Door stops
Door sweep with Drip: Equal to NGP 101 VA, Mill Finish

Weatherstrip Head and Jambs: Equal to NGP 137NA, Mill Finish

Door Bottom: Equal to NGP3 12V

Threshold: Extruded Aluminum, ½ inch high by 5 inches (field verify required width).

Coordinator

2.5 FRAME FABRICATION

A. General: Fabricate steel 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. 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. Floor Anchors: Weld anchors to bottom of jambs and mullions with at least four spot welds per anchor. Provide floor anchors for all frames.

   2. Jamb Anchors: 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:

      a. Stud-Wall Type:

         1) Three anchors per jamb up to 60 inches in height.

         2) Four anchors per jamb from 60 to 90 inches in height.

   3. Provide frames with temporary spreader bars for shipping. Shipping spreader bars to be removed before installation, with template jig used to properly square up and space jambs.
C. Hardware Preparation: Factory prepare steel frames to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping, according to the Door Hardware Schedule.
   1. Reinforce frames to receive non-templated mortised and surface-mounted door hardware. Through bolting will not be acceptable.
   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.

2.6 STEEL FINISHES

A. General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
   1. Apply primers to steel door and frames after assembly.

B. 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 steel frames.
   1. If unacceptable conditions are encountered, prepare written report, endorsed by Installer, listing conditions detrimental to performance of work.

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

3.2 PREPARATION

A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces.

B. Prior to installation, adjust and securely brace 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.

C. Drill and tap frames to receive non-templated mortised and surface-mounted door hardware.

3.3 INSTALLATION

A. General: Provide frames of sizes, thicknesses, and designs indicated. Install steel frames plumb, rigid, properly aligned, and securely fastened in place; comply with Drawings and manufacturer's written instructions.

B. Steel Frames: Install 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. Remove shipping straps at bottom of frames. Properly space frame using wood template that is full depth of frame and of proper spacing width during setting and anchoring of frames to maintain proper width, with frame plumb and square without twists. Remove temporary braces necessary for installation only after frames have been properly set and secured.
      b. Check plumb, squareness, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
   2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor and secure with post installed expansion anchors. Floor anchors are in addition to wall anchors.
      a. Floor anchors may be set with powder-actuated fasteners instead of post installed expansion anchors if so indicated and approved on Shop Drawings.
   3. Metal-Stud Partitions: Attach wall anchors to studs with screws. Provide floor anchor at each jamb, in addition to the wall anchors.
   4. 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.

C. Factory-Fitted Wood Door: Install doors to comply with manufacturer's written instructions and the referenced quality standard, and as indicated. Align in frames for uniform clearance at each edge.

D. Hardware Installation:
   1. Hinges shall be shimmed with metal shims at each door to provide equal clearance at each jamb.
   2. Locksets, door closers and other hardware shall be installed in accordance with the manufacturer's instructions. Pilot holes of recommended size for wood screws required to fasten hardware shall be drilled by installing Contractor before screws are fastened to wood doors.
3.4 ADJUSTING AND CLEANING

A. 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 doors or frames that are warped, bowed, or otherwise unacceptable.

B. Prime-Coat Touchup for Steel Frames: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying primer.

C. Finished Wood Doors: Replace doors that are damaged or that 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 081000
SECTION 083113 - ACCESS DOORS AND FRAMES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawing 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. Floor doors and frames (floor hatch).

1.3 SUBMITTALS

A. General: Submit in accordance with Division 01 Section "Submittal Procedures."
B. Product Data: For each type of door and frame indicated. Include construction details, materials, individual components and profiles, and finishes.
C. Shop Drawings: Show fabrication and installation details of floor hatch. Include plans, elevations, sections, details, and attachments to other Work.

PART 2 - PRODUCTS

2.1 FLOOR ACCESS DOORS AND FRAMES

A. Manufacturer: The Bilco Company; Floor Door Type J-AL.
B. Floor Doors, General: Equip each door with adjustable counterbalancing springs, heavy-duty hold-open arm that automatically locks door open at 90 degrees, release handle with vinyl grip that allows for one-handed closure.
C. Aluminum Channel-Frame Floor Door: Single-leaf opening as indicated. Structural-aluminum channel frame with 1/4-inch- thick, diamond-pattern, aluminum tread plate door with perimeter debris gasket; nonwatertight; loading capacity to support 300-lbf/sq. ft. pedestrian live load.
D. Hardware: Provide the following:
   2. Springs: Composite spring tube assembly with electrostatically-coated compression springs.
   3. Handle: Stainless-steel slam latch with removable key wrench and gasketed plug for fixed areaway leafs.
      a. 
E. Finish: Mill-finish aluminum with bituminous coating applied to exterior of frame.
PART 3 - EXECUTION

3.1 INSTALLATION

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

B. Set frames accurately in position and attach securely to supports with plane of face panels aligned with adjacent finish surfaces.

3.2 ADJUSTING AND CLEANING

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

B. Remove and replace doors and frames that are warped, bowed, or otherwise damaged.

END OF SECTION 083113
SECTION 085113 - ALUMINUM WINDOWS

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. Exterior aluminum-framed windows of the following types:
      a. Single hung.
      b. Fixed.

B. Related Sections include the following:
   1. Division 07 Section "Self-Adhering Sheet Air/Vapor Barrier System" for stripping in nailing fin around perimeter.

1.3 DEFINITIONS

A. Performance class designations according to AAMA/WDMA 101/I.S.2/NAFS:

B. Performance grade number according to AAMA/WDMA 101/I.S.2/A440-08:
   1. Design pressure number in pounds force per square foot used to determine the structural test pressure and water test pressure.

C. Structural Test Pressure: For uniform load structural test, is equivalent to 150 percent of the design pressure.

D. Minimum Test Size: Smallest size permitted for performance class (gateway test size). Products must be tested at minimum test size or at a size larger than minimum test size to comply with requirements for performance class.

1.4 SUBMITTALS

A. General: Submit in accordance with Division 01 Section “Submittal Procedures”.

B. Product Data: Include construction details, material descriptions, fabrication methods, dimensions of individual components and profiles, hardware, finishes, STC ratings and operating instructions for each type of aluminum window indicated.

C. Shop Drawings: Include plans, building elevations at 1/4-inch = 1 foot scale, unit elevations at 3/4-inch = 1 foot scale, sections, details at full scale, hardware, attachments to other work, operational clearances, installation details, and the following:
   1. Mullion details, including reinforcement and stiffeners.
   2. Joinery details.
   4. Flashing and drainage details.
5. Weather-stripping details.
7. Nailing fin details.
8. Glazing details.
9. Field measure and indicate the width of each existing masonry opening for custom width and proper clearances for each opening.

D. Product Schedule: For aluminum windows. Use same designations indicated on Drawings.

E. Product Test Reports: Based on evaluation of comprehensive tests performed within the last four years by a qualified testing agency for each type, class, grade, and size of aluminum window. Test results based on use of downsized test units will not be accepted.

F. Maintenance Data: For operable window sash, operating hardware, weather stripping, and finishes to include in maintenance manuals.

G. Warranty: Special warranty specified in this Section.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain aluminum windows through one source from a single manufacturer.

B. Product Options: Drawings indicate size, profiles, dimensional requirements, and aesthetic effects of aluminum windows and are based on the specific window type and system indicated. Refer to Division 01 Section "Product Requirements." Do not modify size and dimensional requirements.
   1. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.


D. Glazing Publications: Comply with published recommendations of glass manufacturers and with GANA's "Glazing Manual" unless more stringent requirements are indicated.

E. Insulating Glass Certification Program: Provide insulating glass units permanently marked on spacers or at least on one component pane of units with the appropriate certification label of the inspecting agency indicated below:
   1. Insulating Glass Certification Council (IGCC).
   2. Associated Laboratories, Inc. (ALI).

F. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

G. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination." Review methods and procedures related to aluminum windows including, but not limited to, the following:
1. Meet with Owner, Architect, window Installer, window manufacturer's representative, air/vapor barrier Installer, and installers whose work interfaces with or affects windows.
2. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
3. Review and discuss the finishing of aluminum windows that is required to be coordinated with the finishing of other aluminum work for color and finish matching.
4. Review, discuss, and coordinate the interrelationship of aluminum windows with other exterior wall components. Include provisions for structural anchorage, tie-in with air/vapor barrier, flashing, weeping, sealants, and protection of finishes.
5. Review and discuss the sequence of work required to construct a watertight and weathertight exterior building envelope.
6. Inspect and discuss the condition of substrate and other preparatory work performed by other trades.
7. Review weather and forecasted weather conditions and procedures for coping with unfavorable conditions.
8. Document proceedings, including corrective measures and actions required, and furnish copy of record to each participant.
9. Provide 5 business days minimum advance notice to participants prior to convening preinstallation conference.

1.6 PROJECT CONDITIONS

A. Field Measurements: Verify aluminum window openings by field measurements before fabrication and indicate measurements on Shop Drawings.
   1. Coordinate requirements for rough openings and masonry openings.
   2. Field measure and indicate the width of each existing masonry opening for custom width and proper clearances for each opening.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Protect glass and glazing to prevent chipping, cracking and other similar damage.
B. Protect finished surfaces to prevent damage.
C. Store windows in upright position, off ground.
D. Protect window units from lime, mortar, runoff from concrete and copper, weld splatter, acids, solvents, abrasive cleaners, and other items that could damage the window units.

1.8 WARRANTY

A. General: Special warranties specified in this Section shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and will be in addition to and run concurrent with other warranties made by the Contractor under requirements of the Contract Documents.
B. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace aluminum windows that fail in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Failure to meet performance requirements.
b. Structural failures including excessive deflection, water leakage, air infiltration, or condensation.
c. Faulty operation of movable sash and hardware.
d. Deterioration of metals, other materials, and metal finishes beyond normal weathering.
e. Failure of insulating glass.

2. Warranty Period:
   a. Window: Two years from date of Substantial Completion.
   b. Glazing: 10 years from date of Substantial Completion against coating and seal failure.
   c. Metal Finish: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with specified requirements, provide products by one of the following:
   1. Traco;
      b. Fixed Units.
   2. Manufacturers wishing to be considered as a substitution shall submit documentation continuous fin for receipt of air/vapor barrier complying with the drawings, and a sample jamb and sill corner. Submit product documentation of windows and frames in accordance with Division 01 Section “Substitutions and Product Options.”

2.2 MATERIALS

A. Aluminum Extrusions: Alloy and temper recommended by aluminum window manufacturer for strength, corrosion resistance, and application of required finish, but not less than 22,000-psi ultimate tensile strength, not less than 16,000-psi minimum yield strength, and not less than 0.062-inch thickness at any location for the main frame and sash members.

B. Fasteners: Aluminum, nonmagnetic stainless steel, epoxy adhesive, or other materials warranted by manufacturer to be noncorrosive and compatible with aluminum window members, trim, hardware, anchors, and other components.
   1. Exposed Fasteners: Unless unavoidable for applying hardware, do not use exposed fasteners. For application of hardware, use fasteners that match finish of member or hardware being fastened, as appropriate.

C. Anchors, Clips, and Accessories: Aluminum, nonmagnetic stainless steel, or zinc-coated steel or iron complying with ASTM B 633 for SC 3 severe service conditions; provide sufficient strength to withstand design pressure indicated.

D. Reinforcing Members: Aluminum, nonmagnetic stainless steel, or nickel/chrome-plated steel complying with ASTM B 456 for Type SC 3 severe service conditions, or zinc-coated steel or iron complying with ASTM B 633 for SC 3 severe service conditions; provide sufficient strength to withstand design pressure indicated.
E. Compression-Type Weather Stripping: Provide compressible weather stripping designed for permanently resilient sealing under bumper or wiper action and for complete concealment when aluminum window is closed.
   1. Weather-Stripping Material: Manufacturer's standard system and materials complying with AAMA/WDMA 101/I.S.2/NAFS.

   1. Weather Seals: Provide weather stripping with integral barrier fin or fins of semirigid, polypropylene sheet or polypropylene-coated material. Comply with AAMA 701/702.

G. Replaceable Weather Seals: Comply with AAMA 701/702.

H. Sealant: For sealants required within fabricated windows, provide window manufacturer's standard, permanently elastic, nonshrinking, and nonmigrating type recommended by sealant manufacturer for joint size and movement.

2.3 WINDOW

A. Window Type: Thermally broken single hung units and fixed units having a continuous nailing flange around entire window perimeter.

B. AAMA/WDMA Performance Requirements: Provide aluminum windows of performance indicated that comply with AAMA/WDMA 101/I.S.2/A440-08 unless more stringent performance requirements are indicated.
   1. Performance Class and Grade: Shall be as follows:
      a. Single Hung Units: Not less than H-HC40.
      b. Fixed Units: Not less than F-HC80.

C. Condensation-Resistance Factor (CRF): Provide aluminum windows tested for thermal performance according to AAMA 1503, showing a CRF of 50 minimum.

D. Thermal Transmittance: Provide aluminum windows with a whole-window, U-factor maximum indicated at 15-mph exterior wind velocity and winter condition temperatures when tested according to AAMA 1503.
   1. U-Factor:
      a. Single Hung Units: 0.61 Btu/sq. ft. x h x deg F or less.

E. Air Infiltration: Maximum rate not more than indicated when tested according to AAMA/WDMA 101/I.S.2/NAFS, Air Infiltration Test.
   1. Single Hung Units: Shall not exceed 0.12 cm/ft of sash crack per ASTM E 283 at a differential static pressure of 1.56 psf.

F. Water Resistance: No water leakage as defined in AAMA/WDMA referenced test methods at a water test pressure equaling that indicated, when tested according to AAMA/WDMA 101/I.S.2/NAFS, Water Resistance Test.

G. Forced-Entry Resistance: Comply with Performance Grade 10 requirements when tested according to ASTM F 588.
2.4 GLAZING

A. Glass: Clear, insulating-glass units, argon gas filled, with low-E coating on third surface.
   1. Insulating units shall be 1-inch thick insulating glass unit. Provide tempered glass where indicated and where required by code.
   2. Provide obscured glass at locations indicated.

B. Glazing System: Manufacturer's standard factory-glazing system that produces weathertight seal.

2.5 HARDWARE

A. General: Provide manufacturer's standard hardware fabricated from aluminum, stainless steel, carbon steel complying with AAMA 907, or other corrosion-resistant material compatible with aluminum; designed to smoothly operate, tightly close, and securely lock aluminum windows, and sized to accommodate sash or ventilator weight and dimensions. Do not use aluminum in frictional contact with other metals. Where exposed, provide solid white metal hardware with a special coating finish and plated steel or brass/bronze operating bars and rods.

B. Counterbalancing Mechanism: Comply with AAMA 902.
   1. Sash Balance: Concealed, of size and capacity to hold sash stationary at any open position; Class 5.

C. Locks and Latches: Designed to allow unobstructed movement of the sash across adjacent sash in direction indicated and operated from the inside only.

D. Single-Hung Windows: Provide the following operating hardware and weather stripping:
   1. Sash Balances: Two per sash.
   2. Handle: Continuous, integral, sash lift bar on bottom rail of forward-placed operating sash.
   3. Sash Lock: Cam-action sweep lock and keeper on meeting rail; on sash wider than 36 inches provide two per sash.
   4. Weather Stripping: Provide full-perimeter weather stripping for each operable sash, unless otherwise indicated.

2.6 INSECT SCREENS

A. General: Design windows and hardware to accommodate screens in a tight-fitting, removable arrangement, with a minimum of exposed fasteners and latches. Fabricate insect screens to fully integrate with window frame. Locate screens on outside of single hung windows. Provide screen for each operable exterior sash.
   1. Comply with SMA 1004, "Specifications for Aluminum Tubular Frame Screens for Windows," for minimum standards of appearance, fabrication, attachment of screen fabric, hardware, and accessories unless more stringent requirements are indicated.

B. Aluminum Insect Screen Frames: Manufacturer's standard aluminum alloy complying with SMA 1004. Fabricate frames with mitered or coped joints or corner extrusions, concealed fasteners, and removable PVC spline/anchor concealing edge of frame.
   1. Extruded-Aluminum or Aluminum Tubular Framing Sections and Cross Braces: Not less than 0.050-inch wall thickness.
   2. Finish: Match aluminum window members, unless otherwise noted.
C. Aluminum Wire Fabric: 18-by-16 mesh of 0.011-inch diameter, coated aluminum wire.

2.7 ACCESSORIES

A. Nailing Fins: Nailing fins, full perimeter, shall be fabricated of extruded aluminum not less than 0.062-inch thickness; shall be continuous with hair line joints at corners.
   1. Nailing fins shall be factory-assembled with all four corner intersections sealed by manufacturer.

B. Mullion Covers: Extruded aluminum mullion covers with a minimum nominal wall thickness of 0.062-inch and cover plates to complete window to window connections. Finish shall match window finish.

2.8 INSTALLATION MATERIALS

A. Polyurethane Foam Insulation (Minimal Expansive): Single- or two-component, UL classified sealant, to insulate, seal, fill, and stop air infiltration; shall not expand to the point to cause pressure on window jambs.
   1. Density: 1.2 lbs./cu. ft.
   2. R-Value: Not less than 4.0 per inch of thickness.
   3. Fire-Test-Response Characteristics: ASTM E 84, as follows:
      b. Smoke Developed: 50.
   4. Products:
      a. Insta-Foam Products Inc., 1500 Cedarwood Drive, Joliet, IL 60435, (800) 800-FOAM.
      c. Convenience Products, 866 Horan Drive, Fenton, MO 63026, (800) 325-6180.

2.9 FABRICATION

A. Fabricate aluminum windows in sizes indicated. Include a complete system for assembling components and anchoring windows.

B. Fixed Window Units: Provide fixed sash in frame to match operable units.

C. Fabricate aluminum windows that are re-glazable without dismantling sash or ventilator framing.

D. Thermally Improved Construction: Fabricate aluminum windows with an integral, concealed, low-conductance thermal barrier; located between exterior materials and window members exposed on interior side; in a manner that eliminates direct metal-to-metal contact.
   1. Provide thermal-break construction that has been in use for not less than three years and has been tested to demonstrate resistance to thermal conductance and condensation and to show adequate strength and security of glass retention.

E. Weather Stripping: Provide full-perimeter weather stripping for each operable sash.

F. Weep Holes: Provide weep holes and internal passages to conduct infiltrating water to exterior.
G. Mullions: Provide mullions and cover plates as shown, matching window units, complete with anchors for support to structure and installation of window units. Allow for erection tolerances and provide for movement of window units due to thermal expansion and building deflections, as indicated. Provide mullions and cover plates capable of withstanding design loads of window units.

H. Factory-Glazed Fabrication: Glaze aluminum windows in the factory where practical and possible for applications indicated. Comply with requirements in AAMA/WDMA 101/I.S.2/NAFS.

I. Glazing Stops: Provide snap-on glazing stops coordinated with Division 8 Section "Glazing" and glazing system indicated. Provide glazing stops to match sash frames.

2.10 FINISHES, GENERAL

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

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

2.11 ALUMINUM FINISHES

A. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.

B. High-Performance Organic Finish (2-Coat Fluoropolymer): AA-C12C40R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: conversion coating; Organic Coating: manufacturer's standard 2-coat, thermocured system consisting of specially formulated inhibitive primer and fluoropolymer color topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight). Prepare, pretreat, and apply coating to exposed metal surfaces to comply with AAMA 2605 and with coating and resin manufacturers' written instructions.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine openings, substrates, structural support, anchorage, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work. Verify rough opening dimensions, levelness of sill plate, and operational clearances. Examine wall flashings, air/vapor barriers, and other built-in components to ensure a coordinated, weathertight window installation.
1. Masonry Surfaces: Visibly dry and free of excess mortar, sand, and other construction debris.
2. Metal Surfaces: Dry; clean; free of grease, oil, dirt, rust, corrosion, and welding slag; without sharp edges or offsets at joints.
3. Verify that rough openings are correct and sill plates are level.

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

3.2 INSTALLATION

A. Comply with Drawings, Shop Drawings, and manufacturer's written instructions for installing windows, hardware, accessories, and other components.

B. Install windows level, plumb, square, true to line, without distortion or impeding thermal movement, anchored securely in place to structural support, and in proper relation to wall flashing and other adjacent construction.
   1. Maintain alignment with adjacent work.
   2. Secure assembly to framed openings without distortion.
   3. Center window in opening, rest bottom on sill plate.
   4. Leave adequate clearance for caulking around entire perimeter between jambs and masonry.
   5. Shim and block as required; check width at center to avoid "hourglass" or bowed out installation.
   6. Foam around interior perimeter of window with minimal expanding foam, to a depth of approximately 1 inch, providing continuous perimeter seal.

C. Install windows and components to drain condensation, water penetrating joints, and moisture migrating within windows to the exterior.

D. Separate aluminum and other corrodible surfaces from sources of corrosion or electrolytic action at points of contact with other materials.

3.3 ADJUSTING, CLEANING, AND PROTECTION

A. Adjust operating sashes, screens, hardware, and accessories for a tight fit at contact points and weather stripping for smooth operation and weathertight closure. Lubricate hardware and moving parts.

B. Clean aluminum surfaces immediately after installing windows. Avoid damaging protective coatings and finishes. Remove excess sealants, glazing materials, dirt, and other substances.

C. Clean factory-glazed glass immediately after installing windows. Comply with manufacturer's written recommendations for final cleaning and maintenance. Remove nonpermanent labels, and clean surfaces.

D. Remove and replace glass that has been broken, chipped, cracked, abraded, or damaged during construction period.

E. Protect window surfaces from contact with contaminating substances resulting from construction operations. In addition, monitor window surfaces adjacent to and below exterior concrete and masonry surfaces during construction for presence of dirt, scum, alkaline deposits,
stains, or other contaminants. If contaminating substances do contact window surfaces, remove contaminants immediately according to manufacturer's written recommendations.

END OF SECTION 085113
SECTION 092950 - GYPSUM BOARD ASSEMBLIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:
   1. Interior gypsum wallboard.
   3. Acoustical insulation in metal-framed assemblies.
   4. Firestopping for rated partitions at interface of structure.
   5. Acoustical sealant.

B. Related Sections include the following:
   1. Division 05 Section "Cold-Formed Metal Framing" for load-bearing steel framing and gypsum sheathing.
   2. Division 06 Section "Rough Carpentry" for concealed wood blocking in gypsum board assembly walls.
   3. Division 07 Sections "Through-Penetration Firestop Systems" and "Fire-Resistive Joint Systems" for fire-resistive joints not covered by work of this Section.
   4. Division 07 Section "Joint Sealants" for sealants not covered by work of this Section.

1.3 DEFINITIONS

A. Gypsum Board Terminology: Refer to ASTM C 11 and GA-505 for definitions of terms for gypsum board assemblies not defined in this Section or in other referenced standards.

1.4 SUBMITTALS

A. General: Submit in accordance with Division 01 Section "Submittal Procedures."

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

1.5 QUALITY ASSURANCE

A. Fire-Test-Response Characteristics: For gypsum board assemblies with fire-resistance ratings, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing and inspecting agency acceptable to authorities having jurisdiction.
   2. Deflection Firestop Track: Top runner indicated in fire-resistance-rated assemblies shall be labeled and listed by UL, Warnock Hersey, or another testing and inspecting agency acceptable to authorities having jurisdiction.
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.

C. Stack gypsum panels flat on leveled supports off floor or slab to prevent sagging.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Comply with ASTM C 840 requirements or gypsum board manufacturer's written recommendations, whichever are more stringent.

B. Do not install panels that are wet, those that are moisture damaged, and those that are mold damaged.
   1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
   2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

C. Ventilation: Ventilate building spaces as required to dry joint treatment materials. Avoid drafts during hot, dry weather to prevent finishing materials from drying too rapidly.

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. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.
   2. Products: Subject to compliance with requirements, provide one of the products specified.

2.2 NON-LOAD-BEARING STEEL FRAMING, GENERAL

A. Framing Members, General: Comply with ASTM C 754 for conditions indicated.
   1. Steel Sheet Components: Comply with ASTM C 645 requirements for metal, unless otherwise indicated.

2.3 STEEL PARTITION AND SOFFIT FRAMING

A. Manufacturers:
   2. Dietrich Industries, Inc.
   3. MarinoWare; Division of Ware Ind.
B. Steel Studs and Runners: ASTM C 645.
  1. Minimum Base Metal Thickness: 0.027 inch (22gage) minimum, unless otherwise indicated.
  2. Depth: 3-5/8 inches, unless indicated otherwise.
  3. Maximum Allowable Deflection: Increase metal thickness where required to meet the following:
     a. Maximum Allowable Deflection for Drywall Assemblies: L/240 calculated using a 5 pound per square uniform load perpendicular to studs and based on stud properties alone.

C. Deep-Leg Deflection Track: ASTM C 645 top runner with flanges to allow for 3/4-inch deflection at floors and 1-1/2 inch at roofs.

D. Firestop Deflection Track: Top runner manufactured to allow partition heads to expand and contract with movement of the structure while maintaining continuity of fire-resistance-rated assembly indicated; in thickness not less than indicated for studs and in width to accommodate depth of studs. Provide deflection track with flanges to allow for 3/4-inch deflection at floors and 1-1/2 inch at roofs.
  1. Product: Fire Trak Corp.; Fire Trak attached to studs with Fire Trak Slip Clip.

E. Cold-Rolled Channel Bridging: 0.0538-inch (16 gage) minimum bare steel thickness, with minimum 1/2-inch- wide flange.
  1. Depth: 1-1/2 inches.
  2. Clip Angle: 1-1/2 by 1-1/2 inch, 0.068-inch- thick, galvanized steel.

F. Hat-Shaped, Rigid Furring Channels: ASTM C 645.
  1. Minimum Base Metal Thickness: 0.0312 inch (20 gage).
  2. Depth: 7/8 inch, unless otherwise indicated.

G. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel framing and furring members to substrates involved; complying with the recommendations of gypsum board manufacturers for applications indicated.

2.4 PANELS, GENERAL

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

B. Manufacturers:

2.5 INTERIOR GYPSUM WALLBOARD

A. General: Complying with ASTM C 36/C 36M or ASTM C 1396/C 1396M, as applicable to type of gypsum board indicated and whichever is more stringent.

B. Type X, GPDW:
  1. Thickness: 5/8 inch.
2. Long Edges:  Tapered.
3. Location:  All locations, except as otherwise noted.

2.6 TRIM ACCESSORIES

A. Interior Metal Trim:  ASTM C 1047, galvanized steel.
   1. Shapes:
      a. Cornerbead:  1-1/4 inch x 1-1/4 inch external corner with 1/8-inch nose bead.  Use
         at outside corners, unless otherwise indicated.
      b. LC-Bead (Casing):  J-shaped casing with 1/16-inch nose bead ground, not less than
         30 gage; exposed long flange receives joint compound; use at exposed panel edges.
      c. Expansion (Control) Joint:  One-piece control joint formed with V-shaped slot and
         removable strip covering slot opening.

B. Interior PVC Trim:  ASTM C 1047, PVC plastic.
   1. Shadow Mold with Tear Away Bead (Vinyl Trim with Tear Away Reveal):  Z-shaped
      trim to create 1/2-inch wide reveal.
      a. Manufacturer:  Trim-Tex, Inc.

2.7 JOINT TREATMENT MATERIALS

A. General:  Comply with ASTM C 475 and the recommendations of both the manufacturers of
   sheet products and of joint treatment materials for each application indicated.

B. Joint Tape:

C. Setting-Type Joint Compound:  Factory-packaged, job-mixed, chemical-hardening powder
   products formulated for uses indicated.
   1. Where setting-type joint compounds are indicated as a taping compound only or for
      taping and filling only, use formulation that is compatible with other joint compounds
      applied over it.

D. Drying-Type Joint Compound:  Factory-packaged vinyl-based products complying with the
   following requirements for formulation and intended use.

E. Type of Joint Compound for Interior Gypsum Wallboard:  For each coat use formulation that is
   compatible with other compounds applied on previous or for successive coats.
   1. Prefilling:  At open joints, beveled panel edges, and damaged surface areas, use setting-
      type taping compound.
   2. Embedding and First Coat:  For embedding tape and first coat on joints, fasteners, and
      trim flanges, use setting-type taping compound or drying-type, all-purpose compound.
   3. Fill Coat:  For second coat, use setting-type, sandable topping compound or drying-type,
      all-purpose compound.
   4. Finish Coat:  For third coat, use setting-type, sandable topping compound or drying-type,
      all-purpose compound.
2.8 ACOUSTICAL SEALANT

A. Products:
   1. Acoustical Sealant for Exposed and Concealed Joints:
      a. Pecora Corp.; AC-20 FTR Acoustical and Insulation Sealant.
   2. Acoustical Sealant for Concealed Joints:
      b. Pecora Corp.; AIS-919.

B. Acoustical Sealant for Exposed and Concealed Joints:  Nonsag, paintable, nonstaining, latex sealant complying with ASTM C 834 that effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.

C. Acoustical Sealant for Concealed Joints:  Nondrying, nonhardening, nonskinning, nonstaining, gunnable, synthetic-rubber sealant recommended for sealing interior concealed joints to reduce airborne sound transmission.

2.9 SEALANTS FOR FIRE-RESISTANCE-RATED CONSTRUCTION

A. General:  Provide fire-resistive joint systems that are produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of assemblies in or between which fire-resistive joint systems are installed.  Fire-resistive joint systems shall accommodate building movements without impairing their ability to resist the passage of fire and hot gases.

B. Joints in or between Fire-Resistance-Rated Construction:  Materials shall comply with Division 07 Section "Fire-Resistive Joint Systems" and submitted UL assemblies.
   1. Provide firestopping where fire rated gypsum board assemblies butt masonry, steel deck, joists, beams, and structural members as part of the gypsum board assembly work.
   2. Fire-Resistance Rating:  Equal to or exceeding the fire-resistance rating of construction they will join.
   3. Joints shall be sealed with fire-resistance-rated sealants; use of joint compound for sealing of joints is not permitted.

C. Exposed Fire-Resistive Joint Sealants:  Exposed sealants shall be paintable.

2.10 AUXILIARY MATERIALS

A. General:  Provide auxiliary materials that comply with referenced installation standards and manufacturer's written recommendations.

B. Steel Drill Screws:  ASTM C 1002, unless otherwise indicated.
   1. Fastening gypsum board to steel members:  Type S bugle head.
   2. Use screws complying with ASTM C 954 for fastening panels to steel members from 0.033 to 0.112 inch thick.

C. Sound Attenuation Blankets (Acoustical Insulation):  ASTM C 665, Type I (blankets without membrane facing) manufactured from inorganic glass bonded with thermosetting resin; with
maximum flame-spread and smoke-developed indices of 25 and 50, respectively; passing ASTM E 136 for combustion characteristics.

1. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.

2. Manufacturers:
   a. Certainteed.
   b. Owens Corning.
   c. Johns Manville.

D. Insulation Support Anchors: Insul-Fast 25 gauge galvanized continuous metal support strip with pre-punched tabs at 8 inches on center.

E. Firestopping: See Division 07 Section "Through-Penetration Firestop Systems." Provide firestopping where fire rated gypsum board assemblies butt masonry, steel deck, joists, beams, and structural members as part of the gypsum board assembly work. Penetrations through fire-resistance-rated walls and partitions by Divisions 22, 23, and 26 work, including both empty openings and openings containing cables, pipes, ducts and conduits are specified as part of the Divisions 22, 23, and 26 work.

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.

B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.

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

3.2 PREPARATION

A. Suspended Assemblies: Coordinate installation of suspension systems with installation of overhead structure to ensure that inserts and other provisions for anchorages to building structure have been installed to receive hangers at spacing required to support the Work and that hangers will develop their full strength.

3.3 STEEL FRAMING INSTALLATION, GENERAL

A. Installation Standards: ASTM C 754, and ASTM C 840 requirements that apply to framing installation.

B. Install supplementary framing, blocking, and bracing at terminations in gypsum board assemblies to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction. Comply with details indicated and with gypsum board manufacturer's written recommendations or, if none available, with United States Gypsum's "Gypsum Construction Handbook."
C. Isolate steel framing from building structure at locations indicated to prevent transfer of loading imposed by structural movement. Comply with details shown on Drawings.
   1. Isolate ceiling assemblies where they abut or are penetrated by building structure.
   2. Isolate partition framing and wall furring where it abuts structure, except at floor. Install slip-type joints at head of assemblies that avoid axial loading of assembly and laterally support assembly.
      a. Allow for 3/4-inch deflection at floors and 1-1/2 inches at roofs.
      b. Install deflection track top runner or deflection brackets to attain lateral support and avoid axial loading.
      c. Install deflection firestop track top runner at fire-resistance-rated assemblies.
         1) Attach jamb studs at openings to tracks using manufacturer's standard stud clip.

D. Do not bridge building control and expansion joints with steel framing or furring members. Frame both sides of joints independently.

3.4 INSTALLING STEEL PARTITION AND SOFFIT FRAMING

A. Install tracks (runners) at floors, ceilings, and structural walls and columns where gypsum board assemblies abut other construction.

B. 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.

C. 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 board.
   1. Cut studs 1/2 inch short of full height to provide perimeter relief. Do not fasten studs to top track to allow independent movement of studs and track.
   2. For fire-resistance-rated partitions that extend to the underside of floor/roof slabs and decks or other continuous solid-structure surfaces to obtain ratings, install framing around structural and other members extending below floor/roof slabs and decks, as needed to support gypsum board closures and to make partitions continuous from floor to underside of solid structure.

D. Install steel studs and furring at the following spacings:

E. 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.
   1. Attach both flanges to floor runner track with screws.

F. Frame door openings to comply with GA-600 and with gypsum board manufacturer's applicable 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, even when partitions are not full height. Provide diagonal bracing at tall partitions to stop deflection and vibration of studs when doors are slammed shut.

4. Extend jamb studs one-piece full height.

G. 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.

H. Installation Tolerance: Framing members shall be within the following limits:
1. Install each framing member so fastening surfaces vary not more than 1/8 inch from the plane formed by faces of adjacent framing, a total variation of 1/4 inch in 8 feet from a true plane.
2. Layout of Walls and Partitions: 1/4 inch from intended position.
3. Plates and Runners: 1/4 inch in 10 feet from a straight line.
4. studs: 1/4 inch in 10 feet out of plumb, not cumulative.
5. Headers and Sills of Openings: 1/8 inch from level across width of opening.
6. Soffits: 1/4 inch in 10 feet from level straight line.
7. Spacing of Framing Members: Comply with requirements of ASTM C 754.

3.5 INSTALLATION OF ACOUSTICAL INSULATION

A. Install acoustical insulation at locations indicated before installing gypsum panels, unless blankets are readily installed after panels have been installed on one side. Cut and fit tightly around obstructions, and fill voids with insulation. Remove projections that interfere with placement. Install insulation in voids as framing is installed that that would be inaccessible after completion of framing.

B. Install a single layer of insulation of required thickness to fill the full depth of cavity, unless otherwise shown. Where cavity requires insulation that is thicker than standard size, install next larger size and compress into cavity.

C. Hold batt insulation in place with insulation support anchors located at 5 feet on center full height of wall, starting at the top of each stud space.

D. Stuff glass fiber loose fill insulation into miscellaneous voids and cavity spaces. Fill box headers, and voids while framing is being erected that will be inaccessible for installation later. Compact to approximately 40 percent of normal maximum volume (to a density of approximately 2.5 pcf).

3.6 APPLYING AND FINISHING PANELS, GENERAL

A. Gypsum Board Application and Finishing Standards: ASTM C 840 and GA-216, except as specified otherwise.

B. Install acoustical insulation, where indicated, before installing gypsum panels, unless blankets are readily installed after panels have been installed on one side.

C. Install gypsum 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.
D. Locate edge and end joints over supports. 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.

E. Attachment to Steel Framing: Attach gypsum panels to steel studs so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.

F. Attach gypsum panels to framing provided at openings and cutouts.

G. Form control and expansion joints with space between edges of adjoining gypsum panels.
   1. Where control joints are not shown, provide control joints at a maximum spacing of 30 feet; review proposed locations with Architect prior to commencement of work.

H. Cover both faces of steel stud partition framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.
   1. Unless concealed application is indicated or required for fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. in area.
   2. Fit gypsum panels around ducts, pipes, and conduits.
   3. Where partitions intersect beams, joists and other structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by beams, joists, and other structural members; allow 1/4- to 3/8-inch- wide joints to install sealant. Caulk smoke partitions with acoustical sealant on both sides of wall to prevent the passage of smoke. Run board to within 1/4 inch of floor slabs to provide full support of resilient base.

I. Isolate perimeter of non-load-bearing gypsum board partitions at structural abutments, except floors. Provide 1/4- to 1/2-inch- wide spaces at these locations, and trim edges with casing bead edge trim where edges of gypsum panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.
   1. Use fire-rated acoustical sealant for fire-rated walls.

J. Space fasteners in gypsum panels according to referenced gypsum board application and finishing standard and manufacturer's written recommendations.
   1. Space screws a maximum of 12 inches o.c. for vertical applications.

K. Remove screws that do not hit studs, supports, or blocking.

3.7 PANEL APPLICATION METHODS

A. Single-Layer Application:
   1. On partitions/walls, apply gypsum panels vertically (parallel 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 board.
   2. Fastening Methods: Apply gypsum panels to supports with steel drill screws.
3.8 Single-Layer Fastening Methods: Apply gypsum panels to supports with steel drill screws.

INSTALLING TRIM ACCESSORIES

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

B. Install corner bead at external corners.

C. Install edge trim where edge of gypsum panels would otherwise be exposed. Provide edge trim type with face flange formed to receive joint compound, except where other types are indicated.
   1. Install LC-bead where gypsum panels are tightly abutted to other construction and back flange can be attached to framing or supporting substrate.
   2. Install L-bead where edge trim can only be installed after gypsum panels are installed.
   3. Install U-bead where indicated.

D. Control Joints: Install control joints according to ASTM C 840 and in specific locations approved by Architect for visual effect.

3.9 FINISHING GYPSUM BOARD ASSEMBLIES

A. General: Treat gypsum board joints, interior angles, flanges of corner bead, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.

B. Prefill open joints, beveled edges, and damaged surface areas using setting-type joint compound.

C. Apply joint tape over gypsum board joints and to flanges of trim accessories, except those with trim having flanges not intended for tape.

D. Gypsum Board Finish Levels: Finish panels to levels indicated below, according to ASTM C 840, for locations indicated:
   1. Level 1: At ceiling plenum areas, concealed areas, and where indicated, unless a higher level of finish is required for fire-resistance-rated assemblies.
   2. Level 2: At ceiling plenum areas, concealed areas, and where indicated, for fire-resistance-rated assemblies and smoke assemblies.
   3. Level 4: At panel surfaces that will be exposed to view, unless otherwise indicated.

E. Where Level 1 gypsum board finish is indicated, embed tape in joint compound. Surface shall be free of excess joint compound.

F. Where Level 2 gypsum board finish is indicated, fill fastener heads, embed tape in joint compound and apply thin coat of joint compound over all joints and interior angles.

G. For Level 4 gypsum board finish, embed tape in joint compound and apply first, fill (second), and finish (third) coats of joint compound over joints, angles, fastener heads, and accessories. Touch up and sand between coats and after last coat as needed to produce a surface free of visual defects and ready for decoration.
1. At tapered edge joints, draw compound down to a level plane, leaving a monolithic surface that is flush with paper face. Finish coat shall be feathered a minimum of 8 inches beyond both sides of center of joint tape.

2. At end-to-end butt joints, draw compound down to minimize hump created by joint tape application. Finish coat shall be feathered a minimum of 16 inches beyond both sides of center of joint tape.

3. End product shall be a surface that appears level without telegraphing joint locations as high spots when viewed down wall after painting.

4. Finish board to within 1/4 inch of floor, providing full support for resilient wall base without telegraphing joint.

3.10 CLEANING

A. Promptly remove any residual joint compound from adjacent surfaces.

3.11 PROTECTION

A. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.

B. Remove and replace panels that are wet, moisture damaged, and mold damaged.

1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.

2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION 092950
SECTION 095113 - ACOUSTICAL PANEL CEILINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:
   1. Acoustical panels.
   2. Exposed suspension systems.
   3. Re-installation of acoustical tile ceiling systems removed in Division 02 Section "Selective Demolition and Alterations."

A. Related Sections include the following:
   1. Division 21, 22, 23, and 26 Sections for coordination of air handling devices, fire protection devices, and electrical devices installed in ceiling systems.

1.3 DEFINITIONS

A. CAC: Ceiling Attenuation Class.

B. LR: Light Reflectance coefficient.

C. NRC: Noise Reduction Coefficient.

1.4 SUBMITTALS

A. General: Submit in accordance with Division 01 Section "Submittal Procedures."

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

C. Samples: For each component indicated and for each exposed finish required, prepared on Samples of size indicated below.
   1. Acoustical Panel: Set of 6-inch square Samples of each type, color, pattern, and texture.

D. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each acoustical panel ceiling.

1.5 QUALITY ASSURANCE

A. Source Limitations:
   1. Acoustical Ceiling Panel: Obtain all panels through one source from a single manufacturer.
   2. Suspension System: Obtain all suspension systems through one source from a single manufacturer.
B. Fire-Test-Response Characteristics: Provide acoustical panel ceilings that comply with the following requirements:

1. Fire-Resistance Characteristics: Where indicated, provide acoustical panel ceilings identical to those of assemblies tested for fire resistance per ASTM E 119 by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.
   a. Fire-Resistance Ratings: Indicated by design designations from UL's "Fire Resistance Directory" or from the listings of another testing and inspecting agency.
   b. Identify materials with appropriate markings of applicable testing and inspecting agency.

2. Class A systems have a flame-spread index not exceeding 25 and a smoke-developed index not exceeding 50; Class B systems have a flame-spread index not exceeding 75 on face side; and Class C systems have a flame-spread index not exceeding 200 on face side. Most products available in the U.S. are Class A.

3. Surface-Burning Characteristics: Provide acoustical panels with the following surface-burning characteristics complying with ASTM E 1264 for Class A materials as determined by testing identical products per ASTM E 84:
   a. Smoke-Developed Index: 450 or less.

1.6 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. Store materials flat.

B. Before installing acoustical panels, permit them to reach room temperature and a stabilized moisture content.

C. Handle acoustical panels carefully to avoid chipping edges or damaging units in any way.

1.7 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.

B. Mechanical, electrical, and other utility service installations above the ceiling plane shall have been completed prior to the installation of the ceilings.

1.8 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.

1.9 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.
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. Products: Subject to compliance with requirements, provide one of the products specified.

2.2 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.
   1. Mounting Method for Measuring NRC: Type E-400; plenum mounting in which face of test specimen is 15-3/4 inches away from test surface per ASTM E 795.
   2. Test Method for Ceiling Attenuation Class (CAC). Where acoustical panel ceilings are specified to have a CAC, provide units identical to those tested per ASTM E 1414 by a qualified testing agency.

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.

2.3 ACOUSTIC PANELS

A. Acoustic Panel: ACT-1.
   1. Size: 24 inches x 48 inches x 5/8-inch thick.
   2. Composition: Mineral wool fiber.
   4. Surface Texture: Factory-applied latex paint; white.
   5. Edge: Square.
   6. NRC Range: .55.
   7. CAC Range: 35.
      a. Verify product matches existing.
   10. Suspension System Type: A.

2.4 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.

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:
   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. Hold-Down Clips: Where indicated, provide manufacturer's standard hold-down clips spaced 24 inches o.c. on all cross tees.
   1. Locations:
      a. In Vestibules and for a distance of 10 feet inside exterior doors without Vestibules.

2.5 METAL SUSPENSION SYSTEMS FOR ACOUSTICAL PANEL CEILINGS

A. Type A: 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.
   2. End Condition of Cross Runners: Override (stepped) or butt-edge type, as standard with manufacturer.
   3. Face Design: Flat, flush.
   4. Cap Material: Steel or aluminum cold-rolled sheet, as standard with manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

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

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

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

3.3 INSTALLATION, 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. Hangers shall be single lengths of wire without splices; coordinate lengths in deep ceiling cavities.
2. 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.
3. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
4. 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.
5. 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.
6. Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to cast-in-place hanger inserts, postinstalled mechanical or adhesive anchors, or power-actuated fasteners that extend through forms into concrete.
7. Do not attach hangers to steel deck tabs.
8. Do not attach hangers to steel roof deck. Attach hangers to structural members.
9. 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.
10. Exposed pop rivets for grid alignment purposes shall not be permitted.
11. Each individual fixture and attachment with combined weight of 56 pounds or less shall have two 12-gage wire hangers attached at diagonal corners of the fixture. These wires shall be slack. Fixtures and attachments with a combined weight of greater than 56 pounds shall be independently supported from the structure at all four corners.

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. 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.
2. 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 to run in the same direction. For square-edged panels, install panels with edges fully hidden from view by flanges of suspension system runners and moldings.
   2. Paint cut edges of panel remaining exposed after installation; match color of exposed panel surfaces using coating recommended in writing for this purpose by acoustical panel manufacturer.
   3. Install hold-down clips in Vestibules and for fire-resistance ratings; space as required by panel manufacturer's written instructions.

3.4 CLEANING

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

END OF SECTION 095113
SECTION 099000 - PAINTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:
   1. Exposed exterior items and surfaces with low VOC coatings.
   2. Exposed interior items and surfaces with low VOC coatings.
   3. Surface preparation, priming, and finish coats specified in this Section are in addition to shop priming and surface treatment specified in other Sections.

B. Related Sections include the following:
   1. Division 05 Section "Metal Fabrications" for shop priming ferrous metal.
   2. Division 09 Section "Gypsum Board Assemblies" for surface preparation of gypsum board.
   3. Review all sections for shop primed items requiring field painting.

1.3 DEFINITIONS

A. General: Standard coating terms defined in ASTM D 16 apply to this Section.
   1. Flat refers to a lusterless or matte finish with a gloss range below 15 when measured at an 85-degree meter.
   2. Eggshell refers to low-sheen finish with a gloss range between 20 and 35 when measured at a 60-degree meter.
   3. Satin refers to low-sheen finish with a gloss range between 15 and 35 when measured at a 60-degree meter.
   4. Semigloss refers to medium-sheen finish with a gloss range between 35 and 70 when measured at a 60-degree meter.
   5. Full gloss refers to high-sheen finish with a gloss range more than 70 when measured at a 60-degree meter.

1.4 SUBMITTALS

A. General: Submit in accordance with Division 01 Section "Submittal Procedures."

B. Product Data: For each paint system indicated. Include block fillers and primers.
   1. Material List: An inclusive list of required coating materials. Indicate each material and cross-reference specific coating, finish system, and application. Identify each material by manufacturer's catalog number and general classification.
   2. Manufacturer's Information: Manufacturer's technical information, including label analysis and instructions for handling, storing, and applying each coating material proposed for use.

C. Schedule: Provide schedule of all surfaces to be coated, with prime and finish coat material listed, and manufacturer's recommended wet film thickness.
D. Manufacturer Certificates: Signed by manufacturers certifying that products with limit VOC amounts specified comply with requirements.

E. Qualification Data: For Applicator.

1.5 QUALITY ASSURANCE

A. Applicator Qualifications: Engage an experienced Applicator who has completed painting system applications similar in material, design, and extent to those indicated for this Project, whose work has resulted in applications with a record of successful in-service performance.

B. Source Limitations: Obtain block fillers, primers and undercoat materials for each coating system from the same manufacturer as the finish coats.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to the Project Site in 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. Manufacturer's stock number and date of manufacture.
   4. Contents by volume, for pigment and vehicle constituents.
   5. Thinning instructions.
   6. Application instructions.
   7. Color name and number.
   8. VOC content.

B. Store materials not in use in tightly covered containers in a well-ventilated area at a minimum ambient temperature of 45 deg F. Maintain containers used in storage in a clean condition, free of foreign materials and residue.
   1. Protect from freezing. Keep storage area neat and orderly.
   2. Remove oily rags and waste daily.
   3. Take necessary measures to ensure that workers and work areas are protected from fire and health hazards resulting from handling, mixing, and application.

1.7 PROJECT CONDITIONS

A. Apply paints only when temperatures of surfaces to be painted and surrounding air are between 45 and 95 deg F.

B. Do not apply paint in snow, rain, fog, or mist; or when relative humidity exceeds 85 percent; or at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.
   1. Painting may continue during inclement weather if surfaces and areas to be painted are enclosed and heated within temperature limits specified by manufacturer during application and drying periods.
   2. Allow wet surfaces to dry thoroughly and attain temperature and conditions specified before proceeding with or continuing coating operation.
PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Products: Subject to compliance with requirements, provide one of the products listed in other Part 2 articles.

B. Manufacturers' Names: Shortened versions (shown in parentheses) of the following manufacturers' names are used in other Part 2 articles:
1. Benjamin Moore & Company (Moore).
2. ICI Dulux Paints (ICI).

2.2 COATINGS MATERIALS, GENERAL

A. Material Compatibility: Provide block fillers, primers, undercoats, and finish-coat materials that are compatible with one another and with the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.

B. Material Quality: Provide manufacturer's best quality coating material of the various coating types specified that are factory formulated and recommended by manufacturer for application indicated. Paint-material containers not displaying manufacturer's product identification will not be acceptable.
1. Proprietary Names: Use of manufacturer's proprietary product names to designate colors or materials is not intended to imply that products named are required to be used to the exclusion of equivalent products of other manufacturers listed in the specification schedule. Furnish manufacturer's material data and certificates of performance for proposed substitutions.

C. VOC Compliance for Exterior and Interior Paints and Coatings: Provide the manufacturer's formulation for the products specified below that are VOC compliant with the State of Maine Department of Environmental Protection Regulation, "Chapter 151: Architectural and Industrial Maintenance (AIM) Coatings" and the following chemical restrictions expressed in grams per liter:
1. Flat Paints and Coatings: VOC content of not more than 100 g/L.
2. Non-Flat Paints and Coatings: VOC content of not more than 150 g/L.
3. Non-Flat Paints and Coatings - High Gloss: VOC content of not more than 250 g/L.
4. Anticorrosive (Rust Preventative) Coatings: VOC content of not more than 400 g/L.
5. Industrial Maintenance Coatings (IMC): VOC content of not more than 340 g/L.
6. Primers, Sealers, and Undercoaters: VOC content of not more than 200 g/L.
7. Quick-Dry Primers, Sealers, and Undercoaters: VOC content of not more than 200 g/L.
8. Specialty Primers, Sealers, and Undercoaters: VOC content of not more than 350 g/L.

D. Colors: Provide color selections made by the Architect.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Applicator present, under which painting will be performed for compliance with paint application requirements.
1. If unacceptable conditions are encountered, prepare written report, endorsed by Applicator, listing conditions detrimental to performance of work.
2. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
3. Application of coating indicates Applicator's acceptance of surfaces and conditions within a particular area.
4. Begin coating application only after unsatisfactory conditions have been corrected and surfaces are dry.

B. Coordination of Work: Review other Sections in which primers are provided to ensure compatibility of the total system for various substrates. On request, furnish information on characteristics of specified finish materials to ensure use of compatible primers.
   1. Notify Architect about anticipated problems when using the materials specified over substrates primed by others.

3.2 PREPARATION

A. General: Remove hardware and hardware accessories, plates, machined surfaces, lighting fixtures, and similar items already installed that are not to be painted. If removal is impractical or impossible because of size or weight of the item, provide surface-applied protection before surface preparation and painting.
   1. After completing painting operations in each space or area, reinstall items removed using workers skilled in the trades involved.

B. Cleaning: Before applying paint or other surface treatments, clean substrates of substances that could impair bond of the various coatings. Remove oil and grease before cleaning.
   1. Schedule cleaning and painting so dust and other contaminants from the cleaning process will not fall on wet, newly painted surfaces.

C. Surface Preparation: Clean and prepare surfaces to be painted according to manufacturer's written instructions for each particular substrate condition and as specified.
   1. Provide barrier coats over incompatible primers or remove and reprime.
   2. Cementitious Materials: Prepare concrete unit masonry, surfaces to be painted. Remove efflorescence, chalk, dust, dirt, grease, oils, and release agents. Roughen as required to remove glaze.
   3. Wood: Clean surfaces of dirt, oil, and other foreign substances with scrapers, mineral spirits, and sandpaper, as required. Sand surfaces exposed to view smooth and dust off.
      a. Scrape and clean small, dry, seasoned knots, and apply a thin coat of white shellac or other recommended knot sealer before applying primer.
      b. Prime, stain, or seal wood to be painted immediately on delivery. Prime edges, ends, faces, undersides, and back sides of wood.
      c. After priming, fill holes and imperfections in finish surfaces with putty or plastic wood filler. Sand smooth when dried.
   4. Ferrous Metals: Clean ungalvanized ferrous-metal surfaces that have not been shop coated; remove oil, grease, dirt, loose mill scale, and other foreign substances. Use solvent or mechanical cleaning methods that comply with SSPC’s standards.
      a. Treat bare and sandblasted or pickled clean metal with a metal treatment wash coat before priming.
      b. Touch up bare areas and shop-applied prime coats that have been damaged. Clean with solvents recommended by paint manufacturer and SSPC SP2; and touch up with same primer as the shop coat.
D. Material Preparation: Mix and prepare paint materials according to manufacturer's written instructions.
1. Maintain containers used in mixing and applying paint in a clean condition, free of foreign materials and residue.
2. Stir material before application to produce a mixture of uniform density. Stir as required during application. Do not stir surface film into material. If necessary, remove surface film and strain material before using.
3. Use only thinners approved by paint manufacturer and only within recommended limits.

3.3 APPLICATION

A. General: Apply paint according to manufacturer's written instructions. Use applicators and techniques best suited for substrate and type of material being applied.
1. Paint colors, surface treatments, and finishes are indicated in the paint schedules.
2. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions detrimental to formation of a durable paint film.
3. Provide finish coats that are compatible with primers used.
4. The term "exposed surfaces" includes areas visible when permanent or built-in fixtures, grilles, convector covers, covers for finned-tube radiation, and similar components are in place. Extend coatings in these areas, as required, to maintain system integrity and provide desired protection.
5. Paint interior surfaces of ducts with a flat, nonspecular black paint where visible through registers or grilles.
6. Sand lightly between each succeeding enamel or varnish coat.

B. Scheduling Painting: Apply first coat to surfaces that have been cleaned, pretreated, or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.
1. The number of coats and film thickness required are the same regardless of application method. Do not apply succeeding coats until previous coat has cured as recommended by manufacturer. If sanding is required to produce a smooth, even surface according to manufacturer's written instructions, sand between applications.
2. If undercoats, stains, or other conditions show through final coat of paint, apply additional coats until paint film is of uniform finish, color, and appearance. Give special attention to ensure that edges, corners, crevices, welds, and exposed fasteners receive a dry film thickness equivalent to that of flat surfaces.
3. Allow sufficient time between successive coats to permit proper drying. Do not recoat surfaces until paint has dried to where it feels firm, and does not deform or feel sticky under moderate thumb pressure, and until application of another coat of paint does not cause undercoat to lift or lose adhesion.

C. Paint all exposed surfaces, except where the paint schedules indicate that a surface or material is not to be painted or is to remain natural. If the paint schedules do not specifically mention an item or a surface, paint the item or surface the same as similar adjacent materials or surfaces whether or not schedules indicate colors. If the schedules do not indicate color or finish, the Architect will select from standard colors and finishes available.

D. Do not paint prefinished items, concealed surfaces, finished metal surfaces, operating parts, and labels.
1. Labels: Do not paint over Underwriters Laboratories (UL), Factory Mutual (FM), or other code-required labels or equipment name, identification, performance rating, or nomenclature plates.

E. Application Procedures: Apply paints and coatings by brush, roller, spray, or other applicators according to manufacturer's written instructions. Walls shall have roller finish.
1. Brushes: Use brushes best suited for type of material applied. Use brush of appropriate size for surface or item being painted.
2. Rollers: Use rollers of carpet, velvet-back, or high-pile sheep's wool as recommended by manufacturer for material and texture required.
3. Spray Equipment: Use airless spray equipment with orifice size as recommended by manufacturer for material and texture required.

F. Minimum Coating Thickness: Apply paint materials no thinner than manufacturer's recommended spreading rate to achieve dry film thickness indicated. Provide total dry film thickness of the entire system as recommended by manufacturer.

G. Mechanical and Electrical Work: Painting of mechanical, plumbing, fire protection, and electrical work is limited to items exposed in occupied spaces (outside mechanical and electrical rooms).

H. Block Fillers: Apply block fillers to concrete masonry units at a rate to ensure complete coverage with pores filled.

I. Prime Coats: Before applying finish coats, apply a prime coat, as recommended by manufacturer, to material that is required to be painted or finished and that has not been prime coated by others. Recolat primed and sealed surfaces to ensure a finish coat with no burn-through or other defects due to insufficient sealing.

J. Pigmented (Opaque) Finishes: Completely cover surfaces as necessary to provide a smooth, opaque surface of uniform finish, color, appearance, and coverage. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections will not be acceptable.

K. Stipple Enamel Finish: Roll and redistribute paint to an even and fine texture. Leave no evidence of rolling, such as laps, irregularity in texture, skid marks, or other surface imperfections.

L. Exterior Ferrous Metal Items to Be Painted Include, but Are Not Limited To, the Following (New and Existing):
1. Exposed structural steel and lintel plates.
   a. Galvanized single angle lintels do not require painting.
2. Steel doors and frames.
4. Metal Fabrications. See Section 055000.
5. Factory primed louvers.
   a. Louvers in insulated metal panels do not require painting.
6. Miscellaneous metal items, including galvanized steel.
M. Interior Ferrous Metal Items to Be Painted Include, but Are Not Limited To, the Following:
1. Steel door frames.
2. Exposed lintel plates and angles.
3. Miscellaneous metal items.

3.4 CLEANING

A. Cleanup: At the end of each workday, remove empty cans, rags, rubbish, and other discarded paint materials from the Project site.
1. After completing painting, clean glass and paint-spattered surfaces. Remove spattered paint by washing and scraping. Be careful not to scratch or damage adjacent finished surfaces.

3.5 PROTECTION

A. Protect work of other trades, whether being painted or not, against damage by painting. Correct damage by cleaning, repairing or replacing, and repainting, as approved by Architect.

B. Provide "Wet Paint" signs to protect newly painted finishes. Remove temporary protective wrappings provided by others to protect their work after completing painting operations.
1. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.6 EXTERIOR PAINT SCHEDULE

A. VOC Compliance, General: Provide the manufacturers' formulations for the products specified below that comply with the VOC requirements for the State of Maine Department of Environmental Protection in paragraph 2.2.C of this Section.

B. Exterior Metal: Provide the following finish systems over ferrous and non-ferrous metal surfaces:
1. Semigloss, Acrylic-Enamel Finish: 2 IMC finish coats over a primer.
   a. Primer: Quick-drying, corrosion resistant, metal primer applied to galvanized metals not previously shop-primed applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than indicated for product.
      1) Moore: IMC Acrylic Metal Primer No. M04; 2.0 mils DFT.
      2) ICI: IMC 4020-XXXX Devflex DTM Flat Interior/Exterior Waterborne Primer & Finish; 2.5 mils DFT.
      3) S-W: IMC DTM Acrylic Primer/Finish, B66W1; 3.0 mils DFT.
   b. First and Second Coats: Semigloss, exterior, IMC acrylic-latex enamel applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than indicated for product.
      1) Moore: IMC DTM M29 Acrylic Semigloss; 5.0 mils DFT.
      2) ICI: IMC 4206-XXXX, Interior/Exterior Acrylic Semi-Gloss Enamel; 8.0 mils DFT.
      3) S-W: IMC DTM Acrylic Coating Semi-Gloss (Waterborne) B66W200 Series; 7.0 mils DFT.
3.7 LOW VOC INTERIOR COATINGS

A. VOC Compliance, General: Provide the manufacturers’ formulations for the products specified below that comply with the VOC requirements for the State of Maine Department of Environmental Protection in paragraph 2.2.C of this Section.

B. Concrete Masonry Units: Provide the following finish systems over interior concrete masonry block units:
   a. Block Filler (Exposed Patches Only): High-performance, latex-based, block filler applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than indicated for product.
      1) Moore: Latex Block Filler No. M88; 8.0 mils DFT.
      2) ICI: Bloxfil 4000-1000 Interior/Exterior Heavy Duty Acrylic Block Filler; 7.0 mils DFT.
      3) S-W: PrepRite Block Filler B25W25; 8.0 mils DFT.
   b. First and Second Coat (One coat over existing painted surfaces): Low-luster (eggshell or satin), acrylic-latex, interior enamel applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than indicated for product.
      1) Moore: Eco Spec Interior Latex Eggshell Enamel No. 223; 2.8 mils DFT.
      2) ICI: 9300-XXXX Dulux Lifemaster Eggshell Interior Latex Enamel; 2.8 mils DFT.
      3) S-W: Harmony Interior Latex Eg-Shel B9 Series, 3.2 mils DFT.

C. Gypsum Board, Plaster Ceilings: Provide the following finish systems over interior gypsum board surfaces:
1. Flat Acrylic Finish, New GWBD Soffits: 2 finish coats over a primer.
   a. Primer: Latex-based, interior primer applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than indicated for product.
      1) Moore: Eco Spec Interior Latex Primer Sealer No. 231; 1.0 mils DFT.
      2) ICI: LM9116, Prep & Prime Odor-Less Interior Water-Based Primer-Sealer; 1.9 mils DFT.
      3) S-W: Harmony Interior Latex Primer B11W900 Series; 1.3 mils DFT.
   b. First and Second Coats: Flat, acrylic-latex-based, interior paint applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than indicated for product.
      1) Moore: Eco Spec Interior Latex Flat No. 219; 2.4 mils DFT.
      2) ICI: 9100-XXXX, Dulux Lifemaster Flat Interior Latex Enamel; 2.8 mils DFT.
      3) S-W: Harmony Interior Latex Flat, B5 Series; 3.4 mils DFT.
2. Flat Acrylic Finish, Existing Ceilings: 1 finish coat over a primer at patched, marred and dirty areas resulting from demolition and construction operations.
   a. Primer: Latex-based, interior primer applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than indicated for product.
      1) Moore: Eco Spec Interior Latex Primer Sealer No. 231; 1.0 mils DFT.
      2) ICI: LM9116, Prep & Prime Odor-Less Interior Water-Based Primer-Sealer; 1.9 mils DFT.
3) S-W: Harmony Interior Latex Primer B11W900 Series; 1.3 mils DFT.
   b. First Coat: Flat, acrylic-latex-based, interior paint applied at spreading rate
      recommended by the manufacturer to achieve a total dry film thickness of not less
      than indicated for product.
      1) Moore: Eco Spec Interior Latex Flat No. 219; 2.4 mils DFT.
      2) ICI: 9100-XXXX, Dulux Lifemaster Flat Interior Latex Enamel; 2.8
             mils DFT.
      3) S-W: Harmony Interior Latex Flat, B5 Series; 3.4 mils DFT.

3. Low-Luster (Eggshell), Acrylic-Enamel Finish, Existing Plaster Walls: 1 finish coat over
   a primer at patched, marred and dirty areas resulting from demolition and construction
   operations; paint entire wall from inside or outside corner to inside or outside corner.
   a. Primer: Latex-based, interior primer applied at spreading rate recommended by
      the manufacturer to achieve a total dry film thickness of not less than indicated for
      product.
      1) Moore: Eco Spec Interior Latex Primer Sealer No. 231; 1.0 mils DFT.
      2) ICI: LM9116, Prep & Prime Odor-Less Interior Water-Based Primer-
             Sealer; 1.9 mils DFT.
      3) S-W: Harmony Interior Latex Primer B11W900 Series; 1.3 mils DFT.
   b. First Coat: Low-luster (eggshell or satin), acrylic-latex, interior enamel applied at
      spreading rate recommended by the manufacturer to achieve a total dry film
      thickness of not less than indicated for product.
      1) Moore: SuperSpec Latex Eggshell Enamel W274; 2.6 mils DFT.
      2) ICI: 9300-XXXX Dulux Lifemaster Eggshell Interior Latex Enamel;
             2.8 mils DFT.
      3) S-W: Harmony Interior Latex Eg-Shel B9 Series; 3.2 mils DFT.

4. Low-Luster (Eggshell), Acrylic-Enamel Finish, New GWBD Walls: 2 finish coats over a
   primer.
   a. Primer: Latex-based, interior primer applied at spreading rate recommended by
      the manufacturer to achieve a total dry film thickness of not less than indicated for
      product.
      1) Moore: Eco Spec Interior Latex Primer Sealer No. 231; 1.0 mils DFT.
      2) ICI: LM9116, Prep & Prime Odor-Less Interior Water-Based Primer-
             Sealer; 1.9 mils DFT.
      3) S-W: Harmony Interior Latex Primer B11W900 Series; 1.3 mils DFT.
   b. First and Second Coats: Low-luster (eggshell or satin), acrylic-latex, interior
      enamel applied at spreading rate recommended by the manufacturer to achieve a
      total dry film thickness of not less than indicated for product.
      1) Moore: SuperSpec Latex Eggshell Enamel W274; 2.6 mils DFT.
      2) ICI: 9300-XXXX Dulux Lifemaster Eggshell Interior Latex Enamel;
             2.8 mils DFT.
      3) S-W: Harmony Interior Latex Eg-Shel B9 Series; 3.2 mils DFT.

D. New Woodwork, Opaque Finish: Provide the following paint finish systems over new, interior
   wood surfaces:
   1. Semigloss, Acrylic-Enamel Finish (Opaque Trim): 2 finish coats over a wood
      undercoater.
      a. Primer: Stain-blocking, alkyd- or acrylic-latex-based, interior wood undercoater,
         as recommended by the manufacturer for this substrate, applied at spreading rate
         recommended by the manufacturer to achieve a total dry film thickness of not less
         than indicated for product.
         1) Moore: Eco Spec Interior Latex Primer Sealer No. 231; 1.0 mils DFT.
2) ICI: LM9116, Prep & Prime Odor-Less Interior Water-Based Primer-Sealer; 1.9 mils DFT.
3) S-W: Harmony Interior Latex Primer B11W900 Series; 1.3 mils DFT.

b. First and Second Coats: Semigloss, acrylic-latex, interior enamel applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than indicated for product.
1) Moore: Eco Spec Interior Latex Semi-Gloss Enamel 224; 3.0 mils DFT.
2) ICI: 9200-XXXX Dulux Lifemaster Semi-Gloss Interior Latex Enamel; 3.0 mils DFT.
3) S-W: Harmony Interior Latex Semi-Gloss, B10 Series; 3.2 mils DFT.

E. Ferrous Metal, New: Provide the following finish systems over ferrous metal:
1. Semigloss, Acrylic-Enamel Finish: 2 IMC finish coats over a primer.
   a. Primer: Quick-drying, corrosion resistant, acrylic primer, as recommended by the manufacturer for this substrate, applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than indicated for product.
      1) Moore: IMC Acrylic Metal Primer M04; 2.0 mils DFT.
      2) ICI: IMC 4020-XXXX Devflex DTM Flat Interior/Exterior Waterborne Primer & Finish; 2.2 mils DFT.
      3) S-W: IMC Pro-Cryl Universal Water Based Primer, B66-310 Series; 3.0 mils DFT.
   b. First and Second Coats: IMC Semigloss, acrylic-latex, interior enamel applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than indicated for product.
      1) Moore: IMC DTM M29 Acrylic Semigloss; 5.0 mils DFT.
      2) ICI: IMC 4206-XXXX, Interior/Exterior Acrylic Semi-Gloss Enamel; 8.0 mils DFT.
      3) S-W: IMC Sher-Cryl HPA High Performance Semi-Gloss Acrylic, B66-350 Series; 7.5 mils DFT.
SECTION 210500 - COMMON WORK RESULTS FOR FIRE SUPPRESSION

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. The work includes modifications to the existing wet pipe sprinkler system in the portion of the building indicated on the Drawings. Modifications shall be as required due to the work of other trades.

B. The building shall remain protected during the entire construction schedule. Existing areas under construction shall be coordinated with the Owner and the local fire department before performing work.

C. The fire protection system shall be installed in accordance with the 2010 edition of NFPA.

D. This Section includes the following:
   1. Piping materials and installation instructions common to most piping systems.
   2. Sleeves.
   3. Escutcheons.
   4. Equipment installation requirements common to equipment sections.

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, crawlspace, 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 rubber materials:
   1. EPDM: Ethylene-propylene-diene terpolymer rubber.
   2. NBR: Acrylonitrile-butadiene rubber.

1.4 SUBMITTALS

A. Product Data: For the following:
   1. Escutcheons.

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.

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.

1.7 COORDINATION

A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for fire-suppression installations.

B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

2.2 PIPE, TUBE, AND FITTINGS

A. Refer to individual Division 21 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 21 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.

2.4 SLEEVES

A. Galvanized-Steel Sheet: 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint.

B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.

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, Cast-Brass Type: With set screw.
   1. Finish: Polished chrome-plated or white painted in finished spaces.

D. One-Piece, Floor-Plate Type: Cast-iron floor plate.

PART 3 - EXECUTION

3.1 PIPING SYSTEMS - COMMON REQUIREMENTS

A. Install piping according to the following requirements and Division 21 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 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 free of sags and bends.

H. Install fittings for changes in direction and branch connections.

I. Select system components with pressure rating equal to or greater than system operating pressure.

J. 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, cast-brass type with polished chrome-plated finish.
      b. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type.
      c. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with polished chrome-plated finish.
      d. Bare Piping in Equipment Rooms: One-piece, cast-brass type.
      e. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.

K. Sleeves are not required for core-drilled holes.

L. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.

M. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
   1. Cut sleeves to length for mounting flush with both surfaces.
      a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches (50 mm) above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
   2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
   3. Install sleeves that are large enough to provide 1/4-inch (6.4-mm) annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
      a. Steel Pipe Sleeves: For pipes smaller than NPS 6 (DN 150).
      b. Steel Sheet Sleeves: For pipes NPS 6 (DN 150) and larger, penetrating gypsum-board partitions.
   4. 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.

N. 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 "Joint Sealants" for materials.

O. Verify final equipment locations for roughing-in.

P. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.
3.2 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 21 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. 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.

E. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

3.3 PAINTING

A. Painting of fire-suppression systems, equipment, and components is specified in Division 09 Section "Painting."

B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.4 ERECTION OF METAL SUPPORTS AND ANCHORAGES

A. Refer to Division 05 for structural steel.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor fire-suppression materials and equipment.

C. Field Welding: Comply with AWS D1.1.

END OF SECTION 210500
SECTION 211313 - WET-PIPE SPRINKLER SYSTEMS

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. The work includes modifications to the existing wet pipe sprinkler system in the portion of the building indicated on the Drawings. Modifications shall be as required due to the work of other trades.

B. Section Includes:
   1. Pipes, fittings, and specialties.
   2. Sprinklers.

1.3 DEFINITIONS

A. Standard-Pressure Sprinkler Piping: Wet-pipe sprinkler system piping designed to operate at working pressure of 175 psig (1200 kPa) maximum.

1.4 SYSTEM DESCRIPTIONS

A. Wet-Pipe Sprinkler System: Automatic sprinklers are attached to piping containing water and that is connected to water supply through alarm valve. Water discharges immediately from sprinklers when they are opened. Sprinklers open when heat melts fusible link or destroys frangible device. Hose connections are included if indicated.

1.5 PERFORMANCE REQUIREMENTS

A. Standard-Pressure Piping System Component: Listed for 175-psig (1200-kPa) minimum working pressure.

B. Delegated Design: Design sprinkler system(s), including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

C. Sprinkler system design shall be approved by authorities having jurisdiction.
   1. Margin of Safety for Available Water Flow and Pressure: 10 percent, including losses through water-service piping, valves, and backflow preventer.
   2. Sprinkler Occupancy Hazard Classifications:
   3. Minimum Density for Automatic-Sprinkler Piping Design:
      a. Light-Hazard Occupancy: 0.10 gpm over 1500-sq. ft. (4.1 mm/min. over 139-sq. m.)
      b. Ordinary-Hazard, Group 1 Occupancy: 0.15 gpm over 1500-sq. ft. (6.1 mm/min. over 139-sq. m) area.
c. Ordinary-Hazard, Group 2 Occupancy: 0.20 gpm over 1500-sq. ft. (8.1 mm/min. over 139-sq. m) area.

4. Maximum Protection Area per Sprinkler:
   a. Classrooms, Offices and Public Areas: 225 sq. ft. (20.9 sq. m)
   b. Storage Areas: 130 sq. ft. (12.1 sq. m)
   c. Mechanical Equipment Rooms: 130 sq. ft. (12.1 sq. m)
   d. Electrical Equipment Rooms: 130 sq. ft. (12.1 sq. m)
   e. Other Areas: According to NFPA 13 recommendations unless otherwise indicated.

5. Total Combined Hose-Stream Demand Requirement: According to NFPA 13 unless otherwise indicated:
   a. Light-Hazard Occupancies: 100 gpm (6.3 L/s) for 30 minutes

1.6 SUBMITTALS

A. It is the intent of this Section to only require submittals as required by the extent of necessary system modifications.

B. Product Data: For each type of product indicated

C. Shop Drawings: For wet-pipe sprinkler systems. Include plans, elevations, sections, details, and attachments to other work.
   1. Wiring Diagrams: For power, signal, and control wiring.

D. Delegated-Design Submittal: For sprinkler systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

E. Coordination Drawings: Sprinkler systems, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
   1. Domestic water piping.
   2. HVAC Ductwork.
   3. HVAC hydronic piping.
   4. Items penetrating finished ceiling include the following:
      a. Lighting fixtures.
      b. Air outlets and inlets
   5. Structural framing components.

F. Qualification Data: For qualified Installer.

G. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, that have been approved by authorities having jurisdiction, including hydraulic calculations if applicable.

H. Fire-hydrant flow test report.

I. Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13. Include "Contractor's Material and Test Certificate for Aboveground Piping."

J. Field quality-control reports.
K. Operation and Maintenance Data: For sprinkler specialties to include in emergency, operation, and maintenance manuals.

1.7 QUALITY ASSURANCE

A. Installer Qualifications:
   1. Installer's responsibilities include designing, fabricating, and installing sprinkler systems and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire-hydrant flow test.
      a. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a qualified professional engineer.

B. Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

C. 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.

D. NFPA Standards: Sprinkler system equipment, specialties, accessories, installation, and testing shall comply with the following:
   1. NFPA 13, "Installation of Sprinkler Systems."

1.8 PROJECT CONDITIONS

A. Interruption of Existing Sprinkler Service: Do not interrupt sprinkler service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary sprinkler service according to requirements indicated:
   1. Notify Owner no fewer than 2 days in advance of proposed interruption of sprinkler service.
   2. Do not proceed with interruption of sprinkler service without Owner's written permission.

1.9 COORDINATION

A. Coordinate layout and installation of sprinklers with other construction that penetrates ceilings, including light fixtures, HVAC equipment, and partition assemblies.

1.10 EXTRA MATERIALS

A. If sprinklers are furnished as part of this work, and they are of a type different from the Owner’s existing stock of spare heads, provide a sprinkler cabinet as described herein. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Sprinkler Cabinet: Finished, wall-mounted, steel cabinet with hinged cover, and with space for minimum of six spare sprinklers plus sprinkler wrench. Include number of sprinklers required by NFPA 13 and sprinkler wrench. Include separate cabinet with sprinklers and wrench for each type of sprinkler used on Project.
PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, and fitting materials, and for joining methods for specific services, service locations, and pipe sizes.

2.2 STEEL PIPE AND FITTINGS

A. Standard Weight, Black-Steel Pipe: ASTM A 53/A 53M. Pipe ends may be factory or field formed to match joining method.

B. Thinwall Black-Steel Pipe: ASTM A 135 or ASTM A 795/A 795M, threadable, with wall thickness less than Schedule 30 and equal to or greater than Schedule 10. Pipe ends may be factory or field formed to match joining method.

C. Schedule 10, Black-Steel Pipe: ASTM A 135 or ASTM A 795/A 795M, Schedule 10 in NPS 5 (DN 125) and smaller; and NFPA 13-specified wall thickness in NPS 6 to NPS 10 (DN 150 to DN 250), plain end.

D. Cast-Iron Flanges: ASME 16.1, Class 125.

E. Grooved-Joint, Steel-Pipe Appurtenances:
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      a. Victaulic Company.
   2. Pressure Rating: 175 psig (1200 kPa minimum).
   3. Grooved-End-Pipe Couplings for Steel Piping: AWWA C606 and UL 213, rigid pattern, unless otherwise indicated, for steel-pipe dimensions. Include ferrous housing sections, EPDM-rubber gasket, and bolts and nuts.

2.3 PIPING JOINING MATERIALS

   1. Class 125, Cast-Iron Flanges and Class 150, Bronze Flat-Face Flanges: Full-face gaskets.

B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

2.4 LISTED FIRE-PROTECTION VALVES

A. General Requirements:
   1. Valves shall be UL listed or FM approved.

B. Ball Valves:
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product name or designation or comparable product by one of the following:
   a. Victaulic Company.
4. Valves NPS 1-1/2 (DN 40) and Smaller: Bronze body with threaded ends.
5. Valves NPS 2 and NPS 2-1/2 (DN 50 and DN 65): Bronze body with threaded ends or ductile-iron body with grooved ends.
6. Valves NPS 3 (DN 80): Ductile-iron body with grooved ends.

C. Check Valves:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product name or designation or comparable product by one of the following:
   a. American Cast Iron Pipe Company; Waterous Company Subsidiary.
   b. Anvil International, Inc.
   c. Crane Co.; Crane Valve Group; Crane Valves.
   d. Crane Co.; Crane Valve Group; Jenkins Valves.
   e. Crane Co.; Crane Valve Group; Stockham Division.
   g. Kennedy Valve; a division of McWane, Inc.
   h. Metraflex, Inc.
   i. Milwaukee Valve Company.
   j. Mueller Co.; Water Products Division.
   k. NIBCO INC.
   l. Potter Roemer.
   m. Reliable Automatic Sprinkler Co., Inc.
   n. Tyco Fire & Building Products LP.
   o. United Brass Works, Inc.
   p. Victaulic Company.
   q. Viking Corporation.
   r. Watts Water Technologies, Inc.
4. Pressure Rating: 250 psig (1725 kPa) minimum 300 psig (2070 kPa).
5. Type: Swing check.
7. End Connections: Flanged or grooved.

D. Iron OS&Y Gate Valves:
1. Manufacturers: Subject to compliance with requirements available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product name or designation or comparable product by one of the following:
   a. American Valve, Inc.
   b. Crane Co.; Crane Valve Group; Crane Valves.
   c. Crane Co.; Crane Valve Group; Jenkins Valves.
   d. Crane Co.; Crane Valve Group; Stockham Division.
   e. Hammond Valve.
   f. Milwaukee Valve Company.
E. Indicating-Type Butterfly Valves:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Anvil International, Inc.
   b. Global Safety Products, Inc.
   c. Kennedy Valve; a division of McWane, Inc.
   d. Milwaukee Valve Company.
   e. NIBCO INC.
   f. Tyco Fire & Building Products LP.
   g. Victaulic Company.
2. Basis-of-Design Product: Subject to compliance with requirements, provide product name or designation or comparable product by one of the following:
   b. Pressure Rating: 250 psig (1725 kPa) minimum
   c. Body Material: Cast or ductile iron.
   d. End Connections: Flanged or grooved.

2.5 TRIM AND DRAIN VALVES

A. General Requirements:
2. Pressure Rating: 175 psig (1200 kPa) minimum.

B. Angle Valves:
1. Manufacturers: Subject to compliance with requirements available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Fire Protection Products, Inc.
   b. United Brass Works, Inc.
C. **Ball Valves:**
   1. **Manufacturers:** Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      a. Anvil International, Inc.
      b. Conbraco Industries, Inc.; Apollo Valves.
      c. Fire Protection Products, Inc.
      d. Kennedy Valve; a division of McWane, Inc.
      e. Kitz Corporation.
      f. Milwaukee Valve Company.
      g. NIBCO INC.
      h. Tyco Fire & Building Products LP.
      i. Victaulic Company.
      j. Watts Water Technologies, Inc.

2.6 **SPECIALTY VALVES**

A. **General Requirements:**
   2. **Body Material:** Cast or ductile iron.
   3. **Size:** Same as connected piping.
   4. **End Connections:** Flanged or grooved.

B. **Flexible, Sprinkler Hose Fittings:**
   1. **Manufacturers:** Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      a. FlexHead Industries, Inc.
      b. Viking.
   2. **Standard:** UL 1474.
   3. **Type:** Flexible hose for connection to sprinkler, and with bracket for connection to ceiling grid.
   4. **Pressure Rating:** 175 psig (1200 kPa) minimum.
   5. **Size:** Same as connected piping, for sprinkler.
   6. **Flexible hose may be used in lieu of hard piped sections only if acceptable the local authority having jurisdiction.**

2.7 **SPRINKLERS**

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. Reliable Automatic Sprinkler Co., Inc.
   2. Tyco Fire & Building Products LP.
   3. Victaulic Company.
B. General Requirements:
2. Pressure Rating for Automatic Sprinklers: 175 psig (1200 kPa) minimum.

C. Automatic Sprinklers with Heat-Responsive Element:
2. Nonresidential Applications: UL 199.
3. Residential Applications: UL 1626.
4. Characteristics: Nominal 1/2-inch (12.7-mm) orifice with Discharge Coefficient K of 5.6, and for "Ordinary" temperature classification rating unless otherwise indicated or required by application.

D. Sprinkler Finishes:
1. Acoustical Tile Ceilings: White two piece semi-recessed in all finished spaces.
2. Bronze upright in all unfinished spaces such as mechanical rooms (provide cages on sprinklers located under ducts).
3. Bronze upright above all ceilings.
4. Finished spaces without ceilings: White exposed upright or pendant type.
5. Finished spaces sidewall: White Semi-recessed two piece escutcheon (provide extended coverage sprinkler as required).

E. Sprinkler Escutcheons: Materials, types, and finishes for the following sprinkler mounting applications. Escutcheons for concealed, flush, and recessed-type sprinklers are specified with sprinklers.
2. Interior Sidewall Mounting: White painted steel, two piece, semi-recessed with 1-inch (25-mm) adjustment.
3. Exterior Sidewall Mounting: Dry-sidewall, chrome plated, semi-recessed with 1-inch (25-mm) adjustment.
Sprinkler Guards: Chrome plated, tested in conjunction with the sprinkler type installed.
4. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Reliable Automatic Sprinkler Co., Inc.
   b. Tyco Fire & Building Products LP.
   c. Victaulic Company.
   d. Viking Corporation.
5. Standard: UL 199.
6. Type: Wire cage with fastening device for attaching to sprinkler.

2.8 ALARM DEVICES

A. Alarm-device types shall match piping and equipment connections.

B. Valve Supervisory Switches:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
3. Type: Electrically supervised.
5. Design: Signals that controlled valve is in other than fully open position.

2.9 PRESSURE GAGES

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. AMETEK; U.S. Gauge Division.
2. Ashcroft, Inc.
4. WIKA Instrument Corporation.

B. Standard: UL 393.

C. Dial Size: 3-1/2- to 4-1/2-inch (90- to 115-mm) diameter.

D. Pressure Gage Range: 0 to 250 psig (0 to 1725 kPa) minimum.

E. Water System Piping Gage: Include "WATER• label on dial face.

2.10 ESCUTCHEONS

A. General: Manufactured ceiling, floor, and wall escutcheons and floor plates.

B. One-Piece, Stamped Steel or Plastic Split Escutcheons: Polished chrome-plated or white painted finish.

2.11 SLEEVES

A. Cast-Iron Wall Pipe Sleeves: Cast or fabricated of cast iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.

PART 3 - EXECUTION

3.1 PREPARATION

A. Perform fire-hydrant flow test according to NFPA 13 and NFPA 291. Use results for system design calculations required in "Quality Assurance" Article.

B. Report test results promptly and in writing.

3.2 PIPING INSTALLATION

A. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated, as far as practical.
1. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with Architect before deviating from approved working plans.
B. Piping Standard: Comply with requirements for installation of sprinkler piping in NFPA 13.
C. Use listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.
D. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
E. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
F. Provide "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve, and sized and located according to NFPA 13.
G. Install sprinkler piping with drains for complete system drainage.
H. Install sprinkler control valves, test assemblies, and drain risers adjacent to standpipes when sprinkler piping is connected to standpipes.
I. Install alarm devices in piping systems.
J. Install hangers and supports for sprinkler system piping according to NFPA 13. Comply with requirements for hanger materials in NFPA 13.
K. Provide pressure gages on riser or feed main, at each sprinkler test connection, and at top of each standpipe. Include pressure gages with connection not less than NPS 1/4 (DN 8) and with soft metal seated globe valve, arranged for draining pipe between gage and valve. Install gages to permit removal, and install where they will not be subject to freezing.
L. Fill sprinkler system piping with water.

3.3 JOINT CONSTRUCTION
A. Provide couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure ratings same as or higher than system's pressure rating for aboveground applications unless otherwise indicated.
B. Provide unions adjacent to each valve in pipes NPS 2 (DN 50) and smaller.
C. Provide flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 (DN 65) and larger end connections.
D. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with gasket and bolts according to ASME B31.9.
E. 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.
F. Steel-Piping, Pressure-Sealed Joints: Join lightwall steel pipe and steel pressure-seal fittings with tools recommended by fitting manufacturer.

G. Steel-Piping, Cut-Grooved Joints: Cut square-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe joints.

3.4 VALVE AND SPECIALTIES INSTALLATION

A. Provide listed fire-protection valves, trim and drain valves, specialty valves and trim, controls, and specialties according to NFPA 13 and authorities having jurisdiction.

B. Provide listed fire-protection shutoff valves supervised open, located to control sources of water supply except from fire-department connections. Install permanent identification signs indicating portion of system controlled by each valve.

C. Specialty Valves:
   1. General Requirements: Install in vertical position for proper direction of flow, in main supply to system.

3.5 SPRINKLER INSTALLATION

A. Install sprinklers in suspended ceilings in the center of acoustical ceiling panels.

B. Provide flexible sprinkler hose fittings as necessary. Install sprinklers into flexible sprinkler hose fittings, and install hose into bracket on ceiling grid.

3.6 ESCUTCHEON INSTALLATION

A. Provide escutcheons for penetrations of walls, ceilings, and floors.

B. Escutcheons for New Piping:
   1. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One piece, cast brass with polished chrome-plated or white painted finish.
   2. Bare Piping at Ceiling Penetrations in Finished Spaces: One piece, cast brass with polished chrome-plated or white painted finish.
   3. Bare Piping in Unfinished Service Spaces: One piece, cast brass with polished chrome-plated finish.
   4. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece floor plate.

3.7 SLEEVE INSTALLATION

A. General Requirements: Sleeves are not required for sprinkler piping.

B. For interior wall penetrations, seal annular space between wall and pipe using joint sealants appropriate for size, depth, and location of joint. Comply with requirements for joint sealants in Division 07 Section "Joint Sealants."

C. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements
for firestop materials and installations in Division 07 Section "Through-Penetration Firestop Systems."

3.8 IDENTIFICATION

A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13.

B. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Division 26.

3.9 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:
   1. Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest until no leaks exist.
   2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
   3. Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter.
   4. Energize circuits to electrical equipment and devices.
   5. Coordinate with fire-alarm tests. Operate as required.
   6. Verify that equipment hose threads are same as local fire-department equipment.

C. Sprinkler piping system will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

3.10 CLEANING

A. Clean dirt and debris from sprinklers.

B. Remove and replace any new sprinklers which have paint other than the factory finish.

3.11 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain the system.

3.12 PIPING SCHEDULE

A. Standard-pressure, wet-pipe sprinkler system, NPS 2 (DN 50) and smaller, shall be one of the following:
   1. Standard-weight, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.
   2. Standard-weight black-steel pipe with cut-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.

B. Standard-pressure, wet-pipe sprinkler system, NPS 2-1/2 to NPS 4 (DN 65 to DN 100) shall be one of the following:
1. Standard-weight, black-steel pipe with cut-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.

2. Schedule 10 black-steel pipe with roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.

C. Standard-pressure, wet-pipe sprinkler system, NPS 5 (DN 125) and larger, shall be one of the following:

1. Standard-weight black-steel pipe with cut-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.

2. Schedule 10 black-steel pipe with roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.

3.13 SPRINKLER SCHEDULE

A. Use sprinkler types in subparagraphs below for the following applications:

1. Rooms without Ceilings: Upright sprinklers

2. Rooms with Suspended Acoustical Tile Ceilings: Semi-Recessed sprinklers

3. Hard ceilings (gypsum) and soffits: Concealed plate type sprinklers.


B. Provide sprinkler types in subparagraphs below with finishes indicated.

1. Concealed Sprinklers: Rough brass, with factory-painted white cover plate.

2. Semi-Recessed Sprinklers: Bright chrome, with bright chrome escutcheon.

3. Upright Sprinklers: Chrome plated in finished spaces exposed to view; rough bronze in unfinished spaces not exposed to view.

END OF SECTION 211313
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.

B. Related Sections:
   1. Division 23 Section “Common Work Results for HVAC.”

1.2 SUMMARY

A. Plumbing work associated with renovations on 3 floors.

B. This Section includes the following:
   1. Piping materials and installation instructions common to most piping systems.
   2. Transition fittings.
   3. Dielectric fittings.
   4. Mechanical sleeve seals.
   5. Sleeves.
   7. Equipment installation requirements common to equipment sections.
   8. Painting and finishing.

C. The Plumbing Subcontractor is responsible for obtaining the plumbing permit for the project.

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, crawlspace, 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 in 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 plastic materials:
   2. CPVC: Chlorinated polyvinyl chloride plastic.
3. PVC: Polyvinyl chloride plastic.

G. 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. Mechanical sleeve seals.
   3. Escutcheons.

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 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.

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."
PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

2.2 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. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

C. Solvent Cements for Joining Plastic Piping:
   1. CPVC Piping: ASTM F 493.
   2. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.

D. Fiberglass Pipe Adhesive: As furnished or recommended by pipe manufacturer.

2.4 SLEEVES

A. Galvanized-Steel Sheet: 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint.

B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.


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-Brass Type: With set screw or spring clips and chrome-plated finish.
2.6 ACCESS PANELS

A. Access panels required for items furnished under Division 22 shall be provided under this Division.

B. Selection and installation of access panels shall be in accordance with Division 08 Section “Access Doors and Frames”. Access panels shall be standard panels, 12 in. x 16 in. (305 mm x 406 mm) minimum unless indicated otherwise. Panels installed in areas of high moisture concentration, such as restrooms and locker rooms, shall be fabricated of paintable stainless steel or aluminum for corrosion resistance. Access panels in fire-rated construction shall have the same UL rating as the building assembly in which they are installed.

C. Provide access panels in building construction where required for access to control valves, tempering valves and other related items

PART 3 - EXECUTION

3.1 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 within 18 inches (457 mm) of the ceiling 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.

J. Install piping to allow application of insulation.

K. Select system components with pressure rating equal to or greater than system operating pressure.

L. 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. Insulated Piping: One-piece, stamped-steel type with spring clips.
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 Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type.

M. Sleeves are not required for core-drilled holes.

N. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
1. Cut sleeves to length for mounting flush with both surfaces.
   a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches (50 mm) above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
3. Install sleeves that are large enough to provide 1/4-inch (6.4-mm) annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
   a. Steel Pipe Sleeves: For pipes smaller than NPS 6 (DN 150).
   b. Steel Sheet Sleeves: For pipes NPS 6 (DN 150) and larger, penetrating gypsum-board partitions.
      1) Seal space outside of sleeve fittings with grout.
4. 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.

O. 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.

P. 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 "Joint Sealants" for materials.

Q. Verify final equipment locations for roughing-in.

R. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.2 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 22 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. Plastic Piping Solvent-Cement Joints: 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. PVC Nonpressure Piping: Join according to ASTM D 2855.

3.3 PIPING CONNECTIONS

A. Make connections according to the following, unless otherwise indicated:
   1. Install unions, in piping NPS 2 (DN 50) and smaller, adjacent to each valve and at final connection to each piece of equipment.

3.4 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.

D. Install equipment to allow right of way for piping installed at required slope.

3.5 ERECTION OF METAL SUPPORTS AND ANCHORAGES

A. Refer to Division 05 Section "Metal Fabrications" for structural steel.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor plumbing materials and equipment.

C. Field Welding: Comply with AWS D1.1.

END OF SECTION 220500
SECTION 220523 - GENERAL-DUTY 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. Bronze ball valves.
   2. Bronze swing check valves.

B. Related Sections:
   1. Division 22 Section "Identification for Plumbing Piping and Equipment" for valve tags and schedules.

1.3 DEFINITIONS

A. CWP: Cold working pressure.

B. EPDM: Ethylene propylene copolymer rubber.

C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.

D. NRS: Nonrising stem.

E. OS&Y: Outside screw and yoke.

F. RS: Rising stem.

G. SWP: Steam working pressure.

1.4 SUBMITTALS

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

1.5 QUALITY ASSURANCE

A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.

B. ASME Compliance:
   1. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
   2. ASME B31.1 for power piping valves.
   3. ASME B31.9 for building services piping valves.

C. NSF Compliance: NSF 61 for valve materials for potable-water service.
1.6 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:
   1. Protect internal parts against rust and corrosion.
   2. Protect threads, flange faces, grooves, and weld ends.
   3. Set ball and plug 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.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

A. Refer to valve schedule articles for applications of valves.

B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

C. Valve Sizes: Same as upstream piping unless otherwise indicated.

D. Valves in Insulated Piping: With 2-inch (50-mm) stem extensions and the following features:
   1. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.

E. Valve-End Connections:
   1. Flanged: With flanges according to ASME B16.1 for iron valves.
   2. Solder Joint: With sockets according to ASME B16.18.
   3. Threaded: With threads according to ASME B1.20.1.

F. Valve Bypass and Drain Connections: MSS SP-45.

2.2 BRONZE BALL VALVES

A. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim:
   1. Manufacturers: Subject to compliance with requirements:
      b. Milwaukee Valve Company.
      c. NIBCO INC.
      d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
   2. Description:
      b. SWP Rating: 150 psig (1035 kPa).
      c. CWP Rating: 600 psig (4140 kPa).
      d. Body Design: Two piece.
      e. Body Material: Bronze.
      f. Ends: Threaded.
g. Seats: PTFE or TFE.
h. Stem: Bronze.
i. Ball: Chrome-plated brass.
j. Port: Full.

2.3 BRONZE SWING CHECK VALVES

A. Class 125, Bronze Swing Check Valves with Bronze Disc:
   1. Manufacturers: Subject to compliance with requirements,:
      a. Hammond Valve.
      b. Milwaukee Valve Company.
      c. NIBCO INC.
      d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
   2. Description:
      a. Standard: MSS SP-80, Type 3.
      b. CWP Rating: 200 psig (1380 kPa).
      c. Body Design: Horizontal flow.
      e. Ends: Threaded.
      f. Disc: Bronze.

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.

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 check valves for proper direction of flow and as follows:
   1. Swing Check Valves: In horizontal position with hinge pin level.

3.3 ADJUSTING

A. Adjust or replace valve packing after piping systems have been tested and put into service but
   before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

A. If valve applications are not indicated, use the following:
   1. Shutoff Service: Ball, valves.
   2. Throttling Service: Ball valves.

B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves
   with higher SWP classes or CWP ratings may be substituted.

C. Select valves, except wafer types, with the following end connections:
   1. For Copper Tubing, NPS 2 (DN 50) and Smaller:Threaded ends except where solder-
      joint valve-end option is indicated in valve schedules below.
   2. For Copper Tubing, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Flanged ends except where
      threaded valve-end option is indicated in valve schedules below.

3.5 DOMESTIC, HOT- AND COLD-WATER VALVE SCHEDULE

A. Pipe NPS 3 and Smaller:
   1. Bronze Valves: May be provided with solder-joint ends instead of threaded ends.
   2. Ball Valves: Two piece, full port, bronze with bronze trim.
   3. Bronze Swing Check Valves: Class 125, bronze disc.

END OF SECTION 220523
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. This Section includes the following hangers and supports for plumbing system piping and equipment:
   1. Copper pipe supports.
   2. Pipe positioning and acoustical isolation systems.
   3. Equipment supports.

1.3 DEFINITIONS

A. MSS: Manufacturers Standardization Society for The Valve and Fittings Industry Inc.
B. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

1.4 SUBMITTALS

A. Product Data: For the following:
   1. Steel pipe hangers and supports.
   2. Copper pipe supports.
   3. Pipe positioning and acoustical isolation systems.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

2.2 STEEL PIPE HANGERS AND SUPPORTS

A. Description: MSS SP-58, Types 1 through 58, factory-fabricated components. Refer to Part 3 "Hanger and Support Applications" Article for where to use specific hanger and support types.
B. Available Manufacturers:
2. Carpenter & Paterson, Inc.
3. ERICO/Michigan Hanger Co.
4. Grinnell Corp.

C. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion for support of bearing surface of piping.

D. Copper-plated hangers are plated for identification only. Traditional thin copper plating on steel substrate does not provide adequate protection from galvanic corrosion due to contact between dissimilar metals.
   1. Where copper-plated supports are specified for use with copper piping, either copper plating or a copper-colored finish such as Cooper B-Line’s Dura-Copper epoxy coating is acceptable. This is for identification, and does not protect dissimilar metals.
   2. Where copper piping is used with steel hangers and supports, provide protection from galvanic corrosion such as thick plastic or vinyl factory coating, or plastic-lined cushion clamps.

2.3 METAL FRAMING SYSTEMS

A. Description: MFMA-3, shop- or field-fabricated pipe-support assembly made of steel channels and other components.

B. Available Manufacturers:
2. ERICO/Michigan Hanger Co.; ERISTRUT Div.
4. Unistrut Corp.; Tyco International, Ltd.

C. Coatings: Manufacturer's standard finish unless bare metal surfaces are indicated.

2.4 PIPE POSITIONING AND ACOUSTICAL ISOLATION SYSTEMS

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

B. Available Manufacturers:
1. HOLDRITE Corp.; Hubbard Enterprises.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT APPLICATIONS

A. Specific hanger and support requirements are specified in Sections specifying piping systems and equipment.

B. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping system Sections.
C. Use hangers and supports with galvanized, metallic coatings for piping and equipment that will not have field-applied finish.

D. Use nonmetallic coatings or cushions on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

E. 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. Pipe Hangers (MSS Type 5): For suspension of pipes, NPS 1/2 to NPS 4 (DN 15 to DN 100), to allow off-center closure for hanger installation before pipe erection.

F. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8 (DN 15 to DN 200).

G. 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 20 (DN 20 to DN 500).
   2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers, NPS 3/4 to NPS 20 (DN 20 to DN 500), if longer ends are required for riser clamps.

H. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
   1. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction to attach to top flange of structural shape.
   2. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
   3. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
   4. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.

I. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
   1. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.

J. Comply with MFMA-102 for metal framing system selections and applications that are not specified in piping system Sections.

K. Use pipe positioning and acoustical isolation systems in walls and pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

3.2 HANGER AND SUPPORT INSTALLATION

A. Steel Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to support piping from building structure.

B. Metal Framing System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled metal framing systems.
C. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.

D. Pipe Positioning and Acoustical Isolation System Installation: Install support devices to make rigid and quiet supply and waste piping connections to each plumbing fixture. Refer to Division 22 Section "Domestic Water Piping Specialties" for plumbing fixtures.

E. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.

F. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.9 (for building services piping) are not exceeded.

G. Insulated Piping: Comply with the following:
   1. Attach clamps and spacers to piping.
      a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
      b. Do not exceed pipe stress limits according to ASME B31.9 for building services piping.
   2. 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.
   3. Shield Dimensions for Pipe:
      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.
   4. Insert Material: Length at least as long as protective shield.
   5. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.3 METAL FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers.

3.4 ADJUSTING

A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

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
   A. Section Includes:
      1. Warning signs and labels.
      2. Pipe labels.
      3. Valve tags.
      4. Warning tags.

1.3 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. Valve numbering scheme.
   D. 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 WARNING SIGNS AND LABELS
   A. Material and Thickness: Multilayer, multicolor, plastic nameplates for mechanical engraving, 1/16 inch (1.6 mm).

2.2 PIPE LABELS
   A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.
B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.

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.

2.3 VALVE TAGS

A. Valve Tags: 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: Brass wire-link or beaded chain; or S-hook .

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.

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. 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. 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.

B. Pipe Label Color Schedule:

   1. Domestic Cold Water Piping:
      a. Background Color: Green.
2. Domestic Hot Water, and Hot Water Return Piping:
   a. Background Color: Yellow.
   b. Letter Color: Black.
3. Storm Drainage Piping:
   a. Background Color: Green.

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. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:

   1. Valve-Tag Size and Shape:
      a. Cold Water: 1-1/2 inches (38 mm), round.
      b. Hot Water: 1-1/2 inches (38 mm), round.

   2. Valve-Tag Color:
      b. Hot Water: Natural.

3.4 WARNING-TAG INSTALLATION

   A. Write required message on, and attach warning tags to, equipment and other items where required.

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. Flexible elastomeric.
      b. Mineral fiber.
   2. Adhesives.
   3. Factory-applied jackets.
   4. Tapes.
   5. Securements.
   6. Corner angles.

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. Qualification Data: For qualified Installer.

D. 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.

E. 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.

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.

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.
      c. RBX Corporation; Insul-Sheet 1800 and Insul-Tube 180.

G. Mineral-Fiber, Preformed Pipe Insulation:
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Johns Manville; Micro-Lok.
      b. Knauf Insulation; 1000 Pipe Insulation.
      c. Owens Corning; Fiberglas Pipe Insulation.
   2. Type I, 850 deg F (454 deg C) Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

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 Adhesive: Comply with MIL-A-24179A, Type II, Class I.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Aeroflex USA Inc.; Aerosol.
      b. Armacell LLC; 520 Adhesive.
      c. Foster Products Corporation, H. B. Fuller Company; 85-75.
      d. RBX Corporation; Rubatex Contact Adhesive.
   2. 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. Products: Subject to compliance with requirements, provide one of the following:
      a. Childers Products, Division of ITW; CP-82.
      c. ITW TACC, Division of Illinois Tool Works; S-90/80.
      d. Marathon Industries, Inc.; 225.
      e. Mon-Eco Industries, Inc.; 22-25.
   2. 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).

   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Childers Products, Division of ITW; CP-82.
2. 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).

E. PVC Jacket Adhesive: Compatible with PVC jacket.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Dow Chemical Company (The); 739, Dow Silicone.
      d. Speedline Corporation; Speedline Vinyl Adhesive.
   2. 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 SEALANTS

A. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Childers Products, Division of ITW; CP-76.

2.4 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.

2.5 FIELD-APPLIED JACKETS

A. PVC Plastic.
   1. Manufacturers:
      a. Ceel-Co division of Johns Manville.
      b. Johns Manville (Zeston plastic jacket systems).
      c. Proto Corporation.
   2. Jacket: ASTM D1784, One piece molded type fitting covers and sheet material, off-white color.
      a. Minimum service temperature: 0°F (-18°C).
      c. Moisture vapor transmission: ASTM E96; 0.002 perm-inches.
      d. Thickness: 30 mil (0.76 mm).
      e. Connections: Brush on welding adhesive, tacks (for heating systems only) or pressure sensitive color matching vinyl tape.
2.6 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 0835.
      b. Compac Corp.; 104 and 105.
      c. Ideal Tape Co., Inc., an American Biltrite Company; 428 AWF ASJ.
      d. 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. 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. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0555.
      b. Compac Corp.; 130.
      c. Ideal Tape Co., Inc., an American Biltrite Company; 370 White PVC tape.
      d. 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.

2.7 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.

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. 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.
   5. Handholes.
   6. Cleanouts.

3.4 PENETRATIONS

A. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated):
   Install insulation continuously through walls and partitions.

B. 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 "Joint Sealants" and fire-resistant joint sealers.

C. 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 "Joint Sealants".

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 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.

6. 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.

7. For services not specified to receive a field-applied jacket except for flexible elastomeric, 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.

8. 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.

3.6 FLEXIBLE ELASTOMERIC INSULATION INSTALLATION

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 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 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.

3.7 MINERAL-FIBER INSULATION INSTALLATION

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 (150 mm) o.c.
   4. For insulation with factory-applied jackets on below ambient surfaces, do not staple longitudinal tabs but 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 Fittings and Elbows:
   1. Install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Place PVC cover fitting over the elbow and secure with bands.

C. Insulation Installation on Valves and Pipe Specialties:
   1. Install sections of pipe insulation, to a thickness equal to adjoining pipe insulation.
   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.

3.8 FIELD-APPLIED JACKET INSTALLATION

A. Provide PVC jacket on exposed piping up to 10 feet above the finished floor. 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 2 continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.
3.9 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.

B. Flexible elastomeric insulation shall only be used in concealed locations. Mineral-fiber insulation may be used in both exposed and concealed locations.

C. Pipe insulation is not required outdoors.

3.10 INDOOR PIPING INSULATION SCHEDULE

A. Domestic Cold Water:
   1. NPS 1/2 and NPS 3/4: 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.
   2. NPS 1 (DN 25) and NPS 1-1/4 (DN 32): 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.
   3. NPS 1-1/2 (DN 40) and Larger: 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 inch (25 mm) thick.

B. Domestic Hot Water:
   1. NPS 1 (DN 25) and Smaller: Insulation shall be one of the following:
      a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch (25 mm) thick.
   2. NPS 1-1/4 (DN 32): Insulation shall be one of the following:
      a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1-1/2 inch (38 mm) thick.
   3. NPS 1-1/2 (DN 40) and NPS 2 (DN 50): Insulation shall be the following:
      a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1-1/2 inch (38 mm) thick.
   4. NPS 2-1/2 (DN 63): Insulation shall be the following:
      a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 2 inch (50 mm) thick.

C. Condensate Drain:
   1. NPS 1/2 and NPS 3/4: 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.
   2. NPS 1 (DN 25) and NPS 1-1/4 (DN 32): 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.

D. Stormwater and Overflow:
   1. All Pipe Sizes: Insulation shall be the following:
      a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch (25 mm) thick.

END OF SECTION 220700
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. Escutcheons.
2. Sleeves and sleeve seals.

1.3 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
B. Comply with NSF 61 for potable domestic water piping and components.

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.

2.2 COPPER TUBE AND FITTINGS

A. Hard Copper Tube: ASTM B 88, Type L (ASTM B 88M, Type B) water tube, drawn temper.
3. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.
   a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      1) Elkhart Products Corporation; Industrial Division.
      2) NIBCO INC.
4. Copper-Tube Extruded-Tee Connections:
   a. Manufacturers: Subject to compliance with requirements, provide products by the following:
      1) T-DRILL Industries Inc.

2.3 SOLDER MATERIALS:

A. Manufacturers:
1. Harris (Product: Stay-Brite).
4. No substitutions.

B. Nominal Composition: Alloy of silver and tin (3-6% Ag, remainder Sn). Antimony-free.

C. Physical Properties:
1. Color: Bright Silver
2. Solidus: 430°F (221°C)
3. Liquidus: 430°F (221°C)
4. Electrical Conductivity: 16.4% IACS
5. Shear Strength: 10,600 psi (73 MPa)
6. Tensile Strength: 14,000 psi (96 MPa)
7. Elongation: 48%

D. Specification Compliance:
1. NSF 51
2. ASTM B32-89, Alloy Grade Sn96
3. Federal Spec. QQ-S-571E, Class Sn 96 with exception to QPL paragraph 3.1
4. J-STD-006, Sn96Ag04A

E. Flux:
1. ASTM B 813, water-flushable.

2.4 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.

B. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.

PART 3 - EXECUTION

3.1 PIPING INSTALLATION

A. 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.

B. Install domestic water piping level and plumb.

C. Install piping concealed from view and protected from physical contact by building occupants 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, and coordinate with other services occupying that space.

F. Install piping adjacent to equipment and specialties to allow service and maintenance.

G. Install piping to permit valve servicing.

H. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than system pressure rating used in applications below unless otherwise indicated.

I. Install piping free of sags and bends.

J. Install fittings for changes in direction and branch connections.

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. Soldered Joints: Apply flux to end of tube. Join copper tube and fittings according to ASTM B 828 or CDA's "Copper Tube Handbook."

3.3 VALVE INSTALLATION

A. General-Duty Valves: Comply with requirements in Division 22 Section "General-Duty Valves for Plumbing Piping" for valve installations.

B. Install shutoff valve close to water main on each branch and riser serving plumbing fixtures or equipment, on each water supply to equipment, and on each water supply to plumbing fixtures that do not have supply stops. Use ball valves for piping NPS 2 (DN 50) and smaller.

C. Install ball-type 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."

   1. Hose-End Drain Valves: At low points in water mains, risers, and branches.

3.4 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.

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.

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.

G. Install supports for vertical steel piping every 15 feet (4.5 m).

3.5 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. Connect domestic water piping to water piping provided by division 33.
   1. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:
      a. 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.
      b. 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.

3.6 ESCUTCHEON INSTALLATION

A. Install escutcheons for penetrations of walls, ceilings, and floors.

B. Escutcheons for New Piping:
   1. Piping with Fitting or Sleeve Protruding from Wall: One piece, deep pattern.
   2. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One piece, cast brass with polished chrome-plated finish.
   3. Bare Piping at Ceiling Penetrations in Finished Spaces: One piece, cast brass with polished chrome-plated finish.

C. Escutcheons for Existing Piping:
   2. Insulated Piping: Split plate, stamped steel with concealed hinge and spring clips.
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 1 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 to stand 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 bibbs.
2. Open shutoff valves to fully open position.
3. Remove plugs used during testing of piping and for temporary sealing of piping during installation.
4. Check plumbing specialties and verify proper settings, adjustments, and operation.

3.10 CLEANING

A. 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 (50 mg/L) 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 (200 mg/L) 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. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.

B. Prepare and submit reports of purging and disinfecting activities.

C. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

3.11 PIPING SCHEDULE

A. Aboveground domestic water piping, NPS 3 and smaller, shall be one of the following:
   1. Hard copper tube, ASTM B 88, Type L (ASTM B 88M, Type B); cast-copper solder-joint fittings; and soldered joints.
   2. Tee branch connections may be made with T-DRILL extruded connections.

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 3” and smaller. Use butterfly or ball type with flanged ends for piping NPS 4” and larger.
   2. Drain Duty: Hose-end ball-type drain valves.

END OF SECTION 221116
SECTION 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. Wall hydrants.

1.3 PERFORMANCE REQUIREMENTS
   A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig (860 kPa), unless otherwise indicated.

1.4 SUBMITTALS
   A. Product Data: For each type of product indicated.
   B. Field quality-control test reports.
   C. Operation and Maintenance Data: For domestic water piping specialties to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE
   A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
   B. NSF Compliance:
      2. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 01 through 09."

PART 2 - PRODUCTS

2.1 WALL HYDRANTS
   A. Nonfreeze Wall Hydrants:
      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 following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Watts Drainage Products Inc.
   b. Woodford Manufacturing Company.
   c. Zurn Plumbing Products Group; Specification Drainage Operation.
5. Operation: Loose key.
6. Casing and Operating Rod: Of length required to match wall thickness. Include wall clamp.
8. Outlet: Concealed, with integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
11. Outlet: Behind cover, with integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
13. Operating Keys(s): One with each wall hydrant.

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.

3.2 CONNECTIONS
   A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping and specialties.

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, sanitary vent and condensate drain piping inside the building and above grade outside the building including vents through the roof:
   1. Pipe, tube, and fittings.
   2. Special pipe fittings.

1.3 DEFINITIONS


B. PVC: Polyvinyl chloride plastic.

1.4 PERFORMANCE REQUIREMENTS

A. Components and installation shall be capable of withstanding the following minimum working pressure, unless otherwise indicated:

B. Soil, Waste, and Vent Piping: 10-foot head of water, 30 kPa or 5 psi.

1.5 SUBMITTALS

A. Product Data: For pipe, tube, fittings, and couplings.

B. Field quality-control inspection and test reports.

1.6 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

B. Comply with NSF 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-dwv" for plastic drain, waste, and vent piping; "NSF-drain" for plastic drain piping; "NSF-tubular" for plastic continuous waste piping; and "NSF-sewer" for plastic sewer piping.
PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

2.2 PIPING MATERIALS

A. Refer to Part 3 "Piping Applications" Article for applications of pipe, tube, fitting, and joining materials.

2.3 PVC PIPE AND FITTINGS

A. Solid-Wall PVC Pipe: ASTM D 2665, drain, waste, and vent.
   1. PVC Socket Fittings: ASTM D 2665, socket type, made to ASTM D 3311, drain, waste, and vent patterns.

B. Solvent Cement and Adhesive Primer:
   1. Use PVC solvent cement that has a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
   2. Use adhesive primer that has a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.4 COPPER TUBE AND FITTINGS

A. Hard Copper Tube: ASTM B 306, Type DWV drainage tube (DWV) (or ASTM B 88, Type L water tube), drawn temper.
   3. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.
      a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
         1) Elkhart Products Corporation; Industrial Division.
         2) NIBCO INC.

2.5 SOLDER MATERIALS:

A. Manufacturers:
   1. Harris (Product: Stay-Brite).
   4. No substitutions.

B. Nominal Composition: Alloy of silver and tin (3-6% Ag, remainder Sn). Antimony-free.
C. Physical Properties:
1. Color: Bright Silver
2. Solidus: 430°F (221°C)
3. Liquidus: 430°F (221°C)
4. Electrical Conductivity: 16.4% IACS
5. Shear Strength: 10,600 psi (73 MPa)
6. Tensile Strength: 14,000 psi (96 MPa)
7. Elongation: 48%

D. Specification Compliance:
1. NSF 51
2. ASTM B32-89, Alloy Grade Sn96
3. Federal Spec. QQ-S-571E, Class Sn 96 with exception to QPL paragraph 3.1
4. J-STD-006, Sn96Ag04A

E. Flux:
1. ASTM B 813, water-flushable.

2.6 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.

B. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

A. Aboveground soil, waste, and condensate piping shall be the following:
1. PVC pipe, PVC socket fittings, and solvent-cemented joints.
2. Exposed drain piping from equipment shall be DWV copper. Locations defined as exposed shall include data server rooms, in addition to locations defined elsewhere in the Specifications. Exposed piping shall include insulated piping.

B. Aboveground vent piping shall be the following:
1. PVC pipe, PVC socket fittings, and solvent-cemented joints.

3.2 PIPING INSTALLATION

A. Basic piping installation requirements are specified in Division 22 Section "Common Work Results for Plumbing."

B. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers.
C. 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 standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.

D. Install soil and waste drainage and vent piping at the following minimum slopes, unless otherwise indicated:
   1. Horizontal Sanitary Drainage Piping: 2 percent downward in direction of flow for piping NPS 3 (DN 80) and smaller; 1 percent downward in direction of flow for piping NPS 4 (DN 100) and larger.
   2. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.

E. Install PVC soil and waste drainage and vent piping according to ASTM D 2665.

F. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

3.3 JOINT CONSTRUCTION

A. Basic piping joint construction requirements are specified in Division 22 Section "Common Work Results for Plumbing."

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 pipes, tubes, and fittings before assembly.

D. PVC Nonpressure Piping Joints: Join piping according to ASTM D 2665.

E. Soldered Joints: Apply flux to end of tube. Join copper tube and fittings according to ASTM B 828 or CDA's "Copper Tube Handbook."

3.4 HANGER AND SUPPORT INSTALLATION

A. Pipe hangers and supports are specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment." Install the following:
   1. Vertical Piping: MSS Type 8 or Type 42, clamps.
   2. Install individual, straight, horizontal piping runs according to the following:

B. Install supports according to Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."

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. Maximum spans below were taken from MSS SP-69 for water service and from model plumbing codes. Most restrictive piping and spacing dimensions are shown.

F. 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.

G. Install supports for vertical PVC piping every 48 inches (1200 mm).

H. 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.

I. Install supports for vertical copper tubing every 10 feet (3 m).

J. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.5 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. 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.

3.6 FIELD QUALITY CONTROL

A. 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.

B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

D. 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 head of water (30 kPa). 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

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.

END OF SECTION 221316
SECTION 221613 - FACILITY NATURAL-GAS 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. Pipes, tubes, and fittings.
   2. Piping specialties.
   3. Piping and tubing joining materials.
   4. Valves.

1.3 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, 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.

1.4 PERFORMANCE REQUIREMENTS

A. Minimum Operating-Pressure Ratings:
   1. Piping and Valves: 40 psig minimum unless otherwise indicated.

1.5 SUBMITTALS

A. Product Data: For each type of the following:
   1. Piping specialties.
   2. Valves. Include pressure rating, capacity, settings, and electrical connection data of selected models.
   3. Dielectric fittings.
   4. Escutcheons.

1.6 QUALITY ASSURANCE

A. Steel Support Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.
C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Handling Flammable Liquids: Remove and dispose of liquids from existing natural-gas piping according to requirements of authorities having jurisdiction.

B. 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.

C. Store and handle pipes and tubes having factory-applied protective coatings to avoid damaging coating, and protect from direct sunlight in accordance with manufacturer’s recommendations.

1.8 PROJECT CONDITIONS

A. Perform site survey, research public utility records, and verify existing utility locations. Contact utility-locating service for area where Project is located.

B. Interruption of Existing Natural-Gas Service: Do not interrupt natural-gas service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide purging and startup of natural-gas supply according to requirements indicated:
   1. Notify Owner no fewer than 2 days in advance of proposed interruption of natural-gas service.
   2. Do not proceed with interruption of natural-gas service without Owner's written permission.

C. Provide manual shutoff valves as required to facilitate temporary shutdowns and to minimize service interruptions, as necessary to meet Owner’s requirements.

1.9 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided.

B. Coordinate requirements for access panels and doors for valves installed concealed behind finished surfaces. Comply with requirements in Division 08 Section "Access Doors and Frames."

PART 2 - PRODUCTS

2.1 PIPES, TUBES, AND FITTINGS

A. Steel Pipe: ASTM A 53/A 53M, black steel, Schedule 40, Type E or S, Grade B.
4. Forged-Steel Flanges and Flanged Fittings: ASME B16.5, minimum Class 150, including bolts, nuts, and gaskets of the following material group, end connections, and facings:
   b. End Connections: Threaded or butt welding to match pipe.
   c. Lapped Face: Not permitted underground.

2.2 JOINING MATERIALS

A. Joint Compound and Tape: Suitable for natural gas.


2.3 MANUAL GAS SHUTOFF VALVES

A. General Requirements for Metallic Valves, NPS 2 (DN 50) and Smaller: Comply with ASME B16.33.
   1. CWP Rating: 125 psig (862 kPa)
   3. Dryseal Threads on Flare Ends: Comply with ASME B1.20.3.
   5. Listing: Listed and labeled by an NRTL acceptable to authorities having jurisdiction for valves 1 inch (25 mm) and smaller.
   6. Service Mark: Valves 1-1/4 inches (32 mm) to NPS 2 (DN 50) shall have initials "WOG" permanently marked on valve body.

B. General Requirements for Metallic Valves, NPS 2-1/2 (DN 65) and Larger: Comply with ASME B16.38.
   1. CWP Rating: 125 psig (862 kPa).
   2. Flanged Ends: Comply with ASME B16.5 for steel flanges.
   4. Service Mark: Initials "WOG" shall be permanently marked on valve body.

C. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim: MSS SP-110.
   1. Manufacturers:
      a. Watts
      b. Nibco
   3. Ball: Chrome-plated bronze.
   4. Stem: Bronze; blowout proof.
   5. Seats: Reinforced TFE; blowout proof.
   6. Packing: Threaded-body packnut design with adjustable-stem packing.
   7. Ends: Threaded, flared, or socket.
   8. CWP Rating: 600 psig (4140 kPa).
9. Listing: Valves NPS 1 (DN 25) and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.

10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

2.4 DIELECTRIC FITTINGS

A. Dielectric Unions:
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      b. Central Plastics Company.
      e. Watts Regulator Co.; Division of Watts Water Technologies, Inc.
      f. Wilkins; Zurn Plumbing Products Group.
   3. Combination fitting of copper alloy and ferrous materials.
   4. Insulating materials suitable for natural gas.
   5. Combination fitting of copper alloy and ferrous materials with threaded, brazed-joint, plain, or welded end connections that match piping system materials.

2.5 SLEEVES

A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.

B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

2.6 ESCUTCHEONS

A. General Requirements for Escutcheons: Manufactured wall and ceiling escutcheons and floor plates, with ID to fit around pipe or tube, and OD that completely covers opening.

B. One-Piece, Deep-Pattern Escutcheons: Deep-drawn, box-shaped brass with polished chrome-plated finish.


PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for natural-gas piping system to verify actual locations of piping connections before equipment installation.

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

A. Close equipment shutoff valves before turning off natural gas to premises or piping section.

B. Inspect natural-gas piping according to NFPA 54 and the International Fuel Gas Code to determine that natural-gas utilization devices are turned off in piping section affected.

C. Comply with NFPA 54 and the International Fuel Gas Code requirements for prevention of accidental ignition.

3.3 PIPING INSTALLATION


B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

C. 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.

D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

E. Locate valves for easy access.

F. Install natural-gas piping at uniform grade of 2 percent down toward drip and sediment traps.

G. Install piping free of sags and bends.

H. Install fittings for changes in direction and branch connections.

I. Install escutcheons at penetrations of interior walls, ceilings, and floors.

1. New Piping:
   a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
   b. Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
   c. Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type.
   d. Piping at Ceiling Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
   e. Piping at Ceiling Penetrations in Finished Spaces: One-piece, stamped-steel type and set screw.
   f. Piping in Unfinished Service Spaces: One-piece, cast-brass type with polished chrome-plated finish.
   g. Piping in Equipment Rooms: One-piece, cast-brass type.
   h. Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.

J. Verify final equipment locations for roughing-in.
K. Comply with requirements in Sections specifying gas-fired appliances and equipment for roughing-in requirements.

L. Drips and Sediment Traps: Install drips at points where condensate may collect, including service-meter outlets. Locate where accessible to permit cleaning and emptying. Do not install where condensate is subject to freezing.  
1. Construct drips and sediment traps using tee fitting with bottom outlet plugged or capped.  
   Use nipple a minimum length of 3 pipe diameters, but not less than 3 inches (75 mm) long and same size as connected pipe. Install with space below bottom of drip to remove plug or cap.

M. Conceal pipe installations in walls, pipe spaces, utility spaces, or above ceilings, unless indicated to be exposed to view.

N. Concealed Location Installations: Except as specified below, install concealed natural-gas piping and piping installed under the building in containment conduit constructed of steel pipe with welded joints as described in Part 2. Install a vent pipe from containment conduit to outdoors and terminate with weatherproof vent cap.  
1. Above Accessible Ceilings: Natural-gas piping, fittings, valves, and regulators may be installed in accessible spaces without containment conduit.
2. In Walls or Partitions: Protect tubing installed inside partitions or hollow walls from physical damage using steel striker barriers at rigid supports.  
   a. Exception: Tubing passing through partitions or walls does not require striker barriers.
3. Prohibited Locations:  
   a. Do not install natural-gas piping in or through circulating air ducts, chimneys or gas vents (flues), ventilating ducts, or elevator shafts.  
   b. Do not install natural-gas piping in solid walls or partitions.

O. Use eccentric reducer fittings to make reductions in pipe sizes. Install fittings with level side down.

P. Connect branch piping from top or side of horizontal piping.

Q. Do not use natural-gas piping as grounding electrode.

3.4 VALVE INSTALLATION

A. Install manual gas shutoff valve for each gas appliance

B. Install regulators and overpressure protection devices with maintenance access space adequate for servicing and testing.

3.5 PIPING JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs.

B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

C. Threaded Joints:
1. Thread pipe with tapered pipe threads complying with ASME B1.20.1.
2. Cut threads full and clean using sharp dies.
3. Ream threaded pipe ends to remove burrs and restore full inside diameter of pipe.
4. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
5. 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.

D. Welded Joints:
2. Bevel plain ends of steel pipe.
3. Patch factory-applied protective coating as recommended by manufacturer at field welds and where damage to coating occurs during construction.

3.6 HANGER AND SUPPORT INSTALLATION
A. Comply with requirements for pipe hangers and supports specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."

B. Install hangers for horizontal steel piping with the following maximum spacing and minimum rod sizes:
   1. NPS 1 (DN 25) and smaller: Maximum span, 96 inches (2438 mm); minimum rod size, 3/8 inch (10 mm).
   2. NPS 1-1/4 (DN 32): Maximum span, 108 inches (2743 mm); minimum rod size, 3/8 inch (10 mm).
   3. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): Maximum span, 108 inches (2743 mm); minimum rod size, 3/8 inch (10 mm).
   4. NPS 2-1/2 to NPS 3-1/2 (DN 65 to DN 90): Maximum span, 10 feet (3 m); minimum rod size, 1/2 inch (13 mm).
   5. NPS 4 (DN 100) and Larger: Maximum span, 10 feet (3 m); minimum rod size, 5/8 inch (15.8 mm).

3.7 CONNECTIONS
A. Install natural-gas piping electrically continuous, according to NFPA 70.

B. Install piping adjacent to appliances to allow service and maintenance of appliances.

C. Sediment Traps: Install tee fitting with capped nipple in bottom to form drip, as close as practical to inlet of each appliance.

3.8 LABELING AND IDENTIFYING
A. Comply with requirements in Division 23 Section "Identification for HVAC Piping and Equipment" for piping and valve identification.

B. Gas piping shall be labeled.

C. Gas piping with 2 psig pressure shall be indicated at each label location.
D. PAINTING

E. Comply with requirements in Division 09 Section “Painting” for painting interior and exterior natural-gas piping.

F. Paint exposed, exterior metal piping, valves, service regulators, service meters and meter bars, earthquake valves, and piping specialties, except components, with factory-applied paint or protective coating.
   1. Alkyd System: MPI EXT 5.1D.
      c. Topcoat: Exterior alkyd enamel (semigloss).
      d. Color: Gray.

G. Damage and Touchup: Repair marred and damaged factory-applied finishes with materials and by procedures to match original factory finish.

3.9 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:
   1. Test, inspect, and purge natural gas according to NFPA 54 and the International Fuel Gas Code and authorities having jurisdiction.

C. Natural-gas piping will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

3.10 OUTDOOR PIPING SCHEDULE

A. Aboveground natural-gas piping shall be the following:
   1. Steel pipe with wrought-steel fittings and welded joints.

3.11 INDOOR PIPING SCHEDULE FOR SYSTEM PRESSURES LESS THAN 0.5 PSIG (3.45 kPa)

A. Aboveground, distribution piping shall be one of the following:
   1. Steel pipe with malleable-iron fittings and threaded joints.
   2. Steel pipe with wrought-steel fittings and welded joints.

END OF SECTION 221613
SECTION 230500 – COMMON WORK RESULTS FOR HVAC

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Provide labor, materials, accessories, and other related items as required to complete operations in connection with the complete installation of the HVAC and mechanical systems as indicated on the Drawings and as specified herein.

1.2 RELATED REQUIREMENTS

A. Conditions of the Contract apply to the work, including the work of this Division. Examine Contract Documents for requirements affecting the work.

B. Provide cooperation with, and assistance to, the Testing and Balancing (TAB) Agent specified in Division 23 Section “Testing, Adjusting, and Balancing for Mechanical Systems.”

1.3 MECHANICAL PRE-CONSTRUCTION MEETING

A. Conduct a mechanical conference at Project site to comply with requirements of Division 01 Section “Project Management and Coordination” and the following:

1. At least 14 days prior to beginning of mechanical work, conduct a meeting to review detailed requirements for mechanical systems installation and testing requirements. Review mechanical Drawings and Specifications, discuss project specific details and requirements, and review and discuss expectations for quality control. Establish preliminary work progress schedule and procedures for materials inspection, testing, and certifications. Require representatives of each entity directly concerned with mechanical systems installation to attend conference, including, but not limited to, the following:

   a. General Contractor's superintendent.
   b. Mechanical Subcontractors’ project managers.
   c. Mechanical Subcontractors’ job foremen.
   d. Sheetmetal job foreman.
   e. Plumbing job foreman.
   f. Controls job foreman.
   g. Project mechanical Engineer/designer.
   h. Job clerk.
   i. Architect’s construction administrator.

1.4 DRAWINGS

A. The general location of the apparatus and the details of the work are indicated on the Drawings. Exact locations not indicated shall be determined at the site as the work progresses and shall be subject to the Architect's approval.

B. It is not intended that the Drawings shall show every pipe, pipe rise, pipe drop, duct rise, duct drop, pipe fitting, duct fitting, or appliance, but it shall be a requirement to furnish, without additional expense, material and labor necessary to complete the systems in accordance with the design intent and with the highest possible quality available.
1.5 ALTERATIONS

A. Execute alterations, additions, removals, relocations, new work, and other related items as indicated or required to provide a complete installation in accordance with the intent of the Contract Documents, including changes required by building alterations.

B. Existing work disturbed or damaged by the alterations or the new work shall be repaired or replaced to the Architect's satisfaction and at no additional cost to the Owner.

C. Existing ductwork, piping, and other systems indicated to be removed, shall be removed from the site. Cap off existing services remaining. The Owner retains the right to ownership of heating and ventilating equipment scheduled to be removed; store such equipment where requested by the Owner. Material not retained by the Owner shall be removed from the site.

1.6 CONTINUITY OF SERVICE

A. Arrange to execute the work at such times and in such locations as may be required to provide uninterrupted service for the building or any of its locations. Any unavoidable conditions requiring reduced building capacity shall be arranged for by programming with the Owner's duly authorized representative at the building subject to the Architect’s approval. If necessary, temporary work shall be installed to provide for the condition. Authorization for interrupting service shall be obtained in writing from the Owner. Any interruption of normal service shall be performed during an overtime period to be scheduled with the Owner. Costs for overtime work shall be included in the bid.

1.7 REQUIREMENTS

A. Installation Instructions: Obtain manufacturer’s printed installation instructions to aid in properly executing work on major pieces of equipment. Install equipment in accordance with manufacturer’s recommendations.

B. Objectionable Noise, Fumes and Vibration:
   1. Mechanical and electrical equipment shall operate without creating objectionable noise, fumes, or vibration, as determined by the Architect.
   2. If such objectionable noise, fumes, or vibration is produced and transmitted to occupied portions of building by apparatus, piping, ducts, or any other part of mechanical and electrical work, make necessary changes and additions, as approved, without extra cost to Owner.

C. Equipment Design and Installation:
   1. Uniformity: Unless otherwise specified, equipment or material of same type or classification, used for same purposes, shall be product of same manufacturer.
   2. Design: Equipment and accessories not specifically described or identified by manufacturer's catalog number shall be designed in conformity with ASME, IEEE, or other applicable technical standards, suitable for maximum working pressure, and with neat and finished appearance.
   3. Installation: Erect equipment aligned, level and adjusted for satisfactory operation. Install so that connecting and disconnecting of piping and accessories can be made readily, and so that parts are easily accessible for inspection, operation, maintenance and repair. Minor deviations from indicated arrangements may be made, as approved.
D. Hanging of Equipment, Ductwork and Piping:
   1. Support equipment, ductwork and piping from the top chord of bar joists at the “Panel Points” or from the top flange of beams. Piping 2” (51 mm) nominal and smaller may be supported from the bottom chord of the bar joists at the “Panel Points” or from the bottom flange of the beams.

E. Protection of Equipment and Materials: Responsibility for care and protection of materials and mechanical work rests with the Contractor until the entire project has been completed, tested, and the project is accepted by the Owner.

F. Foundations:
   1. Ceiling Mounting: Where ceiling mounting is indicated or specified, use suspended platform or strap hangers, bracket or shelf, whichever is most suitable for equipment and its location. Construct of structural steel members, steel plates, or rods, as required; brace and fasten to building structure or to inserts as approved, or as detailed.
   2. Where floor mounting is indicated, locate equipment on 4 inch (102 mm) high reinforced concrete pad of adequate size with anchors and base plates as required, on pressure-treated sleepers, or on structural steel frame as detailed. The corners of pads shall be chamfered 1/2 inch (13 mm). Pad and steel sizes and location shall be coordinated with the approved equipment.

1.8 ACCESS PANELS

A. Access panels required for items furnished under Division 23 shall be provided under this Division.

B. Selection and installation of access panels shall be in accordance with Division 08 Section “Access Doors and Frames.”

C. Access panels shall be standard panels, 12 in. x 16 in. (305 mm x 406 mm) minimum unless indicated otherwise. Panels installed in areas of high moisture concentration, such as locker rooms, near plumbing fixtures, food preparation areas, or outdoors, shall be fabricated of paintable stainless steel or aluminum for corrosion resistance.

D. Access panels in fire-rated construction shall have the same UL rating as the building assembly in which they are installed.

E. Provide access panels in building construction where required for access to duct access doors or other components such as valves, air vents, actuators, volume dampers, motorized dampers in ductwork, duct smoke detectors, and other related items.

1.9 ELECTRIC WORK

A. Provide motors, pilot lights, controllers, limit switches, and other related items for equipment provided under Division 23.

B. Except as noted, required line switches, fused switches, and other related items and necessary wiring to properly connect equipment to motors and switches shall be furnished and installed under Division 26, Electric.

C. Provide complete wiring system for automatic temperature controls as specified under Section
Division 23 Section “Instrumentation and Controls for HVAC.”

D. Wiring shall conform to the requirements of the National Electrical Code.

1.10 FIRESTOPPING

A. Firestopping for penetrations of ductwork, piping and equipment through fire rated and smoke rated building assemblies, including but not limited to partitions, walls, floors, ceilings, and roofs, shall be furnished and installed under this Section.

B. Selection of firestopping materials and installation of firestopping materials shall be in accordance with Division 07 Section “Through-Penetration Firestop Systems.” Coordinate with other trades for a consistent installation.

C. Refer to Architectural Drawings for locations of fire rated building assemblies.

1.11 SUBMITTALS

A. After award of Contract and before installation, submit for approval Shop Drawings, bulletins, Product Data, Samples, and other related items.

B. Submit Shop Drawings and Product Data as required in each Section. Submittal shall include physical data and performance data required to verify compliance with the Contract Documents.

C. Submit Samples as required in each Section, and as indicated on the Drawings. These will generally be retained by the Architect/Engineer, unless otherwise indicated. Contractor may request these items returned; provide return shipping for returns.

D. Submit Mock-Ups as required in each Section, and as indicated on the Drawings. For general mock-up procedures, refer to Division 01 Section “Quality Requirements.” Deliver to the Architect/Engineer for review if so indicated. Provide return shipping.

E. Architect/Engineer’s review will not include the review, coordination, or verification of dimensions or quantities; these shall be the responsibility of the Contractor.

1.12 SUBSTITUTIONS

A. Comply with provisions of the Instructions to Bidders and General Requirements.

B. The first item listed under “Acceptable Manufacturers”, “Approved Manufacturers” or “Manufacturers” is the design basis.
   1. Other manufacturers listed may be used in the base bid, but conformance with details of the Specifications, as well as dimensional and electrical data, shall be verified by the Contractor.
   2. Architect/Engineer has not verified that each listed manufacturer has the ability to provide an acceptable substitution for the basis-of-design product. Contractor may not assume that substitutions will be approved.
   3. Modifications required as a result of differences between the design basis item and the submitted and approved item must be approved by the Architect and made at the Contractor’s expense. As an example, if a rooftop HVAC unit is submitted and approved...
and if the unit’s dimensions and weight are different from those of the unit which was used as the design basis, the Contractor shall be responsible for building structural modifications required to accommodate the submitted and approved unit, at no additional cost to the Owner.

4. When, in the Architect or Engineer’s opinion, architectural or engineering services are necessary for the coordination of substituted items, the Contractor shall reimburse the Owner for the cost of these services.

5. For items which have no manufacturers listed, any item conforming with the Contract Documents is acceptable.

C. Substitutions from manufacturers or providers which are not listed may be proposed within the time allowed in the General Conditions of the Specifications.

1. The exception to this is products for which the list of manufacturers or providers is limited by the wording “no substitutions” or similar wording.

1.13 COORDINATION

A. Coordinate scheduling, submittals, and Work of the various Sections of Specifications to assure efficient and orderly sequence of installation of interdependent construction elements, with provisions for accommodating items installed later.

B. Verify that utility requirement characteristics of operating equipment are compatible with building utilities. Coordinate work of various Divisions having interdependent responsibilities for installing, connecting to, and placing in service, such equipment.

C. Coordinate space requirements and installation of mechanical and electrical work which are indicated diagrammatically on Drawings. Follow routing shown for pipes, ducts, and conduit, as closely as practicable; place runs parallel with line of building. Utilize spaces efficiently to maximize accessibility for other installations, for maintenance, and for repairs.

D. In finished areas, conceal pipes, ducts, and wiring within the construction. Coordinate locations of fixtures and outlets with finish elements.

E. Coordinate completion and clean-up of work of separate Sections in preparation for Substantial Completion.

F. After Owner occupancy of premises, coordinate access to site for correction of defective work and work not in accordance with Contract Documents, to minimize disruption of Owner’s activities.

1.14 REQUESTS FOR ARCHITECT’S CADD DRAWINGS

A. In lieu of generating their own CADD drawings, the Contractor may elect to use the Architect’s electronic copies of CADD drawings for the purpose of developing coordination drawings, developing control system graphics or for other reasons that pertain to the requirements of this Contract. If the Contractor elects to utilize the Architect’s electronic copies of CADD drawings, the electronic files shall be purchased from the Architect at the Architect’s current billing rate per drawing. The Contractor shall provide payment and shall sign a release-of-liability form before electronic CADD drawings are released.
1.15 SEISMIC DESIGN

A. This project requires special provisions for the support and restraint of piping, ductwork and equipment. These provisions shall be incorporated in accordance with the following:

1. The requirements of this Section are complementary to requirements listed elsewhere for the fastening and support of piping, ductwork, and equipment. Nothing indicated on the Drawings or in other Sections of these Specifications shall be interpreted as a reason to waive the requirements of this Section.

2. Piping, ductwork and equipment shall be adequately supported and restrained to resist seismic forces in accordance with the 2009 International Mechanical Code and the 2009 International Building Code and associated supplements.

3. Seismic restraints for piping and ductwork:

a. Piping and ductwork not listed as exempt from the requirements for seismic restraints shall be seismically restrained in accordance with the following publications:

   1) Sheet Metal and Air Conditioning Contractors National Association (SMACNA) SEISMIC RESTRAINT MANUAL GUIDELINES FOR MECHANICAL SYSTEMS, Second Edition - 1998
   2) APPENDIX E - Sheet Metal and Air Conditioning Contractors National Association (SMACNA) SEISMIC RESTRAINT MANUAL GUIDELINES FOR MECHANICAL SYSTEMS, Second Edition - 1998

4. Seismic Restraints for Equipment:

a. Engage the services of a licensed professional engineer (hereinafter known as the Engineering Specialist) with experience in the field of equipment support and seismic restraints. The Engineering Specialist shall select and coordinate the restraints and supports based on the final coordinated drawings showing exact locations of equipment and shall coordinate with the project Structural Engineer to ascertain that the connections to the structure will resist the horizontal forces to which they might be subjected. Submit details and calculations from the Engineering Specialist as required to demonstrate compliance. Equipment that shall be considered in the Engineering Specialist’s seismic design shall include, but not be limited to the following:

   1) Pumps
   2) Expansion Tank
   3) Air Handling Units
   4) Air Conditioning Units

5. Refer to Structural Drawings for exposure group and performance category.

6. Provide floor-mounted equipment with approved seismic control devices as required to prevent overturning or movement. Seismic devices shall be capable of keeping equipment captive under seismic loads.

7. Provide suspended equipment with approved seismic control devices as required to maintain the equipment in a captive attitude under seismic loads.

8. The following shall be exempt from requirements for seismic restraints:

   a. Piping suspended by individual hangers 12 inches (305 mm) or less from the top of the pipe to the supporting structure.
   b. Piping with less than 2-1/2" (64 mm) nominal inside diameter.
   c. Ductwork that is suspended by hangers 12 inches (305 mm) or less from the top of the duct to the supporting structure.
   d. Ductwork that has a cross-sectional area less than 6 square feet (0.56 m²).
1.16 CLEANING

A. Remove debris from site daily.

B. Material and pieces of equipment shall be turned over to the Owner free of dust and dirt, both inside and out.

C. At the completion of the Project, equipment shall have a clean, neat appearance of factory finish by cleaning or repainting as required.

D. At the completion of the Project, surfaces exposed to view shall have a clean, neat appearance of finish free from smudges and scratches by cleaning or repainting as required.

1.17 STARTING SYSTEMS

A. Coordinate schedule for start-up of various equipment and systems.

B. Notify Architect/Engineer 7 days prior to start-up of each item.

C. Verify that each piece of equipment or system has been checked for proper lubrication, drive rotation, belt tension, control sequence, or other conditions which may cause damage.

D. Verify that tests, meter readings, and specified electrical characteristics agree with those required by the equipment or system manufacturer.

E. Verify that wiring and support components for equipment are complete and tested.

F. Execute start-up under supervision of responsible manufacturer’s representative in accordance with manufacturer’s instructions.

G. When specified in individual Specification Sections, require manufacturer to provide authorized representative to be present at site to inspect, check, and approve equipment or system installation prior to start-up, and to supervise placing equipment or system in operation.

H. Submit a written report that equipment or system has been properly installed and is functioning correctly.

1.18 FACTORY START-UP AND START-UP REPORTS

A. Provide factory start-up of mechanical equipment listed below. Factory start-up shall be performed by a factory authorized representative of the equipment manufacturer. When factory start-up is successfully completed for each piece of mechanical equipment listed below, submit a formal start-up report to the Architect for approval. Start-up report shall be formatted in accordance with equipment manufacturer’s recommendations. Start-up report shall be typed, not hand written, and shall be submitted in a clean and legible form.

B. Equipment requiring factory start-up
   1. Rooftop air conditioning units
   2. Variable frequency drives
1.19 ADJUSTMENTS AND OWNER'S INSTRUCTIONS

A. After completion of the installation work called for in the Contract Documents, furnish necessary mechanics or engineers for the adjustment and operation of the systems, to the end that the systems are perfectly adjusted and turned over to the Owner in perfect working order. Further instruct the Owner’s authorized representative in the care and operation of the installation, providing framed instruction charts, directions, and other related items.

B. Instructors providing Owner training shall be experienced and familiar with the jobsite.

1.20 TESTING

A. After the entire installation is completed and ready for operation, test the systems as outlined in Division 23 Section “Testing, Adjusting and Balancing for HVAC.” These tests are supplementary to detailed tests specified herein or directed. The Owner will provide water and electric current for the test. Provide necessary labor, test pump, gauges, meters, other instruments, and materials. Perform tests in the presence of the Architect or his representative.

B. Perform other tests specified in individual Sections of this Specification.

1.21 COMPLETION OF SYSTEMS

A. The following mechanical systems shall not be complete until the following conditions are satisfied:

1. Ductwork Systems:
   a. Ductwork and related components and accessories shall be completely installed and insulated as specified.
   b. Ductwork leakage testing shall be completed, and leakage testing reports shall be submitted and approved.
   c. Ductwork shall be balanced, and balancing report submitted and approved.

2. Piping Systems:
   a. Piping, valves and accessories shall be completely installed, insulated, and labeled as specified.
   b. Piping pressure testing be completed, and pressure testing reports shall be submitted and approved.
   c. Piping systems shall be balanced, and balancing report submitted and approved.

3. Equipment:
   a. Equipment, including but not limited to boilers, heat exchangers, terminal heat transfer units, pumps, air handling units, condensing units, chillers, split system air conditioning equipment, and exhaust fans, shall be completely installed.
   b. Equipment start-up reports shall be completed, submitted and approved.
   c. Equipment balancing shall be completed and the balancing report shall be submitted and approved.

4. Automatic Temperature Controls (ATC):
   a. ATC system shall be completely installed.
   b. ATC system shall operate in an automatic mode for a minimum of 4 months during Owner occupancy without substantial deficiencies.
1.22 OPERATING AND MAINTENANCE MANUALS

A. Furnish 2 bound operating and maintenance manuals and forward to the Architect for review and transmittal to the Owner.

B. For maintenance purposes, provide approved Submittals, parts lists, specifications, and manufacturer’s maintenance bulletins for each piece of equipment. For materials used which have been submitted to the Architect for approval but do not require regular maintenance, such as piping, ductwork, and insulation, provide one copy of approved Submittals.

C. Provide name, address and telephone number of the manufacturer’s representative and service company, for each piece of equipment or material so that service or spare parts can be readily obtained.

1.23 WARRANTY

A. Provide guarantees and warranties for work under this Contract as indicated in the general requirements of the Contract.

B. Provide manufacturers’ standard warranties and guarantees for work by the mechanical trades. However, such warranties and guarantees shall be in addition to and not in lieu of other liabilities which the manufacturer and the Mechanical Contractor may have by law or by other provisions of the Contract Documents.

C. Guarantee that elements of the systems provided under this Contract are of sufficient capacity to meet the specified performance requirements as set forth in these Specifications or as indicated on the Drawings.

D. Upon receipt of notice from the Owner of failure of any part of the mechanical systems or equipment during the warranty period, the Mechanical Subcontractor shall replace the affected part or parts.

E. Furnish a written guarantee covering the above requirements before submitting the application for final payment.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 230500
SECTION 230513 – MOTORS, DRIVES, AND ACCESSORIES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Common requirements for electric motors furnished on equipment specified in other Sections, including single phase and three phase electric motors.

B. Shaft Grounding Rings.

C. Starters.

D. Thermal Overload Protection.

E. Belt Drives.

F. Variable Speed Drives.

1.2 REFERENCES

A. Division 01 Section “References”: Requirements for references and standards.

B. AFBMA 9 - Load Ratings and Fatigue Life for Ball Bearings.

C. AFBMA 11 - Load Ratings and Fatigue Life for Roller Bearings.

D. NEMA MG 1 - Motors and Generators.

E. NFPA 70 - National Electrical Code.

F. UL 508A - Industrial Control Panels.

G. UL 674 - UL Standard for Safety Electric Motors and Generators for Use in Division 1 Hazardous (Classified) Locations.

H. UL 1836 - UL Standard for Safety for Electric Motors for Use in Class I, Division 2 and Class II, Division 2 Hazardous (Classified) Locations.

1.3 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Company specializing in manufacturing the Products specified in this Section with minimum 3 years’ experience.

B. Installer Qualifications: Company specializing in performing the work of this Section with minimum 3 years’ experience.

1.4 REGULATORY REQUIREMENTS

A. Conform to UL Component Recognition for appropriate sizes.
B. Conform to NFPA 70 and local energy code.

1.5 DELIVERY, STORAGE, AND PROTECTION

A. Division 01 Section “Product Requirements”: Transport, handle, store, and protect products.

B. Protect motors stored on site from weather and moisture by maintaining factory covers and suitable weather-proof covering. For extended outdoor storage, remove motors from equipment and store separately.

PART 2 - PRODUCTS

2.1 MOTORS

A. Acceptable Manufacturers:
   1. A.O. Smith.
   2. Baldor.
   3. Emerson Motor Technologies.
   5. Marathon Electric.
   8. Toshiba.
   10. WEG.

B. General Construction and Requirements:
   1. Motors Less Than 250 Watts, for Intermittent Service: Equipment manufacturer’s standard and need not conform to these Specifications.
   2. Motors shall have integral thermal overload protection.
   3. Single Phase Motors for general applications: PSC (permanent split capacitor) where available.
   4. Single Phase Motors for fans:
      a. EC (electronically commutated) where available.
      b. PSC (permanent split capacitor) where available, if EC is not available.
   5. Open drip-proof type except where specifically noted otherwise.
   6. Design for continuous operation in 40 degrees C environment.
   7. Design for temperature rise in accordance with NEMA MG 1 limits for insulation class, service factor, and motor enclosure type.
   9. Visible Nameplate: Indicating manufacturer’s name and model number, motor horsepower, RPM, frame size, voltage, phase, cycles, full load amps, insulation system class, service factor, maximum ambient temperature, temperature rise at rated horsepower, minimum efficiency.

C. Inverter Duty: Motors for use with variable frequency drives shall be rated for “inverter duty”, with winding insulation rated for 1600 volts and Class H (180°C) temperature rating.

D. Single-Phase Power for Fans - Electronically-Commutated (EC) Motors - Also Known As Brush-Free DC (BFDC) Motors:
1. Drive: Direct-drive only, not for use with belt drive.
2. Power Supply: Internal motor circuitry shall convert AC power supplied to DC power to operate the motor.
3. Turndown: Speed-controllable down to 20% of full speed (80% turndown).
4. Speed Control: Integral potentiometer with screwdriver setting, remote potentiometer dial with 24 VDC transformer to generate a 0-10 VDC signal, or integral circuitry to accept a 0-10 VDC signal from the building control system, as indicated and specified.
5. Efficiency: Minimum of 85% efficient at all speeds.
6. Soft-start type, capable of reliable start at any speed setting.
7. Enclosure: Open drip-proof.
9. Overload Protection:
   a. Automatic Speed Control: In the event of overheating or overloading, the motor electronics slow the motor to operate within its acceptable range.
   b. Thermal Overload: Internally fused, one-shot type as a last resort to prevent fires.
   c. Locked Rotor: If the motor sees a locked rotor condition, it will automatically shut itself down, then try to restart 3 times. After the 3rd try, the motor will not attempt to restart until the power is cycled.

E. Single Phase Power - Permanent-split Capacitor Motors:
1. Starting Torque: Exceeding one fourth of full load torque.
2. Starting Current: Up to six times full load current.
3. Multiple Speed: Through tapped windings.
4. Open Drip-proof or Enclosed Air Over Enclosure: Class A (50 degrees C temperature rise) insulation, minimum 1.0 Service Factor, prelubricated sleeve or ball bearings, automatic reset overload protector.

F. Single Phase Power - Capacitor Start Motors:
1. Starting Torque: Three times full load torque.
2. Starting Current: Less than five times full load current.
3. Pull-up Torque: Up to 350 percent of full load torque.
5. Motors: Capacitor in series with starting winding; provide capacitor-start/capacitor-run motors with two capacitors in parallel with run capacitor remaining in circuit at operating speeds.
6. Drip-proof Enclosure: Class A (50 degrees C temperature rise) insulation, NEMA Service Factor, prelubricated bearings.
7. Enclosed Motors: Class A (50 degrees C temperature rise) insulation, 1.0 Service Factor, prelubricated ball bearings.

G. Single Phase Power - Split Phase Motors:
1. Starting Torque: Less than 150 percent of full load torque.
2. Starting Current: Up to seven times full load current.
4. Drip-proof Enclosure: Class A (50 degrees C temperature rise) insulation, NEMA Service Factor, prelubricated sleeve or ball bearings.
5. Enclosed Motors: Class A (50 degrees C temperature rise) insulation, 1.0 Service Factor, prelubricated ball bearings.

H. Three Phase Power - Squirrel-cage Motors:
1. Starting Torque: Between 1 and 1-1/2 times full load torque.
2. Starting Current: Six times full load current.
3. Power Output, Locked Rotor Torque, Breakdown or Pull Out Torque: NEMA Design B characteristics.
5. Insulation System: NEMA Class B or better.
6. Motor Frames: NEMA Standard T-Frames of steel, aluminum, or cast iron with end brackets of cast iron or aluminum with steel inserts.
7. Bearings: Grease lubricated anti-friction ball bearings with housings equipped with plugged provision for relubrication, rated for minimum AFBMA 9, L-10 life of 200,000 hours. Calculate bearing load with NEMA minimum V-belt pulley with belt center line at end of NEMA standard shaft extension. Stamp bearing sizes on nameplate.
8. Sound Power Levels: To NEMA MG 1.
9. Part Winding Start Above 254T Frame Size: Use part of winding to reduce locked rotor starting current to approximately 60 percent of full winding locked rotor current while providing approximately 50 percent of full winding locked rotor torque.
10. Weatherproof Epoxy Sealed Motors: Epoxy seal windings using vacuum and pressure with rotor and starter surfaces protected with epoxy enamel; bearings double shielded with waterproof non-washing grease.
11. Nominal Efficiency: To NEMA MG 1, energy efficient for motor sizes 10 and larger.

2.2 SHAFT GROUNDING RINGS

A. Manufacturers:
1. Electro Static Technology Inc. - Aegis SGR product line.
2. Inpro/Seal, a division of Waukesha Bearings Corpororation - CDR product line.

B. Provide shaft grounding rings (SGRs) on 3-phase motors 5 hp or larger which are intended to be used with variable-frequency drives (VFDs). The SGRs may be furnished by the motor manufacturer as an integral part of the motor, furnished factory-installed by the equipment manufacturer, or furnished for field installation by the equipment installer.

C. Description: Circumferential micro-fiber ring with metal frame, designed to conduct VFD-induced bearing currents from the motor shaft to ground. Provides protection recommended in NEMA MG 1. Provide with mounting kit including bolts and bracket, or conductive epoxy to adhere to motor casing, to ensure ground connection from the SGR to the motor frame.

D. Provide SGRs on at least one end of the motor. On motors above 100 hp, provide a bearing insulation kit on the end of the motor without an SGR.

2.3 STARTERS AND OVERLOADS

A. Acceptable Manufacturers:
1. Cerus Industrial, Inc.
5. Siemens.
6. Square D (division of Schneider Electric).

B. Provide motor starters for motors provided under this Division of these Specifications.
C. Cerus Industrial “BAS” building automation HVAC starters are the basis of design. Features of starters/contactors, disconnects, and temperature controls shall be combined in a single package using these starters. Coordination with Automatic Temperature Controls supplier and installer is required to reduce total project costs.

1. 3-phase starter features include:
   a. Multi-tap control power transformer (CPT) for universal control voltage.
   b. Motor circuit protector disconnect (MCP) with high interrupt rating and lockable operator handle.
   c. Contactors rated as high as 2.5 million electrical operations and 25 million mechanical operations.
   d. Anti-cycling feature.
   e. Solid-state electronic overloads with wide adjustment range and highly accurate digital motor protection, including protection for phase loss, phase unbalance, stall and locked rotor conditions. Class 1-30.
   f. Digital keypad, featuring an H-O-A (Hand, Off, Auto) panel with large, clearly labeled push buttons including a front panel reset function and high-intensity LED indicators for settings.
   g. Damper and valve actuator control, to open the actuator before starting the fan or pump motor.
   h. Permissive auto control to disable auto inputs. Commonly used with a high pressure limit switch.
   i. Universal control inputs, including auto dry input, and wet input for voltages from 20 to 138 VAC or VDC.
   j. Power failure reset.
   k. Fireman’s override.
   l. NEMA 1 enclosure with prepunched knockouts. NEMA 3R, 4, 4X, and 12 as required.
   m. BACnet embedded communications option available.
   n. UL Listed assembly.
   o. 5-year warranty.
   p. Factory printed label or engraved nameplate, designating the equipment served.

2. Single-phase starter (Cerus BAS-IP series) features include:
   a. Manually operated quick-make toggle mechanism lockable in the “Off” position, which shall also function as the motor disconnect.
   b. Hand/Auto switch, concealed behind sliding cover to discourage tampering.
   c. Capability to operate in both manual and automatic control modes. In automatic mode, the starter shall have the capability to integrate with a building automation system by providing terminals for run input, run status output, and fault output.
   d. Control terminals integrated in the starter.
   e. Power, run status, and fault LED pilot lights.
   f. Interposing run relay and current sensing status output relay.
   g. Voltage and dry inputs for auto run command.
   h. System override mode (fireman’s, occupancy, or manual).
   i. Solid-state electronic overload with wide adjustment range and highly accurate digital motor protection, including protection for stall and locked rotor conditions. Class 10. Concealed adjustment behind sliding cover.
   j. Surface mount enclosure, UL Type 1, single gang box installation, with sliding covers for concealed items.
   k. Power Input: 1-phase, 110-240 VAC, 1-16 Amps, 0.1-1 HP.
m. Control Outputs: Proof of run and fault, normally-open 0.3 Amps at 125 VAC, 1 Amp at 24 VAC.

n. Ambient operating temperature -5 to 140°F (-20 to 60°C).

o. UL 508A Listed.

p. 5-year warranty.

D. Feature Descriptions:
1. Fireman’s Override Input: Causes the starter to run the motor in any mode (Hand, Off or Auto) regardless of other inputs or lack of inputs either manual or auto. The purpose of the Fireman’s Override input is to act as a smoke purge function. Fireman’s Override has priority over the Emergency Shutdown input.

2. Emergency Shutdown Input: Disables the starter from operating in either Hand or Auto mode regardless of other inputs either manual or auto.

3. Phase Failure Protection: Initiates when phase loss is greater than 70% for 3 seconds or phase unbalance is greater than 50% for more than 5 seconds.

4. Cycling Fault Protection: Activates whenever the starter is cycled at a rate of more than 1000 cycles in a one hour period. This feature shall be selectable to be disabled. Cycling fault shall cause overload LED to blink rapidly.

E. Contactors in starters shall be general purpose NEMA rated for connected H.P. (definite purpose starters not acceptable). Coordinate control voltage with Controls Contractor. Provide auxiliary contacts where required for interlocking of electrical equipment. Provide two-speed motor starters where indicated or required.

F. Single phase motors shall have one of the following factory wired methods of motor protection:
1. Integral thermal overload protection in motor and cord with plug and receptacle in unit casing.

2. Integral thermal overload protection in motor and disconnecting switch mounted in or on casing as specified with equipment.

3. Switch with thermal overload protection for unprotected motors with switch serving as disconnect device.

G. For starters associated with equipment that is required to be shut down upon a fire alarm condition, provide input contacts within the starter enclosure to interface with the building’s fire alarm system. Upon receipt of a signal from the building’s fire alarm system, power to load side of the starter shall be turned off. Circuitry shall be provided to ensure that power is off whether the starter is in the “AUTO”, “HAND” or “BYPASS” mode. If this feature is not available from the starter manufacturer, provide a contactor on the line side of the starter to accomplish the same function. The contactor shall meet the requirements of Division 26.

2.4 V-BELT DRIVES

A. Provide self-aligning roller-bearings mounted in sealed housings with grease fittings and grease overflow valves. Fan wheels and shafts shall be designed for critical speed at least 20% higher than the maximum fan speed. The assembled fan shall be statically and dynamically balanced at the factory. Bearings shall be certified to have an average life per AFBMA of not less than 200,000 hours.

B. The drive base shall be constructed to allow adjustment of belt tension without having to loosen motor hold-down bolts.
C. Cast iron or steel sheaves, dynamically balanced, bored to fit shafts, and keyed. Matched belts, and drive rated as recommended by manufacturer or minimum 1.5 times nameplate rating of the motor.
   1. Provide adjustable-sheave belt drives for motors, except as otherwise specified in individual Sections of the Specifications.
   2. Sheaves on motors 25 hp and over shall be fixed type.

2.5 VARIABLE FREQUENCY DRIVES

A. Acceptable Manufacturers:
   1. ABB (ACH550 Series) (basis of design).
   2. Cerus Industrial, Inc. (P-Series).
   3. Danfoss (VLT FC-100 Series).
   4. Toshiba (Q7 Series).
   5. Yaskawa (E7 Series).
   6. No substitutions.

B. The variable frequency drives (VFDs) with options shall be UL listed as a complete assembly and shall be built in compliance with the latest standards of ANSI, IEEE, NEMA and the National Electric Code.

C. The VFDs shall be designed to meet the requirements of the following standards: IEC801-2, IEC801-4, IEC255-4.

D. Quality Assurance:
   1. Manufacturer: Shall specialize in manufacture, assembly, and field performance of VFDs with minimum 5 years’ experience.
   2. The VFD manufacturer shall have an existing representative, exclusively for HVAC applications, an independent service and start-up organization, and a parts stocking depot local to the installation.

E. Warranty and Start-Up Service:
   1. Start-Up Service: The VFD manufacturer shall provide a start up service package. Service shall include inspection, final adjustment, operational checks, coordination with interface to building’s ATC system (coordinate with Division 23 Section for instrumentation and controls for HVAC.) and a final report for record purpose. Start-up service shall be performed by a factory approved and certified technician.
   2. Owner Training: Provide a session of at least 4 hours, to train 2 or more of the Owner’s representatives in the operation and maintenance of the drives. Schedule the training at the Owner’s convenience within normal working hours, within 2 months after Substantial Completion.
   3. Warranty: For a period of 2 years after factory start-up, the VFD manufacturer shall include a full parts and labor on-site warranty at no additional cost.

F. Construction:
   1. Pulse Width Modulated design converting the fixed utility voltage and frequency to a variable voltage and frequency output. The VFD shall employ a full wave bridge rectifier, DC bus choke, DC bus filter capacitors, and Insulated Gate Bipolar Transistors (IGBTs) as the output switching device. SCRs, GTOs and Darlington transistors are not acceptable. The drive efficiency shall be 97% or better at full speed and full load. Fundamental power factor shall be 0.98 at all speeds and loads.
2. 6-pulse (minimum) converter section.
3. NEMA 1 ABS plastic or metal enclosure.
4. Standard operating conditions are:
   a. Incoming AC power at building power system design’s phase and voltage (see Contract Drawings) ±10%, 60 Hz. Output voltage, phase and frequencies compatible with equipment served (see Contract Drawings).
   b. Humidity 0 to 95% (noncondensing and noncorrosive).
   c. Altitude 0 to 3,300 feet above sea level, without derating.
   d. Ambient temperature 0 to 40°C.
   e. Verify actual operating conditions, and derate drive capacity as required.
5. VFDs shall include the following features:
   a. Customer interface, including digital display in plain English (code numbers are not acceptable), keypad and customer connections.
   b. Carrier (Switching) Frequency: Optimized for a 3 kHz or 4 kHz carrier frequency to reduce motor noise. The carrier frequency shall be adjustable by the start-up technician, in a range at least as low as 1 kHz and as high as 8 kHz. Provide at least the following settings to allow fine tuning: 1 kHz, 4 kHz, and 8 kHz.
   c. Built-in program to automatically vary the carrier (switching) frequency. Acceptable types of control include:
      1) ABB’s switching frequency foldback control, reduces heat generated by the IGBTs by reducing the carrier frequency if the heatsink temperature rises above 176-194°F (80-90°C).
      2) Danfoss automatic switching frequency modulation, reduces noise at low loads (below 60%) by adjusting the carrier frequency up to a selected maximum, and provides maximum power and efficiency at higher loads by adjusting the carrier frequency downward to a more efficient setting.
   d. The option of either (1) displaying a fault, (2) running at a preset speed, or (3) running at the last known speed (average of last 10 seconds) if the input reference (4-20mA or 2-10V) is lost.
   e. Automatic restart after an overcurrent, overvoltage, or undervoltage, or loss of input signal protective trip. The number of restart attempts and trial time shall be programmable.
   f. The ability to start into a rotating load (forward or reverse) and accelerate or decelerate without safety tripping or component damage (flying start).
   g. Automatic power loss ride through circuit that will utilize the inertia of the load to keep the drive powered. Minimum power loss ride through shall be 1 cycle based on full load and no inertia.
   h. Isolated power for control circuits.
   i. Input line fuses.
   j. Acceptable start/stop commands shall include closure of a contact or switch, application and removal of input power and optional application and removal of 115 VAC on-off signal.
   k. Load loss detection. Each VFD shall provide a dry contact closure at a field adjustable load threshold to indicate a loss of motor load (for example, broken fan belt or pump cavitation).
   l. Pilot light cluster to provide visual indication of protective functions and circuit status, including the following LEDs:
      1) Power on (Red): Illuminates when main power is applied to the controller.
      2) AFC Run (Green): Illuminates to announce a drive run condition.
      3) AFC Fault (Yellow): Illuminates to announce a fault condition.
m. Five programmable critical frequency lockout ranges to prevent the VFD from continuously operating at an unstable speed.

n. PI setpoint controller integral to the drive, allowing a pressure or flow signal to be connected to the VFD, using the VFD for the closed loop control, eliminating the need for external controllers.

o. Three programmable digital relay outputs, rated for maximum switching current 8 amps at 24 VDC and 0.4 amps at 250 VAC; Maximum voltage 300 VDC and 250 VAC; continuous current rating 2 amps RMS.

p. Seven programmable preset speeds.

q. Six programmable digital inputs for interface with energy management system.

r. Two independently adjustable acceleration and deceleration ramps, adjustable from 1 to 1800 seconds.

s. Ramp or coast to a stop.

t. Two programmable analog outputs to provide 4-20 ma signals linear to output frequency, motor speed, output current, motor torque, motor power, DC bus voltage, and motor voltage.

6. VFD door mounted operator digital display shall include:

   a. Output Frequency
   b. Motor Speed (RPM)
   c. Motor Current
   d. Calculated Motor Torque
   e. Calculated Motor Power
   f. DC Bus Voltage
   g. Output Voltage
   h. Heat Sink Temperature
   i. Analog Input Values
   j. Keypad Reference Values
   k. Elapsed Time Meter

7. VFD speed command input shall include:

   a. Keypad.
   b. Two analog inputs, each capable of accepting a 0-20 mA, 4-20mA, 0-10V, 2-10V signal inputs isolated from ground, and programmable via the keypad for different uses. Inputs shall have a programmable filter to remove any oscillation of the reference signal. The filter shall be adjustable from 0.01 to 10 seconds. The input shall be able to be inverted, so that minimum reference corresponds to maximum speed, and maximum reference corresponds to minimum speed.
   c. Floating point input to accept a three wire input from a Dwyer Photohelic gauge or equivalent type instrument.
   d. RS-485 communications.

8. The VFD shall include the following protection circuits. In the case of a protective trip, the drive shall stop, and announce the fault condition in plain words.

   a. Overcurrent trip, 200% of the VFD’s variable torque current rating.
   b. Overvoltage trip, 130% of the VFD’s rated voltage.
   c. Undervoltage trip, 60% of the VFD’s rated voltage.
   d. Over temperature, + 70 degrees C.
   e. Ground fault.
   f. Adaptable Electronic Motor Overload Protection: Shall protect the motor based on speed, load curve, and external fan parameter. Circuits that protect the motor only at full speed are unacceptable.
   g. Power line surge protection by means of a metal oxide varistor (m.o.v.).
9. Accessories to be furnished and mounted by the drive manufacturer and contained in a single enclosure (the use of more than one enclosure is not acceptable):
   a. Protection From Harmonics and Voltage Spikes: Provide one of the following:
      1) Line Reactors: 3-percent AC input line reactors to reduce harmonic current distortion to the incoming power line, and to provide some protection to the drive from incoming voltage spikes. Provide reactors in each phase of incoming power to each VFD. Install between the input power and the drive’s input bridge rectifier (so they protect the rectifier). The line reactor shall provide attenuation of line side voltage transients, thus preventing overvoltage trips or other unnecessary VFD shutdowns and providing a reduction in harmonic current distortion. Line reactors shall be manufactured by TCI of Milwaukee, WI and must meet the following requirements: provide a minimum of 2-1/2% line impedance, have a saturation rating of no less than 2.5 times the continuous current rating, and be UL recognized.
      2) ABB Design: Integral 5% swinging chokes in the AC input lines, configured between the input power and the drive’s input bridge rectifier (so they protect the rectifier from spikes in input power).
         a) The swinging choke is an inductor with an inductance value inversely proportional to its operating current. Over a substantial portion of the normal operating current range, the inductance decreases as the current in the choke increases. A conventional or linear choke has a fixed inductance value that changes very little as the operating current varies in the normal operating range.
         b) The harmonic limiting effectiveness of the swinging choke increases when the operating point is less than maximum power.
         c) Compared to a standard linear choke, the swinging choke provides superior line harmonic current reduction when the drive’s output power is less than or equal to rated output.
         d) The effective inductance value of a swinging choke at full load is higher than the value of a linear choke of the same physical size.
         e) The efficiency of a swinging choke is higher than the efficiency of a linear choke of the same inductance value.
         f) Since the design point BHP is nearly always less than the nameplate horsepower of the selected motor, with swinging chokes the harmonic contribution of the drive will nearly always be less than that at maximum rated output power.
         g) See U.S. Patent No. 6,774,758, “Low harmonic rectifier circuit” using non-linear inductor(s).
      3) Danfoss Design: Harmonic suppression and surge suppression integral to the drive using separate components.
         a) Harmonic Suppression: DC link chokes (inductors) installed between the drive’s input bridge rectifier and the inverter bus capacitor, consisting of a dual, 5% DC-link reactor on the positive and negative rails of the DC bus. This reactor reduces the level of harmonics reflected back into the building power system without causing a voltage loss at the drive’s input, and improves input power factor. The reactor is non-saturating (linear) to provide full harmonic filtering throughout the entire load range. In performance, the harmonic suppression of the DC-link reactor is equivalent to a 5% AC line reactor.
b) Incoming Power-Line Surge Suppression: Fast-acting Metal Oxide Varistor (or (MOV) installed between the input power and the drive’s input bridge rectifier, Zener diodes and oversized DC bus capacitors to provide protection against high potential spikes. When the voltage exceeds 2.3 times the expected incoming voltage for 1.3 milliseconds, the MOV shorts, protecting the internal parts of the drive including the 3-phase full-wave diode bridge. The reactor also acts to reduce input current caused by power line disturbances. Provide 4 MOVs, one on each of the 3 inputs and one attached to the DC Link. Comply with the German specification for surge suppression (VDE 0160).

4) Linear chokes or DC link chokes used alone without surge suppression on the incoming power are NOT acceptable as alternatives to line reactors. If they are standard and integral to the VFD, they may be provided in addition to line reactors.

b. Bypass: Manual transfer to line power via contactors and including class 20 bimetal motor thermal overload relays and fuse or circuit breaker protection while in bypass operation, with automatic bypass capability.
   1) Provide bypass on drives which serve single non-redundant motors, such as fan motors in air handling units and air conditioning units.
   2) Bypass is not required on drives which serve one of a pair of matching and fully-redundant motors with individual drive per motor (such as a pair of pumps where one is the lead pump and one is a 100% backup, and each pump has its own VFD).

c. Service switch which provides the ability to service the controller (electrically isolated while in bypass operation) without having to remove power to motor.

d. Hand-off automatic switch (HOA), prewired. The HOA switch shall be operable in both the Normal and Bypass (if provided) modes of operation. The switch may be dial type, or momentary-contact pushbutton type with LED indicator lights. The switch may be integral to the standard VFD keypad, if it is a dedicated physical switch that is always available, but it is not allowed to serve any other functions, and it may not be a virtual switch such as on a touchscreen.
   1) When Auto mode is selected, the external start command and external reference speed signal shall control the motor.
   2) When Hand mode is selected, the motor shall run and the manual potentiometer shall control the motor speed. Other controls and inputs/outputs shall function as in Auto mode.

e. Manual potentiometer, dial type with calibrated nameplate. Provide an analog (dial-type) or digital meter to indicate selected speed.
   1) If the HOA switch is a dedicated button integral to the VFD keypad, and the potentiometer function is immediately available without any further steps when the HOA is in “Hand” position (such as up-down pushbuttons on the face of the keypad), the potentiometer may be integral to the standard VFD keypad. The speed meter may be a display on the general display screen.

f. Customer Interlock Terminal Strip - provide a separate terminal strip for connection of fire, smoke, freeze contacts and external start command. External interlocks and start/stop contacts shall function with drive in hand, auto or bypass.

g. Door interlocked disconnect or circuit breaker, padlockable in off position.

h. For drives that control fans or pumps which are specified to operate in an automatic lead/lag arrangement, provide automatic alternation device in VFD enclosure. (coordinate with Division 23 Section for instrumentation and controls for HVAC.)
10. Energy Management System Interface  
   a. Drive shall have the capability to be controlled and monitored via analog and digital inputs and outputs.  
   b. In addition to analog and digital I/O the VFD shall be capable of communicating with the following controls companies’ communication buses with no extra hardware:  
      1) Alerton Controls  
      2) Invensys Controls  
      3) Johnson Controls  
      4) Siemens Controls  
   c. Drive shall have integral capability to be controlled and monitored through BACnet, LonWorks, Modbus, or other serial communication protocol compatible with the building automatic temperature control system. Provide adapter modules as required.  
   d. Coordinate with suppliers and installers of building automatic temperature control system to ensure compatibility and full functionality. See Division 23 Section for instrumentation and controls for HVAC.  

11. In the event of a power failure and upon restoration of power, the variable frequency drive shall remain responsive to its command signal from the building’s energy management/temperature control system. The drive shall not require manual resetting after a power outage in order to respond to the energy management/temperature control system’s command signal.  

12. For drives that are associated with equipment that is required to be shut down upon a fire alarm condition, provide input contacts within the VFD enclosure to interface with the building’s fire alarm system. Upon receipt of a signal from the building’s fire alarm system, power to load side of the VFD shall be turned off. Circuitry shall be provided to ensure that power is off whether the VFD is in the “AUTO”, “HAND” or “BYPASS” mode. If this feature is not available from the VFD manufacturer, provide a contactor on the line side of the VFD to accomplish the same function. The contactor shall meet the requirements of the Electrical Division of the Specifications.  

13. Occasional input and output power circuit switching shall be able to be accomplished without interlocks or damage to the drive. If drive design cannot tolerate interruption of output, such as by a disconnect switch mounted between the drive and the motor, provide protective devices and coordinate with installers to protect the drive as specified in Part 3 – Execution in this Section.  

G. Compliance to IEEE-519:  
   1. Input Line Reactors: Provide as specified in “Construction” paragraph of this Section.  

PART 3 - EXECUTION  

3.1 INSTALLATION  
   A. Division 01 Section “Quality Requirements”: Manufacturer’s instructions.  
   B. Install securely on firm foundation. Mount ball bearing motors with shaft in any position.  
   C. Coordinate with Division 26 “Electrical.”  
   D. Check line voltage and phase and direction of rotation, and ensure agreement with nameplate.
E. Install guards in accordance with Codes and OSHA requirements.

F. Adjust motor overload devices based on motor amperage ratings and field measurements of running amps, to ensure protection of the motor and eliminate nuisance trips.

G. Disconnect Switch Mounting Height: Install at height above finished floor in accordance with NFPA 70.
   1. In most instances, the center of the grip of the disconnect switch operating handle in its highest position shall be no more than 6’-7” (2.0 m) above finished floor or working platform.
   2. Switches and circuit breakers installed adjacent to the equipment served (and within reach of a portable means such as a ladder) the switch may be installed higher than 6’-7” (2.0 m) above finished floor or working platform.

H. Variable Frequency Drives:
   1. Mounting Height:
      a. Install with the disconnect switch height in accordance with NFPA 70, as described in the paragraph “Disconnect Switch Mounting Height” in this Section.
      b. The VFD shall be considered to be a piece of equipment served by its disconnect switch, for purposes of NFPA 70, unless otherwise indicated, or otherwise directed by the Authority Having Jurisdiction or by the Owner.
         1) If the motor served by the VFD is within sight of the VFD, and within 50 feet (15.2 m) measured in a straight line, this disconnect switch may also serve the motor unless otherwise indicated.
      c. When possible, install VFDs with their operator-interface display at 6’-7” (2.0 m) or less above finished floor, unless otherwise indicated or directed.
         1) To restrict unauthorized access, VFDs in locations accessible to the public (such as but not limited to classrooms, unrestricted storage rooms, and corridors) shall be mounted with the disconnect switch at 6’-0” to 6’-7” (1.8 to 2.0 m) above finished floor, with the VFD operator display and other accessories mounted above the disconnect switch, where ceiling height allows, unless otherwise indicated.
         2) In mechanical rooms and other restricted-access locations, mount VFDs at a height for greatest user convenience.
      d. When possible, mount groups of adjacent VFDs with tops at uniform height above finished floor.
      e. Because VFDs produce heat, do not install a VFD above another one, or above another heat-producing device. Do not install a VFD below or too near to any heat-sensitive device or room temperature sensor. Provide ventilation space and other means of cooling as required by the manufacturer.
      f. Install with service and installation clearances as required by the manufacturer.
   2. Electrical Connections:
      a. Provide separate metal conduits for drive input power, output power to the motor, and control wiring. Output motor cables from multiple drives shall be run separately.
      b. Ground each drive separately.
      c. Ensure that a fused disconnect switch is provided upstream between the transformer and the drive. Fuses are required because they are faster-acting than circuit breakers.
      d. If drive design cannot tolerate interruption of output, such as by a disconnect switch mounted between the drive and the motor, provide protective devices and
coordinate with installers to protect the drive, and coordinate with installers to ensure that no unnecessary switching is installed.

1) When the VFD is out of sight from the equipment served, or is more than 50 feet (15.2 m) from the equipment served, a disconnect switch mounted on or adjacent to the equipment is generally required in Division 26 “Electrical” or by the Authority Having Jurisdiction. If such a disconnect or other switching device is indicated or required, provide protective devices as required by the VFD manufacturer. Such devices typically include an “early-break” auxiliary set of contacts or a “Stop” button on the disconnect switch, field-wired to the VFD’s external fault input or stop input, so that if the switch is opened while the VFD is running, the input will shut off the output of the VFD. The VFD stop method must be set to “Coast.” Provide field wiring in conduit.

2) Provide engraved nameplates at disconnect switches and other devices, instructing users on the proper operation of these devices to prevent damage to the VFD.

3. Carrier Frequency: Adjust to minimize noise, but also to minimize the potential for motor bearing damage due to VFD-induced shaft voltage.
   a. VFDs convert line AC voltage to a pulse width modulated (PWM) AC voltage of variable frequency. The switching frequency of these pulses is referred to as the “carrier frequency.” The switching induces a voltage on the rotor shaft, which, if it builds up to a sufficient level, can discharge as “bearing current” to ground through the bearings. This has an electric discharge machining (EDM) effect, causing pitting of the bearing’s rolling elements and raceways. This effect can be minimized by proper setup.
   b. The higher the carrier frequency, the higher the rate of the current discharge pulses, and the more likely EDM will occur. At higher carrier frequencies the VFD will generally run quieter; however, it becomes more destructive on the motor insulation and bearings.
   c. Adjust the carrier frequency as low as possible without creating unacceptable audible noise levels, and to avoid frequencies above 6 kHz altogether if possible.

4. Coordinate with building controls systems as specified in Part 2 of this Section.

5. Perform startup service, and submit report.

6. Provide warranty service.

7. Provide Owner training.

END OF SECTION 230513
PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Flexible pipe connectors.
B. Pipe anchors and alignment guides.
C. Pre-fabricated flexible expansion loops.

1.2 RELATED SECTIONS

A. Division 23 Section “Hangers and Supports for HVAC Piping and Equipment.”
B. Division 23 Section “Hydronic Piping.”
C. Division 23 Section “Hydronic Specialties.”
D. Division 23 Section “Refrigerant Piping.”

1.3 REFERENCES

A. MIL-E-17814E - Expansion Joints, Pipe, Slip-Type, Packed.

1.4 PERFORMANCE REQUIREMENTS

A. Provide structural work and equipment required to control expansion and contraction of piping. Verify that anchors, guides, and expansion loops provided adequately protect system.

B. Expansion Calculations:
   1. Installation Temperature: 50°F (10°C).
   3. Safety Factor: 30 percent.

1.5 SUBMITTALS

A. Submit under provisions of Division 01 Section “Submittal Procedures.”

B. Product Data:
   1. Flexible Pipe Connectors: Indicate maximum temperature and pressure rating, face-to-face length, live length, hose wall thickness, hose convolutions per foot (meter) and per assembly, fundamental frequency of assembly, braid structure, and total number of wires in braid.

C. Design Data: Indicate selection calculations.

D. Manufacturer's Installation Instructions: Indicate special procedures, and external controls.
1.6 PROJECT RECORD DOCUMENTS
   A. Submit under provisions of Division 01 Section “Project Record Documents.”
   B. Record actual locations of flexible pipe connectors, expansion loops, anchors, and guides.

1.7 OPERATION AND MAINTENANCE DATA
   A. Submit under provisions of Division 01 Section “Operation and Maintenance Data.”
   B. Maintenance Data: Include adjustment instructions.

1.8 QUALIFICATIONS
   A. Manufacturer: Company specializing in manufacturing the products specified in this Section with minimum 3 years’ experience.
   B. Design expansion compensating system under direct supervision of a Professional Engineer experienced in design of this work and licensed at the place where the project is located.

1.9 DELIVERY, STORAGE, AND HANDLING
   A. Deliver, store, protect and handle products to site under provisions of Division 01.
   B. Accept expansion loops on site in factory packing with shipping bars and positioning devices intact. Inspect for damage.
   C. Protect equipment from exposure by leaving factory coverings, pipe end protection, and packaging in place until installation.

1.10 WARRANTY
   A. Provide warranty under provisions of Division 01 Section “Closeout Procedures.”

PART 2 - PRODUCTS

2.1 DOUBLE-SPHERE FLEXIBLE PIPE CONNECTORS
   A. Application: Provide Double-Sphere type wherever flexible connectors are indicated or specified, except in locations where other types are specifically detailed or specified.
   B. Piping 3/4” to 1-1/2” (19 mm to 38 mm):
      1. Manufacturers:
         a. Metraflex.
         b. American Wheatley.
         c. Flex-Hose Co.
         d. Mason Industries - see “Single-Sphere Flexible Pipe Connectors”.
         e. Proco Products, Inc.
         f. Twin City Hose, Inc.
3. Control Cables: Provide if recommended by Manufacturer, with installed length slack at neutral installation to prevent vibration transmission. Cable shall be taut only when the connector exceeds maximum allowable extension.

4. Pressure Rating: 150 psig (1035 kPa) WOG and 220°F (104°C), at 70°F (21°C) room temperature. Vacuum rating 16 in. Hg (54 kPa).

5. Joint: Galvanized steel female unions.


7. Allowable Movements: 0.87 inch (22 mm) axial compression, 0.23 inch (6 mm) axial elongation, 0.87 inch (22 mm) transverse movement on each side of installed center line, 17.5 degrees angular movement.

C. Piping 2" to 12" (50 mm to 304 mm):
   1. Manufacturers:
      a. Mason Industries.
      b. American Wheatley.
      c. Flex-Hose Co.
      d. Metraflex.
      e. Proco Products, Inc. (up to 6" (75 mm) size).
      f. Twin City Hose, Inc. (up to 6" (75 mm) size).
   2. Hose: Neoprene or EPDM inner and outer, with nylon or Kevlar tire cord fabric reinforcing.
   3. Control Cables: Provide if recommended by Manufacturer, with installed length slack at neutral installation to prevent vibration transmission. Cable shall be taut only when the connector exceeds maximum allowable extension.
   4. Pressure Rating: 150 psig (1035 kPa) WOG and 220°F (104°C), at 70°F (21°C) room temperature. Vacuum rating 16 in. Hg (54 kPa).
   5. Joint: 150 psig (1035 kPa) floating flanges; ductile iron with baked enamel finish, or steel.
   7. Allowable Movements, 2" (50 mm) to 2-1/2" (63 mm) Size: 3/4 inch (19 mm) axial compression, 5/8 inch (15 mm) axial elongation, 5/8 inch (15 mm) transverse movement on each side of installed center line, 27 degrees angular movement.
   8. Allowable Movements, 3" (75 mm) Size and Up: 1-1/8 inch (28 mm) axial compression, 7/8 inch (22 mm) axial elongation, 7/8 inch (22 mm) transverse movement on each side of installed center line, 20 degrees angular movement.

2.2 SINGLE-SPHERE FLEXIBLE PIPE CONNECTORS

A. Piping 3/4" to 1-1/2" (19 mm to 38 mm) (not allowed for larger piping):
   1. Manufacturers:
      a. Mason Industries.
      b. No Substitutions.
   3. Pressure Rating: 150 psig (1035 kPa) WOG and 220°F (104°C), at 70°F (21°C) room temperature. Vacuum rating 16 in. Hg (54 kPa).
   4. Joint: Ductile iron floating flanges with baked enamel finish, with female threaded fittings for steel pipe, or sweat-end fittings for copper pipe.
   5. Size: Provide pipe sized units.
   6. Allowable Movements: 3/4 inch (19 mm) axial compression, 3/8 inch (10 mm) axial elongation, 3/8 inch (10 mm) transverse movement on each side of installed center line,
22 degrees angular movement.

B. Single-sphere connectors conforming with these specifications may be used where double-sphere type are indicated.

2.3 PRE-FABRICATED FLEXIBLE EXPANSION LOOPS

A. Manufacturers:
   1. Metraflex “METRALOOP”.
   2. Flex-Hose “TRI-FLEX LOOP”.
   3. Mason Industries “EQUI-V”.
   4. No substitutions.

B. Provide flexible expansion loops of diameter and material consistent with the pipe system in which they are to be installed. Flexible loops shall be designed to impart no thrust loads on the anchors. At a minimum, the loop shall consist of two flexible sections of hose and braid, two 90 degree elbows, and a 180 degree turn. If Mason Industries “EQUI-V” connectors are used, the elbows shall be two 60 degree elbows and a 120 degree turn.
   1. Joint: As specified for pipe joints.
   2. Size: Use pipe sized units.
   3. Nesting: Where nesting is indicated or required, provide extended lengths of the 180-degree turn as required.
   4. Shipping Bars: Remove after installation.

C. Flexible Sections in Steel Piping:
   1. Inner Hose: Stainless Steel.
   2. Exterior Sleeve: Double braided stainless steel.
   3. Pressure Rating: 200 psig (1380 kPa) WOG and 250°F (121°C), at 70°F (21°C) room temperature.

D. Flexible Sections in Copper Piping:
   1. Inner Hose: Bronze.
   2. Exterior Sleeve: Braided bronze.
   3. Pressure Rating: 200 psig (1380 kPa) WOG and 250°F (121°C), at 70°F (21°C) room temperature.

2.4 FLEXIBLE HOSE ASSEMBLIES

A. If a piping connection is indicated or specified as a “flexible connection”, this Section applies.

B. For flexible hoses such as “heat pump hoses” which may be indicated at items of equipment including water-source heat pumps, fan-coil units, and chilled beams, see Division 23 Section “Hydronic Specialties.”

2.5 ACCESSORIES

A. Pipe Alignment Guides:
   1. Manufacturers:
      a. Metraflex.
      b. Hyspan.
      c. Flexonics.
d. Carpenter & Paterson.

2. Two piece welded steel with enamel paint, bolted, with spider to fit standard pipe, frame with four mounting holes, clearance for minimum 1 inch (25 mm) thick insulation, minimum 3 inch (75 mm) travel.

B. Pipe Anchors:
1. Manufacturers:
   a. Metraflex.
   b. Hyspan.
   c. Flexonics.
   d. Carpenter & Paterson.
2. Provide structural I-Beam anchors equal to METRAFLEX PAI series, sizes as required.

C. Provide miscellaneous steel for anchors and guides.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Construct spool pieces to exact size of flexible connection for future insertion.

C. Install flexible pipe connectors on pipes connected to equipment supported by vibration isolation and on pipes connected to base mounted pumps, chillers, air handling units, unit ventilators, fan coil units and as indicated. Provide line size flexible connectors.

D. Install flexible connectors at right angles to displacement (generally parallel to fan or pump shaft). Install one end immediately adjacent to isolated equipment and anchor other end. Install in horizontal plane unless indicated otherwise.

E. Rigidly anchor pipe to building structure. Provide pipe guides so movement is directed along axis of pipe only. Erect piping such that strain and weight is not on cast connections or apparatus.

F. Provide support and equipment required to control expansion and contraction of piping. Provide loops, pipe offsets, and swing joints where indicated.

G. Where flexible grooved couplings are indicated instead of flexible connectors at pumps and other equipment, provide minimum one flexible joint per inch (25 mm) pipe diameter. Grooved piping does not require anchoring at equipment. Submit coupling manufacturer’s design recommendations for quantity and location of flexible couplings at each location.

H. Provide expansion loops as indicated on Drawings.

I. Pre-fabricated flexible expansion loops shall be installed in a neutral, pre-compressed, or pre-extended condition as required for the application. Loops installed hanging down shall have a drain plug. Loops shall not be installed straight up or at any angle above the horizontal plane, but in the event that the Architect’s approval is given to install loops above the horizontal plane, loops shall be fitted with an automatic air release valve to purge air from the high point.
of the loop. Loops installed in any position other than hanging down shall have the 180 degree return supported. Install pre-fabricated flexible expansion loop within four pipe diameters, both upstream and downstream, from a pipe guide or anchor.

1. **Guides and Anchors:** The Mechanical Contractors Association of America “Guidelines for Quality Piping Installations” section 3 - Pipe Hangers and Supports recommends guides on both sides of the expansion loops. Although some loop manufacturers say their loops don’t require guides, it is required to provide guides as indicated and as specified. The intent is to direct pipe movement and to reduce stress on hangers.

### 3.2 MANUFACTURER’S FIELD SERVICES

A. Prepare and start systems under provisions of Division 01 Section “Quality Requirements.”

B. Provide inspection services by flexible pipe manufacturer's representative for final installing. Certify installation is in accordance with manufacturer's recommendations and connectors are performing satisfactorily.

END OF SECTION 230516
PART 1 - GENERAL

1.1 SECTION INCLUDES
   A. Pipe Sleeves.
   B. Escutcheons.
   C. Floor Plates.

1.2 RELATED SECTIONS
   A. Division 23 Section “Common Work Results for HVAC” – Firestopping.
   B. Division 23 Section “Hydronic Piping.”
   C. Division 23 Section “Refrigerant Piping.”

1.3 REFERENCES
   A. ASTM A53 - Pipe, Steel, Black and Hot-Dipped, Zinc Coated Welded and Seamless.
   C. ASTM D1785 - Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.

1.4 PERFORMANCE REQUIREMENTS
   A. Provide sleeves for piping penetrations of building construction such as interior partitions, interior and exterior walls, floors, and roofs.
   B. Provide escutcheons and floor plates at piping penetrations of building construction.

1.5 SUBMITTALS
   A. Submit under provisions of Division 01 Section “Submittal Procedures.”
   B. Product Data: For each type of product indicated.
   C. Manufacturer's Installation Instructions: Indicate special procedures, and external controls.

1.6 QUALIFICATIONS
   A. Manufacturer: Company specializing in manufacturing the products specified in this Section with minimum 3 years’ experience.
1.7  DELIVERY, STORAGE, AND HANDLING
   A. Deliver, store, protect and handle products to site under provisions of Division 01.
   B. Protect materials from exposure by leaving factory coverings and packaging in place until
      installation.

1.8  WARRANTY
   A. Provide warranty under provisions of Division 01 Section “Closeout Procedures.”

PART 2 - PRODUCTS

2.1  PIPE SLEEVES
   A. Cast-Iron Wall Pipes: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron
      pressure pipe, with plain ends and integral waterstop unless otherwise indicated.
   B. Galvanized-Steel Wall Pipes: ASTM A53, Schedule 40, with plain ends and welded steel
      collar; zinc coated.
   C. Galvanized-Steel-Pipe Sleeves: ASTM A53, Type E, Grade B, Schedule 40, zinc coated, with
      plain ends.
   E. Galvanized-Steel-Sheet Sleeves: 0.0239-inch (0.6-mm) minimum thickness; round tube
      closed with welded longitudinal joint.

2.2  ESCUTCHEONS
   A. Material: Brass at floors and in potentially damp or wet locations. Brass or steel in other
      locations.
   B. Finish: Except as indicated below, polished chrome plated in exposed locations, prime
      painted steel or rough brass in mechanical rooms and similar spaces.
   C. One-Piece, Cast-Brass Type: With finish and setscrew fastener.
   D. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with chrome-plated finish and
      spring-clip fasteners.
   E. One-Piece, Stamped-Steel Type: With chrome-plated finish and spring-clip fasteners.
   F. Split-Casting Brass Type: With concealed hinge and setscrew.
   G. Split-Plate, Stamped-Steel Type: With chrome-plated finish, hinge, and spring-clip fasteners.
2.3 FLOOR PLATES

A. Material: Brass in exposed locations. Brass or cast iron in other locations including mechanical equipment spaces.

B. Finish: Except as indicated below, polished chrome plated in exposed locations, prime painted steel or rough brass in mechanical rooms and similar spaces.

C. One-Piece Floor Plates: Cast-iron flange.

D. Split-Casting Floor Plates: Cast brass with concealed hinge.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Provide sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.

C. Size sleeves to allow firestopping.

D. Size holes and sleeves to allow the required clear annular space for insulation, and a minimum of 1/4 in. (6.4 mm) clear outside the pipe and insulation for movement due to and expansion and contraction.

E. Cut sleeves flush with both surfaces, except at floors.

F. Extend sleeves through floors, 2 in. (50 mm) above finished floor level. Finished floor level includes the thickness of floor finish materials such as carpet and tile. Caulk sleeves full depth and provide floor plate.

G. Fasten sleeves permanently in place.

H. Using grout, seal the space outside of sleeves in concrete slabs and walls which do not have watertight sleeve system.

I. Provide escutcheons for piping penetrations of walls, ceilings, and finished floors.

J. Provide floor plates for piping penetrations of equipment-room floors.

K. Escutcheons and floor plates on bare piping shall be one-piece type where possible. Those on insulated piping and on existing piping shall be split, hinged type.

L. Size escutcheons and floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.

END OF SECTION 230517
PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Pressure gauges and Pressure gauge taps.
B. Static pressure gauges.
C. Filter gauges.
D. Test Plugs.
E. Thermometers and thermometer wells.
F. Thermowell heat transfer paste.

1.2 RELATED SECTIONS

A. Division 23 Section “Hydronic Piping.”
B. Division 23 Section “Instrumentation and Controls for HVAC.”

1.3 REFERENCES

A. Division 01 Section “References”: Requirements for references and standards.
B. ASME B40.1 - Gauges - Pressure Indicating Dial Type - Elastic Element.

1.4 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Company specializing in manufacturing the Products specified in this Section with minimum 3 years’ experience.

1.5 SUBMITTALS

A. Division 01 Section “Submittal Procedures”: Procedures for submittals.
B. Product Data: Provide manufacturers data and list which indicates use, operating range, total
range, accuracy, and location for manufactured components.

1.6 PROJECT RECORD DOCUMENTS
   A. Submit under provisions of Division 01 Section “Closeout Procedures.”
   B. Project Record Documents: Record actual locations of components and instrumentation.

1.7 OPERATION AND MAINTENANCE DATA
   A. Submit under provisions of Division 01 Section “Operation and Maintenance Data.”
   B. Include instructions for calibrating instruments.

1.8 ENVIRONMENTAL REQUIREMENTS
   A. Division 01 Section “Product Requirements”: Environmental conditions affecting products on site.
   B. Do not install instruments when areas are under construction, except for required rough-in, taps, supports and test plugs.

PART 2 - PRODUCTS

2.1 PRESSURE GAUGES
   A. Manufacturers:
      1. Weiss.
      2. Trerice.
      3. Marshalltown.
      4. Amtek.
      5. Dwyer.
   B. Gauges, Hot Water Heating and Glycol Systems: Weiss Series 4PG-1 industrial pressure gauge, dry non-filled type, with phosphor bronze bourdon tube, silver brazed connecting joints, brass socket, bushed stainless rotary movement, 1/4” NPT connection, white aluminum dial with black markings, black aluminum pointer with front slotted adjustment.
      1. Case: Cast aluminum or stainless steel.
      2. Lens: Push-in Lexan polycarbonate, or clear glass or acrylic with stainless steel ring, per manufacturer’s standard.
      3. Bourdon Tube: Phosphor bronze.
      4. Dial Size: 4 to 4-1/2 inch (101 to 114 mm).
      5. Connection: Lower or lower back, 1/4” or 1/2” NPT, as selected by Contractor.
      6. Accuracy: 1 percent of full scale range, per ANSI-ASME B40.1 Grade 1A.
      7. Scale: Psi.
      8. Range: 0-60 psig typical, select for application.
   C. Verify suitability of range for each application. Best selection is for typical reading to be close to mid-scale.
2.2 PRESSURE GAUGE TAPPINGS

A. Ball Valve:
   1. Manufacturers:
      a. Weiss.
      b. Trerice.
      c. Marshalltown.
      d. Amtek.
      e. Dwyer.
   2. Brass, 1/4 inch (6 mm) NPT for minimum 300 psi, (2070 kPa).
   3. Ball valves may also be furnished under applicable sections of the Specifications.

B. Pulsation Damper:
   1. Manufacturers:
      a. Weiss.
      b. Trerice.
      c. Marshalltown.
      d. Amtek.
      e. Dwyer.
   2. Pressure snubber, brass with 1/4 inch (6 mm) NPT connections.

2.3 STATIC PRESSURE GAUGES

A. Dial Gauges:
   1. Manufacturers:
      a. Dwyer.
      b. Trerice.
      c. Marshalltown.
      d. Amtek.
   2. 3-1/2 inch (89 mm) diameter dial in metal case, diaphragm actuated, black figures on white background, front recalibration adjustment, 2 percent of full scale accuracy.

B. Accessories: Static pressure tips with compression fittings for bulkhead mounting, 1/4 inch (6 mm) diameter tubing.

2.4 TEST PLUGS

A. Test Plug:
   1. Manufacturers:
      b. Weiss. [http://weissinstruments.com/]
      d. Trerice. [http://www.trerice.com/]
   2. 1/2 inch (13 mm) NPT brass fitting and cap for receiving 1/8 inch (3 mm) outside diameter pressure or temperature probe with self-closing valves as follows:
      a. Nordel (EPDM) core for water and hydronic heating and cooling service, temperatures range 30 to 275°F (-1 to 176°C).
      b. Neoprene core for natural gas or LP gas service, temperature range -40 to 150°F (-40 to 65°C).
      c. Verify core suitability for other fluids and temperatures.
3. Working Pressure: 500 psig
4. Cap Retaining Strap: Color coded to indicate core material.
5. Construction with either dual self-closing valves (Pete’s Plug standard design) or single valve are allowed.
6. For chilled water applications, provide “XL” plugs which include a 1-1/2” (38 mm) extension for insulated piping.

B. Pressure and Temperature Test Kit: Furnish one (1) to the Owner.
   1. Carrying case with inside foam padding.
   2. Pressure gauge, liquid filled with 1/4” (6 mm) NPT connection, range 0 to 100 psig (0 to 700 kPa), with gauge adapter attached.
   3. Additional gauge adapter with 1/8” (3 mm) diameter probe and protecting shield.
   4. Bimetal thermometer, range 25 to 125°F (-5 to 50°C), 5 inch (127 mm) stem, 1-3/4 inch (44 mm) dial, external calibration.
   5. Bimetal thermometer, range 0 to 220°F (-17 to 104°C), 5 inch (127 mm) stem, 1-3/4 inch (44 mm) dial, external calibration.
   6. If extended “XL” plugs are used, provide the XL test kit which is suitable for any length of plug.

2.5 THERMOMETERS - DIAL

A. Manufacturers:
   1. Weiss.
   2. Trerice.
   3. Amtek.
   4. Ernst.

B. Thermometer: Weiss Model 45VA, ASTM E1, stainless steel or cast aluminum case, adjustable angle with front recalibration, vapor actuated, black scale on white-finished metal background, black pointer, sealed lens, brass stem.
   1. Size: 4 to 4-1/2 inch (101 to 114 mm) dial.
   2. Lens: Snap-in Lexan polycarbonate with o-ring, or clear glass with rubber ring.
   4. Extended Bulb: Where required, provide extended capillary tube with braided copper protection.
   5. Connection: Separable socket.
   6. Accuracy: 1 scale division throughout range.
   7. Calibration: Both degrees F and degrees C.
   8. Scale Range: 30 to 240°F (0 to 115°C) for hot water heating and supply air systems.
   9. Graduations: 2°F.
   10. Air Duct Flange: Provide for duct applications.

2.6 THERMOMETER SUPPORTS

A. Socket (Thermometer Well) for Piping: Brass separable sockets for thermometer stems, with extensions for insulated piping. Provide with Honeywell viscous heat transfer paste.

B. Flange for Duct: 3 inch (76 mm) outside diameter reversible flange, designed to fasten to sheet metal air ducts, with brass perforated stem.
2.7 THERMOWELL HEAT TRANSFER PASTE

A. Manufacturers:
   1. MG Chemicals.
   2. Honeywell.
   3. Trerice.

B. Description:
   1. Formulation: Silicone or synthetic base, containing metal oxides.
   2. Thermal Conductivity: At least 4.5 Btu-in./(hr-ft²-ºF) (0.65 W/(m-K)).
   3. Temperature Range: To 392ºF (200ºC).
   5. Dropping Point: ASTM D566, greater than 500ºF (260ºC).
   6. Specific Gravity: 2.3 minimum at 77ºF (25ºC).

PART 3 - EXECUTION

3.1 INSTALLATION

A. Use ball valves for water service; use needle valves for steam service.

B. Division 01 - Quality Requirements: Manufacturer's instructions.

C. Install one pressure gauge per pump, with taps on suction and discharge of pump; pipe to gauge.

D. Install gauge taps in piping; refer to Division 23 Section “Hydronic Piping.”

E. Install pressure gauges with pulsation dampers. Provide ball valve to isolate each gauge. Extend nipples to allow clearance from insulation.

F. Install thermometers in piping systems in sockets in short couplings. Enlarge pipes smaller than 2-1/2 inches (64 mm) for installation of thermometer sockets. Ensure sockets allow clearance from insulation.

G. Install thermometers in air duct systems on flanges.

H. Fill thermometer sockets with heat transfer paste.

I. Install thermometer sockets adjacent to controls systems thermostat, transmitter, or sensor sockets.

J. Locate duct mounted thermometers minimum 10 feet (3 m) downstream of mixing dampers, coils, or other devices causing air turbulence.

K. Coil and conceal excess capillary on remote element instruments.

L. Install static pressure gauges to measure across filters and filter banks, (inlet to outlet).
multiple banks, provide manifold and single gauge.

M. Provide instruments with scale ranges selected according to service with largest appropriate scale.

N. Install gauges and thermometers in locations where they are easily read from normal operating level. Install vertical to 45 degrees off vertical.

O. Adjust gauges and thermometers to final angle, clean windows and lenses, and calibrate to zero.

P. Locate test plugs where indicated.

Q. Provide pressure gauge at high point of system for setting of cold water make-up pressure reducing valve.

R. Provide pressure gauge at connection to bladder type expansion tank for setting of air side pre-charge pressure.

END OF SECTION 230519
SECTION 230529 – HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Pipe and equipment hangers and supports.
B. Equipment bases and supports.
C. Sleeves and seals.
D. Flashing and sealing equipment and pipe stacks.
E. Non-penetrating roof mounted pipe support system.

1.2 RELATED SECTIONS

A. Division 03 Section “Cast-In-Place Concrete”: Equipment bases.
B. Division 07 Section “Through-Penetration Firestop Systems”: Joint seals for piping and duct penetration of fire rated assemblies.
C. Division 09 Section “Painting.”
D. Division 23 Section “Vibration and Seismic Controls for HVAC Piping and Equipment.”
E. Division 23 Section “HVAC Piping Insulation.”
F. Division 23 Section “HVAC Equipment Insulation.”
G. Division 23 Section “Hydronic Piping.”
H. Division 23 Section “Refrigerant Piping.”

1.3 REFERENCES

A. ASME B31.1 - Power Piping.
B. ASME B31.2 - Fuel Gas Piping.
C. ASME B31.5 - Refrigeration Piping.
D. ASME B31.9 - Building Services Piping.
E. ASTM A653 G90 SS Gr. 33 - Specification for Steel Sheet, Zinc Coated (Galvanized) by the Hot Dipped Process.

H. ASTM C672 - Test Methods for Scaling Resistance of Concrete Surfaces Exposed to Deicing Chemicals.


M. ASTM D2240 - Test Method for Rubber Property - Durometer Hardness.

N. ASTM F708 - Design and Installation of Rigid Pipe Hangers.

O. MSS SP58 - Pipe Hangers and Supports - Materials, Design and Manufacturer.

P. MSS SP69 - Pipe Hangers and Supports - Selection and Application.

Q. MSS SP89 - Pipe Hangers and Supports -Fabrication and Installation Practices.

R. NFPA 70 - National Electrical Code

1.4 SUBMITTALS

A. Submit under provisions of Division 01 Section “Submittal Procedures”.

B. Shop Drawings: Indicate system layout with location and detail of trapeze hangers.

C. Product Data: Provide manufacturers catalog data including load capacity.

D. Design Data: Indicate load carrying capacity of trapeze, multiple pipe, and riser support hangers.

E. Manufacturer's Installation Instructions: Indicate special procedures and assembly of components.

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the products specified in this Section with minimum 3 years’ experience.

1.6 REGULATORY REQUIREMENTS

A. Conform to applicable Codes for support of piping.

B. Supports for Electrical: In conformance with NFPA 70 and Division 26 of the Specifications.
PART 2 - PRODUCTS

2.1 HANGERS, SUPPORTS, & PIPE CLAMPS

A. Approved Manufacturers (first manufacturer is basis of design):
   1. Strut Hangers:
      a. Unistrut (division of Tyco).
      b. Anvil International.
      c. Cooper B-Line.
      d. Hydra-Zorb Company.
      e. Thomas & Betts - Superstrut line.
      f. Tolco (division of Nibco).
   2. Adjustable Swivel Band Hangers:
      a. Carpenter & Paterson.
      b. Anvil International.
      c. Cooper B-Line.
      d. Tolco (division of Nibco).
   3. Clevis Hangers:
      a. Carpenter & Paterson.
      b. Anvil International.
      c. Cooper B-Line.
      d. Tolco (division of Nibco).
   4. J-Hangers:
      a. Carpenter & Paterson.
      b. Cooper B-Line.
      c. Thomas & Betts - Superstrut line.
      d. Tolco (division of Nibco).
      e. Unistrut (division of Tyco).
   5. Roof Support Blocks/Non-Penetrating Roof-Mounted Pipe Support System:
      a. Cooper B-Line - Dura-Blok line.
      b. Miro Industries.
      c. Unistrut (division of Tyco) - Unipier line.
      d. No substitutions.
   6. Cushion Clamps:
      b. Cooper B-Line.
      c. Thomas & Betts - Superstrut line.
      d. Tolco (division of Nibco).
      e. Unistrut (division of Tyco).
   7. Insulated Pipe Couplings:
      a. Klo-Shure Corporation.
      b. Cooper B-Line - Armafix line.
   8. No substitutions.

B. Horizontal Piping Supports: Provide struts for trapeze hangers for single or multiple pipes.
   Where individual piping runs are hung with individual hangers, adjustable swivel band hangers,
   clevis hangers, or j-hangers may be used.

C. Strut hangers shall be standard 1-5/8”x1-5/8” (41x41 mm) size.
D. Hangers, clamps, and supports located outdoors or otherwise exposed to weather, or in wet or washdown areas, shall be hot-dipped galvanized steel or 300-series stainless steel. Struts may be extruded aluminum. Threaded rods, nuts, and washers may have standard galvanizing if hot-dipped galvanized is not available.

1. Hot-dipped galvanized steel shall have a nominal zinc coating of 2.6 mil (0.066 mm) thickness and 1.5 oz./sq.ft (458 g/m²) coating weight.
2. In lieu of galvanizing, strut systems and their accessories may have Unistrut Perma-Green III electrodeposited thermoset acrylic coating, or be epoxy-coated equal to B-Line’s Dura-Green or Dura-Copper coatings.
3. Lesser coatings for struts and clamps, such as pre-galvanizing (0.75 mil (0.019 mm) thickness), electroplated zinc (0.2 to 0.5 mil (0.005 to 0.013 mm) thickness), and yellow zinc dichromate coating, are not acceptable in these locations.

E. Pipe hanger rods and nuts shall be plated to match the hangers. Nuts shall be self-locking type, or provide double nuts tightened to lock together. Rods shall be threaded one end, or continuous threaded. Provide washers at each nut.

F. Cushion Clamps for Un-insulated Lines: Plastic cushion shall be Dupont Hytel plastic, 5555HS plastic elastomer, warranted from -40 to 275°F (-40 to 135°C).

G. Copper-plated hangers are plated for identification only. Traditional thin copper plating on steel substrate does not provide adequate protection from galvanic corrosion due to contact between dissimilar metals.

1. Where copper-plated supports are specified for use with copper piping, either copper plating or a copper-colored finish such as Cooper B-Line’s Dura-Copper epoxy coating is acceptable. This is for identification, and does not protect dissimilar metals.
2. Where copper piping is used with steel hangers and supports, provide protection from galvanic corrosion such as thick plastic or vinyl factory coating, or plastic-lined cushion clamps.

H. For Insulated Lines Clamped to Strut: Insulated pipe coupling insert with the same thickness as the insulation. Protects insulation from crushing, and provides continuous insulation and vapor barrier thru the hanger or clamp. Klo-Shure product provides plastic pipe support and rigid outer band, for field insulation into the coupling. Armafix product provides insulation with rigid outer band, for field insulation glued to the ends of the insert.

2.2 PIPE SUPPORTS

A. Hydronic Piping:

1. Conform to ASME B31.9, ASTM F708, MSS SP58, MSS SP69 and MSS SP89.
2. Hangers for Pipe Sizes 1/2 to 1-1/2 Inch (13 to 38 mm): Malleable iron, adjustable swivel, split ring.
3. Hangers for Pipe Sizes 2 to 4 Inches (50 to 100 mm): Carbon steel, adjustable, clevis.
4. Hangers for Pipe Sizes 5 Inches (125 mm) and Over: Adjustable steel yoke, cast iron roll, double hanger.
5. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
6. Multiple or Trapeze Hangers for Pipe Sizes 6 Inches (150 mm) and Over: Steel channels with welded spacers and hanger rods, cast iron roll.
7. Wall Support for Pipe Sizes to 3 Inches (76 mm): Cast iron hook.
8. Wall Support for Pipe Sizes 4 Inches (100 mm) and Over: Welded steel bracket and
wrought steel clamp with adjustable steel yoke and cast iron roll.

10. Floor Support for Pipe Sizes to 4 Inches (100 mm): Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
11. Floor Support for Pipe Sizes 5 Inches (125 mm) and Over: Adjustable cast iron roll and stand, steel screws, and concrete pier or steel support.
12. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.

B. Refrigerant Piping:
1. Conform to ASME B31.5, ASTM F708, MSS SP58, MSS SP69 and MSS SP89.
2. Hangers for Pipe Sizes 1/2 to 1-1/2 Inch (13 to 38 mm): Malleable iron, adjustable swivel, split ring.
3. Hangers for Pipe Sizes 2 Inches (50 mm) and Over: Carbon steel, adjustable, clevis.
4. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
5. Wall Support for Pipe Sizes to 3 Inches (75 mm): Cast iron hook.
6. Wall Support for Pipe Sizes 4 Inches (100 mm) and Over: Welded steel bracket and wrought steel clamp.
8. Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.

2.3 INSERTS

A. Manufacturers:
1. Grinnell.
2. B-Line.

B. Inserts: Malleable iron case of steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.

2.4 FLASHING

A. Metal Flashing: 26 gauge (0.5 mm) thick galvanized steel.

B. Metal Counterflashing: 22 gauge (0.8 mm) thick galvanized steel.

C. Lead Flashing:
1. Waterproofing: 5 lb/sq ft (24.5 kg/sq m) sheet lead
2. Soundproofing: 1 lb/sq ft (5 kg/sq m) sheet lead.

D. Flexible Flashing: 47 mil (1.2 mm) thick sheet butyl; compatible with roofing.

E. Caps: Steel, 22 gauge (0.8 mm) minimum; 16 gauge (1.5 mm) at fire resistant elements.

2.5 SLEEVES

A. Sleeves for Pipes Through Non-fire Rated Floors: 18 gauge (1.2 mm) thick galvanized steel.
B. Sleeves for Pipes Through Non-fire Rated Beams, Walls, Footings, and Potentially Wet Floors: Steel pipe or 18 gauge (1.2 mm) thick galvanized steel.

C. Sleeves for Pipes Through Fire Rated and Fire Resistive Floors and Walls, and Fire Proofing: Prefabricated fire rated sleeves including seals, UL listed.

D. Sleeves for Round Ductwork: Galvanized steel.

E. Sleeves for Rectangular Ductwork: Galvanized steel.

F. Stuffing or Firestopping Insulation: Glass fiber type, non-combustible.

G. Sealant: Acrylic.

2.6 NON-PENETRATING ROOF-MOUNTED PIPE SUPPORT SYSTEM

A. Roof Support Blocks: Cooper B-Line Inc. - Dura-Blok product line.

B. Curb Base:
1. 100% recycled rubber and polyurethane prepolymer, UV resistant.
2. Support capacity of 2500 pounds per linear foot of support. Note: Consult roofing manufacturer; the weakest point may be the insulation board beneath the roof membrane.
3. Each base shall have a reflective yellow stripe.
4. Base Dimensions: 6 inches wide, 4 inches tall, with length as selected by the manufacturer for the load and roof conditions.
5. Material Properties:

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
<th>Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Density</td>
<td>0.6 oz/cu in</td>
<td>ASTM C642</td>
</tr>
<tr>
<td>b. Durometer Hardness</td>
<td>65A +/- 7</td>
<td>ASTM D2240</td>
</tr>
<tr>
<td>c. Tensile Strength</td>
<td>210 psi minimum</td>
<td>ASTM D412</td>
</tr>
<tr>
<td>d. Compression Deformation</td>
<td>10% at 70psi and 68°F</td>
<td>ASTM D395</td>
</tr>
<tr>
<td>e. Britleness at Low Temp</td>
<td>-40°F</td>
<td>ASTM D746</td>
</tr>
<tr>
<td>f. Freeze and thaw when exposed</td>
<td>No loss after 50 cycles</td>
<td>ASTM C672</td>
</tr>
<tr>
<td>g. Coefficient of Thermal</td>
<td></td>
<td></td>
</tr>
<tr>
<td>h. Expansion</td>
<td>8 x 10-6 in/in/°F (min)</td>
<td>ASTM C531</td>
</tr>
<tr>
<td>i. Weathering, 70 hours at 12°F</td>
<td></td>
<td>ASTM D573</td>
</tr>
<tr>
<td>1) Hardness retained</td>
<td>100% (+/- 5%)</td>
<td></td>
</tr>
<tr>
<td>2) Compressive strength</td>
<td>100% (+/-5%)</td>
<td></td>
</tr>
<tr>
<td>3) Tensile strength</td>
<td>100% (+/-5%)</td>
<td></td>
</tr>
<tr>
<td>4) Elongation retained</td>
<td>100% (+/-5%)</td>
<td></td>
</tr>
</tbody>
</table>
6. Note: Acceptable substitutes by Miro Industries and Unistrut have bases of UV-resistant polycarbonate plastic, and accessories of hot-dipped galvanized steel, or stainless steel. The properties of these are different from the rubber block type. In particular, the weight capacity per foot of the polycarbonate bases is less. Consult the factory.

7. Note: Materials other than rubber or polycarbonate, such as polyethylene plastic, are not allowed.

C. Steel Frame: Steel strut, hot-dip galvanized per ASTM A653, 14 gauge strut for C and CE
series, 12 gauge strut for CB and CS series. Struts may be epoxy-coated equal to B-Line’s Dura-Green or Dura-Copper coatings in lieu of galvanizing.

D. Attaching Hardware: Zinc-plated threaded rod, nuts and attaching hardware per ASTM B633.

E. Multi-Pipe/Equipment Support: C-Port single-base C-Series models with 13/16” strut, or dual-base CB-Series “Bridge Type” with 1-5/8” strut. Strut attached to base for fastening of accessories. Select length to suit number of pipes or equipment fastened, allowing 1-inch of space at either end of support.

F. Extendible Height Support: C-Port Model CE10-8, CE10-12, or CE10-16, with 8-inch, 12-inch or 16-inch height to suit application. 13/16” strut for fastening accessories. Two 1/2-inch all-thread rods per 9-inch base (select base length as required), with nuts and washers. Standard load rating is 200 pounds per foot due to point loading at support rods; CLDP10 11-ga. load distribution plates may be used for increased loading. For heavier loads, additional height options and variable angle options, use C-Port CS-Series with B22 channel to field-fabricate an A-frame support for additional stability.

G. Roller Support: C-Port CR-Series with 12-inch overall height, with B3114-3-1/2 pipe roll with sockets, for piping outside diameters up to 3-1/2”. Two 1/2-inch all-thread rods per 9-inch base, with nuts and washers. Standard load rating is 200 pounds per foot due to point loading at support rods; CLDP10 11-ga. load distribution plates may be used for increased loading.

H. Variable Angle/Height Support: C-Port CS-Series with 1-5/8” strut channel, 1/4”-thick x 5-3/4” long adapter leg to accommodate 1-5/8” strut, and connecting hardware.

I. Pipe/conduit clamps shall be channel style, B-Line B2000 or B2400 series or approved equal, made of galvanized steel (or steel with coating to provide equivalent protection for outdoor use). For refrigeration pipes, provide B-Line Vibra-Cushion or Vibra-Clamp internally cushioned clamps. Provide copper plated pipe support where metal is in contact with copper pipe.

J. Provide extendible height supports when spacing above roof, or sloping of pipe to drain, or both, are required.

K. Where piping might be in contact with rubber or plastic materials such as rollers, verify suitability of the material for the piping temperature.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

3.2 INSERTS

A. Provide inserts for placement in concrete formwork.

B. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
C. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches (100 mm).

D. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.

E. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut recessed into and grouted flush with slab.

3.3 PIPE HANGERS AND SUPPORTS

A. Support horizontal piping as scheduled.

B. Install hangers to provide minimum 1/2 inch (13 mm) space between finished covering and adjacent work.

C. Place hangers within 12 inches (300 mm) of each horizontal elbow.

D. Use hangers with 1-1/2 inch (38 mm) minimum vertical adjustment.

E. Support horizontal cast iron pipe adjacent to each hub, with 5 feet (1.5 m) maximum spacing between hangers.

F. Support vertical piping at every floor. Support vertical cast iron pipe at each floor at hub.

G. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.

H. Support riser piping independently of connected horizontal piping.

I. Provide copper plated hangers and supports for copper piping.

J. Design hangers for pipe movement without disengagement of supported pipe.

K. Prime coat exposed steel hangers and supports. Refer to Division 09 Section “Painting”. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.

L. Do not support pipes from other pipes or equipment.

M. Size pipe hangers to accommodate continuous piping insulation.

3.4 EQUIPMENT BASES AND SUPPORTS

A. Provide housekeeping pads of concrete, minimum 4 inches (100 mm) thick and extending 6 inches (150 mm) beyond supported equipment, with 1-inch (25 mm) chamfered edges. Provide dowels to fasten pad to structural floor. Refer to Division 03. Unless otherwise shown or specified, floor-mounted major equipment shall be set on housekeeping pads and anchored to housekeeping pads. This shall include but not be limited to, air handling units, utility set fans, compressors, base mounted pumps, boilers, converters, heat exchangers, storage tanks and expansion tanks.
B. Provide templates, anchor bolts, and accessories for mounting and anchoring equipment.

C. Construct supports of steel members. Brace and fasten with flanges bolted to structure.

D. Provide rigid anchors for pipes after vibration isolation components are installed.

E. Do not support equipment from pipes or from other equipment.

3.5 FLASHING

A. Provide flexible flashing and metal counterflashing where piping and ductwork penetrate weatherproofed or waterproofed walls, floors, and roofs.

B. Flash pipes projecting 3 inches (75 mm) minimum above finished roof surface with lead, 8 inches (200 mm) minimum clear on sides with 24 x 24 inches (600 x 600 mm) sheet size. For pipes through outside walls, turn flanges back into wall and caulk, counterflash with metal, and seal.

C. Provide acoustical lead flashing around ducts and pipes penetrating equipment rooms, installed in accordance with manufacturer's instructions for sound control.

D. Provide curbs for mechanical roof installations 14 inches (350 mm) minimum high above roofing surface. Flash and counterflash with sheet metal; seal watertight. Attach counterflashing mechanical equipment and lap base flashing on roof curbs. Flatten and solder joints.

E. Adjust storm collars tight to pipe with bolts; caulk around top edge. Use storm collars above roof jacks. Screw vertical flange section to face of curb.

3.6 SLEEVES

A. Set sleeves in position in formwork. Provide reinforcing around sleeves.

B. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.

C. Extend sleeves through floors 1 inch (25 mm) above finished floor level. Caulk sleeves.

D. Where piping or ductwork penetrates floor, ceiling, or wall, close off space between pipe or duct and adjacent work with fire stopping insulation and caulk air tight. Provide close fitting metal collar or escutcheon covers at both sides of penetration.

E. Install chrome plated steel escutcheons at finished surfaces.

3.7 SUPPORTS ABOVE ROOF

A. Where possible, support piping and equipment from building structural steel and grillage.

B. Where necessary, use non-penetrating roof-mounted pipe support system.
3.8 NON-PENETRATING ROOF-MOUNTED PIPE SUPPORT SYSTEM

A. Install in accordance with manufacturer’s instructions and recommendations.

B. If roof has stone or gravel ballast, remove ballast around and under pipe support.

C. Consult roofing manufacturer for roof membrane and insulation compression capacities. If necessary, a compatible sheet of roofing material (rubber pad) may be installed under rooftop support to disperse concentrated loads and add further membrane protection.

D. Use properly sized clamps to suit pipe sizes.

3.9 SUPPORTING OTHER TRADES

A. Supports furnished under Division 23 of the Specifications may also be used to support piping furnished under Division 22 “Plumbing” and conduits furnished under Division 26 “Electrical” if this Subcontractor is willing to allow this. Supports shared with other trades shall be designed to accommodate the weight, expansion/contraction, vibration, and other requirements of the other trades’ items without detriment to the function, accessibility, and serviceability of the HVAC items or those of the other trades. Provide flexible sections of piping and conduit as required to allow each trade’s items to expand and contract along with the other trades, and to absorb vibration caused by the other trades.

B. Electrical lighting fixtures and equipment, and architectural items such as ceilings, may not be supported from supports furnished under this Section.

C. Prevent contact between components of other trades, such as architectural suspended ceiling support wires, and HVAC supports which may transmit vibration to the occupied space.

3.10 SCHEDULES

<table>
<thead>
<tr>
<th>PIPE SIZE</th>
<th>HANGER ROD MAX. HANGER SPACING</th>
<th>DIAMETER</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inches</td>
<td>(mm)</td>
<td>Feet</td>
</tr>
<tr>
<td>Steel and Copper Piping</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1/2 to 1-1/4</td>
<td>12 to 32</td>
<td>6.5</td>
</tr>
<tr>
<td>1-1/2 to 2</td>
<td>38 to 50</td>
<td>10</td>
</tr>
<tr>
<td>2-1/2 to 3</td>
<td>62 to 75</td>
<td>10</td>
</tr>
<tr>
<td>4 to 6</td>
<td>100 to 150</td>
<td>10</td>
</tr>
</tbody>
</table>

END OF SECTION 230529
SECTION 230548 – VIBRATION AND SEISMIC CONTROLS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Vibration isolation.

1.2 RELATED SECTIONS

A. Division 03 Section “Cast-in-Place Concrete.”
B. Division 23 Section “Expansion Fittings and Loops for HVAC Piping.”
C. Division 23 Section “Hangers and Supports for HVAC Piping and Equipment.”
D. Division 26 Section “Electrical”: Electrical characteristics and wiring connections.

1.3 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this Section with minimum 3 years’ experience.

1.4 PERFORMANCE REQUIREMENTS

A. Unless otherwise indicated elsewhere in these specifications, provide vibration isolation on motor driven equipment over 0.5 HP (0.35 kW), plus connected piping and ductwork.
B. Provide Minimum Static Deflection of Isolators for Equipment as Indicated:
   1. Under 400 rpm: 3.5 inch (90 mm)
   2. 400 - 600 rpm: 3.5 inch (90 mm)
   3. 600 - 800 rpm: 3.5 inch (90 mm)
   4. 800 - 900 rpm: 2 inch (50 mm)
   5. 1100 - 1500 rpm: 1 inch (25 mm)
   6. Over 1500 rpm: 0.5 inch (12 mm)

1.5 REQUIREMENTS

A. Outdoor Equipment: Provide restraint to withstand the force of a 100 mph wind applied to any exposed surface of the isolated equipment. Provide bolt holes for attachment to equipment and supports.

1.6 SUBMITTALS

A. Submit under provisions of Division 01 Section “Submittal Procedures”.
B. Shop Drawings: Indicate inertia bases and locate vibration isolators, with static and dynamic load on each.
C. Product Data: Provide schedule of vibration isolator type with location and load on each. Indicate static deflection expected under the actual load, and minimum static deflection.

D. Manufacturer's Installation Instructions: Indicate special procedures and setting dimensions.

E. Manufacturer's Certificate: Certify that isolators are properly installed and adjusted to meet or exceed specified requirements.

1.7 PROJECT RECORD DOCUMENTS

A. Submit under provisions of Division 01 Section “Closeout Procedures”.

B. Record actual locations of hangers including attachment points.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Mason Industries, Inc.

B. Amber/Booth Co.

C. Kinetics Noise Control.

D. Korfund Dynamics Corp.

E. Vibration Eliminator Co.

F. Vibration Mountings and Controls, Inc.

2.2 GENERAL

A. Metal parts installed outdoors shall be corrosion resistant after fabrication. Galvanizing shall meet ASTM Salt Spray Test Standards and Federal Test Standard No. 14.

B. Isolator types are scheduled to establish minimum standards. At the Contractor’s option, labor-saving devices may be an integral part of isolators, to provide initial lift of equipment to operating height, to hold piping at fixed elevations during installation and initial filling, and similar installation advantages. Accessories and seismic restraint features shall not degrade the isolation performance of the isolators.

C. Static deflections indicated are the minimum under actual load. Isolators selected solely on the basis of rated deflections are not acceptable.

2.3 VIBRATION ISOLATORS

A. Restrained Spring Isolators:
   1. Spring Isolators:
      a. For Exterior and Humid Areas: Provide hot dipped galvanized housings and neoprene coated springs.
b. Code: Color code springs for load carrying capacity.

2. Springs: Minimum horizontal stiffness equal to 75 percent vertical stiffness, with working deflection between 0.3 and 0.6 of maximum deflection.

3. Spring Mounts: Provide with leveling devices, minimum 0.25 inch (6 mm) thick neoprene sound pads, and zinc chromate plated hardware.

4. Sound Pads: Size for minimum deflection of 0.05 inch (1.2 mm); meet requirements for neoprene pad isolators.

5. Restraint: Provide heavy mounting frame and limit stops.

B. Restrained Closed Spring Isolators:

1. Spring Isolators:
   a. For Exterior and Humid Areas: Provide hot dipped galvanized housings and neoprene coated springs.
   b. Code: Color code springs for load carrying capacity.

2. Type: Closed spring mount with top and bottom housing separated with neoprene rubber stabilizers.

3. Springs: Minimum horizontal stiffness equal to 75 percent vertical stiffness, with working deflection between 0.3 and 0.6 of maximum deflection.

4. Housings: Incorporate neoprene isolation pad meeting requirements for neoprene pad isolators, and neoprene side stabilizers with minimum 0.25 inch (7 mm) clearance and limit stops.

C. Spring Hanger:

1. Spring Isolators:
   a. For Exterior and Humid Areas: Provide hot dipped galvanized housings and neoprene coated springs.
   b. Code: Color code springs for load carrying capacity.

2. Springs: Minimum horizontal stiffness equal to 75 percent vertical stiffness, with working deflection between 0.3 and 0.6 of maximum deflection.


D. Seismic Snubbers:

1. Type: Non-directional and double acting unit consisting of interlocking steel members restrained by neoprene elements.

2. Neoprene Elements: Replaceable, minimum of 0.75 inch (18 mm) thick.

3. Capacity: 4 times load assigned to mount groupings at 0.4 inch (10 mm) deflection.

4. Attachment Points and Fasteners: Capable of withstanding 3 times rated load capacity of seismic snubber.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install isolation for motor driven equipment.

C. Bases:
   1. Set steel bases for 1 inch (25 mm) clearance between housekeeping pad and base.
2. Adjust equipment level.

D. Bolt base-type spring or rubber mounts to the equipment. Bolt to the floor, concrete housekeeping pad, or other support base or frame indicated, unless otherwise indicated.

E. Install spring hangers without binding.

F. On closed spring isolators, adjust so side stabilizers are clear under normal operating conditions.

G. Prior to making piping connections to equipment with operating weights substantially different from installed weights, block up equipment with temporary shims to final height. When full load is applied, adjust isolators to load to allow shim removal.

H. Provide pairs of horizontal limit springs on fans with more than 6.0 inch (1.5 kPa) static pressure, and on hanger supported, horizontally mounted axial fans.

I. Provide resiliently mounted equipment, piping, and ductwork with seismic snubbers. Snub equipment designated for post disaster use to 0.05 inch (1.5 mm) maximum clearance. Other snubbers shall have clearance between 0.15 inch (4 mm) and 0.25 inch (7 mm).

J. Support piping connections to isolated equipment (including equipment which is internally isolated at the factory) resiliently as follows:
   1. Up to 4 Inch (100 mm) Diameter: First three points of support.
   2. 5 to 8 Inch (125 to 200 mm) Diameter: First four points of support.
   3. 10 inch (250 mm) Diameter and Over: First six points of support.
   4. Select three hangers closest to vibration source for minimum 1.0 inch (25 mm) static deflection or static deflection of isolated equipment. Select remaining isolators for minimum 1.0 inch (25 mm) static deflection or 1/2 static deflection of isolated equipment.

K. Connect wiring to isolated equipment with flexible hanging loop.

L. Sheetmetal ducts and air plenums within mechanical rooms or within a distance of 50 feet total duct length of connected vibration isolated equipment (whichever is longer) (including equipment which is internally isolated at the factory) shall be isolated from the building structure by spring hangers.

M. Connect hanger rods for vibration isolated supports to structural beams or joists, not from the floor slab or roof deck between beams and joists. Provide intermediate support members as required.

N. Resiliently isolated pipes shall not contact the building construction or other equipment.

O. No equipment unit shall bear directly on vibration isolators unless its own frame is suitably rigid to span between isolators and such direct support is approved by the equipment manufacturer. This provision shall apply whether or not a base frame is called for on the schedule. In the case that a base frame is required for the unit because of the equipment manufacturer's requirements and is not specifically called for on the equipment schedule, a base frame recommended by the equipment manufacturer shall be provided at no additional expense.

P. Unless otherwise indicated, there shall be a minimum operating clearance of 1-1/2" (37.5 mm) between inertia bases or steel frame bases and the floor beneath the equipment. Position isolator
mounting brackets and adjust isolators so that the required clearance is maintained. Check the clearance space to ensure that no construction debris has been left to short circuit or restrict the proper operation of the vibration isolation system.

Q. If any rotating equipment causes excessive noise or vibration when properly installed on the specified isolators, provide rebalancing, realignment, and/or other remedial work required to reduce noise and vibration levels. Excessive is defined as exceeding the manufacturer’s specifications for the equipment.

3.2 MANUFACTURER’S FIELD SERVICES

A. Examine systems under provisions of Division 01 Section “Quality Requirements”.

B. Inspect isolated equipment after installation and submit report. Include static deflections.

<table>
<thead>
<tr>
<th>ISOLATED EQUIPMENT</th>
<th>BASE Type Thickness</th>
<th>ISOLATOR Type Deflection</th>
</tr>
</thead>
<tbody>
<tr>
<td>HVAC Pumps</td>
<td>Steel support by pump manufacturer</td>
<td>Isolate piping on spring hangers</td>
</tr>
<tr>
<td>Air Handling Units, ceiling hung</td>
<td>Steel frame</td>
<td>Spring hangers, 1.3 in. (32 mm)</td>
</tr>
<tr>
<td>Roof Top Air Conditioning Units</td>
<td>Steel frame integral to unit</td>
<td>Retrained spring Isolators, 2 in. (50 mm)</td>
</tr>
</tbody>
</table>

END OF SECTION 230548
SECTION 230553 – IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Nameplates.
B. Tags.
C. Ceiling Tacks.
D. Labels.
E. Stencils.
F. Pipe Markers.
G. Lockout Devices.

1.2 RELATED SECTIONS

A. Division 09 Section “Painting”: Identification painting.

1.3 REFERENCES

A. Division 01 Section “References”: Requirements for references and standards.

1.4 SUBMITTALS

A. Division 01 Section “Submittal Procedures.”
B. Submit list of wording, symbols, letter size, and color coding for mechanical identification.
C. Submit valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.
D. Product Data: Provide manufacturers catalog literature for each product required.
E. Samples: Submit two tags, 1-1/2 inches (38 mm) in size.
F. Samples: Submit two labels, 1.9 x 0.75 inches (48 x 19 mm) in size.

1.5 PROJECT RECORD DOCUMENTS

A. Submit under Division 01 Section “Closeout Procedures.”
B. Record actual locations of tagged valves; include valve tag numbers.

1.6 OPERATION AND MAINTENANCE DATA

A. Submit under provisions of Division 01 Section “Operation and Maintenance Data.”

B. Include valve tag chart.

1.7 REGULATORY REQUIREMENTS

A. Conform to NFPA 99 requirements for labeling and identification of medical gas piping systems and accessories.

PART 2 - PRODUCTS

2.1 NAMEPLATES

A. Manufacturers:
   1. Seton Identification Products.
   4. No substitutions.

B. Plastic Nameplates: Laminated 3-layer plastic with beveled edges and engraved letters on contrasting background color. 1/16-inch (1.58 mm) thick. Letters shall be black on light backgrounds, or white on dark backgrounds, as applicable. Service temperature range -40 to 175°F (-40 to 79°C); minimum application temperature for adhesive 50°F (10°C). Suitable for average outdoor lifespan of at least 2-3 years.

C. Aluminum Nameplates: For higher temperature applications, and for outdoor applications when manufacturer does not recommend their plastic nameplates for use outdoors, provide aluminum nameplates, with integral anodized or painted surface color coating and natural aluminum engraved letters, 1/32-inch (0.78 mm) thick. Service temperature range -40 to 350°F (-40 to 177°C); minimum application temperature for adhesive 50°F (10°C). Suitable for average outdoor lifespan of at least 2-3 years.

D. Colors: Select background color as appropriate for the application. Color for general applications shall be white (except that aluminum nameplate standard color shall be black). Color for general warnings shall be red or yellow. Colors for fluid services shall comply with ASME A13.1-2007. Comply with ASME/ANSI standards and other regulations as applicable.

E. Provide with factory adhesive, and with side holes for fastener attachment as applicable. Mechanical fasteners are required for applications which are outdoors or otherwise exposed to weather or sunlight, or in moist areas such as kitchens and locker rooms, or on cooled surfaces subject to condensation, or on surfaces with operating temperatures above 150°F (65°C). Where nameplate is on an irregular surface and cannot make complete contact, provide mechanical fasteners or ties in addition to adhesive.
2.2 TAGS

A. Plastic Tags:
   1. Manufacturers:
      a. Seton Identification Products.
      b. E.R. Perry Signs & Engraving.
      d. No substitutions.
   2. Laminated three-layer plastic with engraved black letters on light contrasting background color. Tag size minimum 1-1/2 inches (38 mm) diameter.

B. Metal Tags:
   1. Manufacturers:
      a. Seton Identification Products.
      b. Brady Worldwide, Inc.
      d. No substitutions.
   2. Brass with stamped letters; tag size minimum 1-1/2 inches (38 mm) diameter with smooth edges.

C. Information Tags:
   1. Manufacturer: Seton Identification Products.
   2. Clear plastic with printed "Danger," "Caution," or "Warning" and message; size 3-1/4 x 5-5/8 inches (83 x 143 mm) with grommet and self-locking nylon ties.

D. Tag Chains and Hooks: Brass or stainless steel compatible with tag material for general applications. Brass where in contact with copper piping or other copper-alloy materials.

E. Tag Chart: Typewritten letter size list in anodized aluminum frame with plexiglass cover.

2.3 CEILING TACKS

A. Manufacturer: Seton Identification Products.

B. Description: Steel with 3/4 inch (19 mm) diameter color coded head.

C. Color code as follows:
   1. HVAC Equipment: Yellow.
   2. Fire Dampers/Smoke Dampers: Red.

2.4 LABELS

A. Manufacturer: Seton Identification Products.

B. Description: Polyester, size 1.9 x 0.75 inches (48 x 19 mm), adhesive backed with printed identification.
2.5 STENCILS

A. Manufacturers:
   1. Seton Identification Products.

B. Stencils: With clean cut symbols and letters of following size:
   1. Up to 2 inch (51 mm) Outside Diameter of Insulation or Pipe: 1/2 inch (13 mm) high letters.
   2. 2-1/2 to 6 inches (64-150 mm) Outside Diameter of Insulation or Pipe: 1 inch (25 mm) high letters.
   3. Over 6 inches (150 mm) Outside Diameter of Insulation or Pipe: 1-3/4 inches (44 mm) high letters.

C. Stencil Paint: As specified in Division 09 Section “Painting”, semi-gloss enamel, colors and lettering size conforming to ASME A13.1.

2.6 PIPE MARKERS


B. Plastic Pipe Markers:
   1. Manufacturers:
      a. Seton Identification Products.
      b. Brady Worldwide, Inc.
      d. No substitutions.
   2. Factory fabricated, flexible, semi-rigid plastic, preformed to fit around pipe or pipe covering. Larger sizes may have maximum sheet size with spring fastener.

C. Plastic Underground Pipe Markers:
   1. Manufacturers:
      a. Seton Identification Products.
      b. Brady Worldwide, Inc.
      d. No substitutions.
   2. Bright colored continuously printed plastic ribbon tape, minimum 6 inches (150 mm) wide by 4 mil (0.10 mm) thick, manufactured for direct burial service.

2.7 LOCKOUT DEVICES

A. Lockout Hasps:
   1. Manufacturers:
      a. Seton Identification Products.
      b. Brady Worldwide, Inc.
      c. Master Lock.
   2. Anodized aluminum hasp with erasable label surface; size minimum 7-1/4 x 3 inches (184 x 76 mm).
B. Valve Lockout Devices:
   1. Manufacturers:
      a. Seton Identification Products.
      b. Brady Worldwide, Inc.
      c. Master Lock.
   2. Nylon device preventing access to valve operator, accepting lock shackle.

PART 3 - EXECUTION

3.1 PREPARATION
   A. Degrease and clean surfaces to receive adhesive for identification materials.
   B. Prepare surfaces in accordance with Division 09 Section “Painting” for stencil painting.

3.2 INSTALLATION
   A. Division 01 Section “Quality Requirements”: Manufacturer's instructions.
   B. Install identifying devices after completion of coverings and painting.
   C. Install plastic or aluminum engraved nameplates with corrosion-resistant mechanical fasteners, or adhesive, as specified. In outdoor locations, where lifetime of nameplates is limited, fasteners shall be removable screws or bolts for ease of nameplate replacement.
   D. Install labels with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer. For unfinished canvas covering, apply paint primer before applying labels.
   E. Install tags using corrosion resistant chain. Number tags consecutively by location.
   F. Apply stencil painting in accordance with Division 09 Section “Painting.”
   G. Identify items of mechanical equipment such as fans, terminal units, air handling units, pumps, heat transfer equipment, tanks, and water treatment devices with plastic nameplates. Small devices, such as in-line pumps, may be identified with tags.
   H. Identify control panels and major control components outside panels with plastic nameplates.
   I. Identify valves in main and branch piping with metal tags.
   J. Tag automatic controls, instruments, and relays. Key to control schematic.
   K. Identify piping, concealed or exposed, with plastic pipe markers. Use tags on piping 3/4 inch (20 mm) diameter and smaller. Identify service, flow direction, and pressure. Install in clear view and align with axis of piping. Locate identification not to exceed 20 feet (6 m) on straight runs including risers and drops, at each branch and riser take-off, adjacent to each valve and tee, at each side of penetration of structure or enclosure, and at each obstruction.
   L. Identify ductwork with stenciled painting. Identify with air handling unit identification number
and area served. Locate identification at air handling unit, at each side of penetration of structure or enclosure, and at each obstruction.

M. Identify duct access doors at fire dampers, smoke dampers, and smoke detectors with 1/2-inch (12.7 mm) lettering to indicate the fire protection device(s) within, in accordance with NFPA 90A.

N. Provide ceiling tacks to locate valves, dampers and equipment above T-bar type panel ceilings. Locate in corner of panel closest to equipment.

O. Secure valve tag chart on an easily accessible wall in the mechanical room or in a location as otherwise directed by the Architect.

3.3 COORDINATION WITH EXISTING EQUIPMENT

A. Where an existing equipment identification system is involved, the new system shall be coordinated and compatible with the existing system.

END OF SECTION 230553
SECTION 230593 – TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Testing, Adjustment, and Balancing of Air Systems.
C. Measurement of Final Operating Condition of HVAC Systems.

1.2 RELATED SECTIONS

A. Division 01 Section “Quality Requirements”: Testing laboratory services: Employment of testing agency and payment for services.

1.3 REFERENCES

A. AABC - National Standards for Total System Balance.
B. ADC - Test Code for Grilles, Registers, and Diffusers.

1.4 SUBMITTALS

A. Submit under provisions of Division 01 Section “Submittal Procedures.”
B. Submit name of Testing, Adjusting, and Balancing (TAB) Agency for approval within 14 days after award of Contract.
C. Design Review Reports:
   1. Submit prior to commencement of construction under provisions of Division 01 Section “Quality Requirements.”
   2. Review the Contract Documents, and indicate deficiencies in systems that would prevent proper testing, adjusting, and balancing of systems and equipment to achieve specified performance.
D. Preliminary Report Submittals:
   1. Prior to commencing work of this Section, and no more than 14 days after approval of TAB Agency submittals, submit report forms or outlines indicating adjusting, balancing, and equipment data required, with columns of design data filled in. By means of plan views, equipment profiles, and similar graphical descriptions, indicate where
measurements will be taken.

2. Submit the procedures to be used.

E. Field Reports: Submit draft copies of report for review prior to final acceptance of Project. Provide final copies for Architect/Engineer and for inclusion in operating and maintenance manuals.

F. Provide reports in letter size, 3-ring binder manuals, complete with index page and indexing tabs, with cover identification at front and side. Include set of reduced drawings with air outlets and equipment identified to correspond with data sheets, and indicating thermostat locations.

G. Include detailed procedures, agenda, sample report forms and copy of AABC National Project Performance Guaranty prior to commencing system balance.

H. Test Reports: Indicate data on AABC National Standards for Total System Balance forms, or forms prepared following ASHRAE 111, or NEBB forms, or forms containing information indicated in Schedules.

1.5 QUALITY ASSURANCE

A. Perform total system balance in accordance with AABC National Standards for Field Measurement and Instrumentation, Total System Balance; or ASHRAE 111; or NEBB Procedural Standards for Testing, Balancing and Adjusting of Environmental Systems.

1.6 QUALIFICATIONS

A. Agency: Company specializing in the testing, adjusting, and balancing of systems specified in this Section with minimum 3 years’ experience and certified by AABC or NEBB, or equivalent experience which would qualify for membership in these testing organizations. Agency shall be one of those listed under paragraph 3.01 AGENCIES in this Section.

B. Perform Work under supervision of AABC Certified Test and Balance Engineer, NEBB Certified Testing, Balancing and Adjusting Supervisor, or registered Professional Engineer experienced in performance of this Work and licensed at the place where the Project is located.

C. Certification by the National Balancing Council (NBC) (an affiliate of the National Comfort Institute (NCI)) will not be allowed as a substitute for the specified qualifications.

D. The approved Agency shall be in no way affiliated with the installing Subcontractor.

1.7 SEQUENCING

A. Sequence work under the provisions of Division 01 Section “Summary.”

B. Sequence work to commence after completion of systems or portions of work, and schedule completion of work before Substantial Completion of Project.

1.8 SCHEDULING

A. Schedule and provide assistance in final adjustment and test of life safety system with Fire Authority.
PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 AGENCIES

A. Tekon Technical Consultants, Rochester, NH. Contact: Charles Corlin, (603) 335-3080.

B. Whitetail Air Balance LLC, Lisbon, ME. Contact: Jim Davis, (207) 577-9292.


E. No Substitutions.

3.2 EXAMINATION

A. Verify that systems are complete and operating correctly in accordance with sequence of operations before commencing work. Ensure the following conditions:
   1. Systems are started and operating in a safe and normal condition.
   2. Temperature control systems are installed complete and operable.
   3. Proper thermal overload protection is in place for electrical equipment.
   4. Final filters are clean and in place. If required, install temporary media in addition to final filters.
   5. Duct systems are clean of debris.
   6. Fans are rotating correctly.
   7. Fire and volume dampers are in place and open.
   8. Air coil fins are cleaned and combed.
   9. Access doors are closed and duct end caps are in place.
  10. Air outlets are installed and connected.
  11. Duct system leakage is minimized.
  12. Hydronic systems are flushed, filled, and vented.
  13. Pumps are rotating correctly.
  14. Proper strainer baskets are clean and in place.
  15. Service and balance valves are open.

B. Submit field reports. Report to the responsible Subcontractors, defects and deficiencies noted during performance of services which prevent system balance. Submit list of locations where the Contractor needs to provide additional balancing devices.

C. Beginning of work means acceptance of existing conditions.

3.3 PREPARATION

A. Provide instruments required for testing, adjusting, and balancing operations. Make instruments available to Architect/Engineer to facilitate spot checks during testing.
3.4 INSTALLATION TOLERANCES

A. Air Handling Systems: Adjust to within plus or minus 5 percent of design for supply systems and plus or minus 5 percent of design for return and exhaust systems.

B. Air Outlets and Inlets: Adjust total to within plus 10 percent and minus 5 percent of design to space. Adjust outlets and inlets in space to within plus or minus 10 percent of design.

C. Hydronic Systems: Adjust to within plus or minus 10 percent of design.

3.5 ADJUSTING

A. Ensure recorded data represents actual measured or observed conditions.

B. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.

C. After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.

D. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.

E. For belt driven equipment, provide sheave and belt modifications and/or replacements as required to ensure design flow rates as specified. Variable-frequency drives shall generally be at full speed, or between 60 Hz (full speed) and 55 Hz, and may only be adjusted lower as specified (for example, if other Sections require that some speed be reserved to compensate for air filter loading).

3.6 AIR SYSTEM PROCEDURE

A. Adjust air handling and distribution systems to provide design supply, return, and exhaust air quantities.

B. Make air quantity measurements in ducts by Pitot tube traverse of entire cross sectional area of duct.

C. Measure air quantities at air inlets and outlets.

D. Adjust distribution system to obtain uniform space temperatures free from objectionable drafts and noise.

E. Use volume control devices to regulate air quantities only to extent that adjustments do not create objectionable air motion or sound levels. Effect volume control by duct internal devices such as dampers and splitters.

F. Vary total system air quantities by adjustment of fan speeds. Vary branch air quantities by damper regulation.

G. Provide system schematic (in floor plan view) with required and actual air quantities recorded at each outlet or inlet.
H. Measure static air pressure conditions on air supply units, including filter and coil pressure drops, and total pressure across the fan. Make allowances for 50 percent loading of filters. Provide equipment diagram indicating internal components and measurement points.

I. Adjust outside air automatic dampers, outside air, return air, and exhaust dampers for design conditions. Adjust at minimum position and maximum position, and use manual dampers and actuator limit stops to minimize differences.

J. Measure temperature conditions across outside air, return air, and exhaust dampers to check leakage.

K. Where modulating dampers are provided, take measurements and balance at extreme conditions. Balance variable volume systems at maximum air flow rate, full cooling, and at minimum air flow rate, full heating.

L. Measure building static pressure and adjust supply, return, and exhaust air systems to provide required relationship between each to maintain approximately 0.05 inches (12.5 Pa) positive static pressure near the building entries.

M. Where available fan capacity is less than total flow requirements of individual system parts (due to system diversity), full flow in one part may be simulated by temporary restriction of flow to other parts.

N. Coordinate with Division 23 Section “Instrumentation and Controls for HVAC” for calibration of air handling units’ airflow monitoring stations. Calibrate airflow monitoring stations to ensure that airflow readings from airflow monitoring stations correspond with actual airflows.

O. Coordinate with Division 23 Section “Instrumentation and Controls for HVAC” for calibration of air handling units’ static pressure sensors and determination of pressure setpoints.

P. Set pattern-control vanes and other devices in air inlets and outlets to provide the spread and throw patterns indicated, without objectionable noise or air motion to the occupants. Split the flow of linear slot diffusers in directions as required for good coverage. At completion, patterns shall be uniform and pleasing to the eye.

3.7 WATER SYSTEM PROCEDURE

A. Adjust water systems to provide required or design quantities.

B. Use calibrated Venturi tubes, orifices, or other metered fittings and pressure gauges to determine flow rates for system balance. Where flow metering devices are not installed, base flow balance on temperature difference across various heat transfer elements in the system.

C. Adjust systems to provide specified pressure drops and flows through heat transfer elements prior to thermal testing. Perform balancing by measurement of temperature differential in conjunction with air balancing.

D. Effect system balance with automatic control valves fully open to heat transfer elements.

E. Effect adjustment of water distribution systems by means of balancing cocks, valves, and fittings. Do not use service or shut-off valves for balancing.
F. Where available pump capacity is less than total flow requirements of individual system parts (due to system diversity), full flow in one part may be simulated by temporary restriction of flow to other parts.

G. Coordinate with Division 23 Section “Instrumentation and Controls for HVAC” for calibration of pump static pressure sensors and determination of pressure setpoints.

H. When the available pump head is more than 15% above the required head to meet the design flow, trim the pump impeller to bring the head within 100 to 110 percent of the required head to meet the design flow. At least one balancing valve in the system, and one balancing valve per each multi-circuit sub-main branch served by a branch balancing valve, shall be fully open when balancing is complete.

3.8 COORDINATION OF SERVICES

A. The General Contractor and his Subcontractors shall be responsible for providing the following assistance to the TAB Agent:
   1. Provide access to the Contractor’s on site ladders and man-lifts as required to allow access to required equipment by the TAB Agent.
   2. Keep the TAB Agent informed of the project schedule and ensure that adequate notice is given to the TAB Agent to allow for the proper testing, adjusting and balancing of mechanical systems before ceilings are flooded or access to systems is otherwise obstructed.
   3. Ensure that adequate time is allotted in the project schedule to allow for the proper testing, adjusting and balancing of the mechanical systems.
   4. Coordinate with the TAB Agent to correct system deficiencies that are discovered by the TAB Agent. Notify the TAB Agent once system deficiencies are corrected.

3.9 PROJECT CLOSEOUT

A. At final inspection, recheck random selections of data recorded in report. Recheck points or areas as selected and witnessed by the Architect.

B. Check and adjust systems approximately 6 months after final acceptance and submit report.

C. Retests: If random tests elicit a measured flow deviation of 10 percent or more from that recorded in the certified report listings, at 10 percent or more of the rechecked selections, the report shall be automatically rejected. In the event the report is rejected, systems shall be readjusted and tested, new data recorded, new certified reports submitted, and new inspection tests made.

3.10 SCHEDULES

A. Equipment Requiring Testing, Adjusting, and Balancing:
   1. HVAC Pumps
   2. Air Cooled Refrigerant Condensing Units
   3. Roof Top Air Conditioning Units
   4. Air Coils
   5. Terminal Heat Transfer Units
   6. Air Handling Units
   7. Blower Coil Units
8. Fans
9. Air Filters
10. Air Inlets and Outlets

B. Report Forms:
1. Title Page:
   a. Name of Testing, Adjusting, and Balancing Agency
   b. Address of Testing, Adjusting, and Balancing Agency
   c. Telephone number of Testing, Adjusting, and Balancing Agency
   d. Project name
   e. Project location
   f. Project Architect
   g. Project Engineer
   h. Project Contractor
   i. Project altitude
   j. Report date
2. Summary Comments:
   a. Design versus final performance
   b. Notable characteristics of system
   c. Description of systems operation sequence
   d. Summary of outdoor and exhaust flows to indicate amount of building pressurization
   e. Nomenclature used throughout report
   f. Test conditions
3. Instrument List:
   a. Instrument
   b. Manufacturer
   c. Model number
   d. Serial number
   e. Range
   f. Calibration date
4. Electric Motors:
   a. Manufacturer
   b. Model/Frame
   c. HP/BHP
   d. Phase, voltage, amperage; nameplate, actual
   e. RPM
   f. Service factor
   g. Starter size, rating, heater elements
   h. Variable frequency drive make, model, ratings, settings
   i. Sheave Make/Size/Bore
5. V-Belt Drive:
   a. Identification/location
   b. Required driven RPM
   c. Driven sheave, diameter and RPM
   d. Belt, size and quantity
   e. Motor sheave diameter and RPM
   f. Center to center distance, maximum, minimum, and actual
6. Pump Data:
   a. Identification/number
b. Manufacturer
c. Size/model
d. Impeller
e. Service
f. Design flow rate, pressure drop, BHP
g. Actual flow rate, pressure drop, BHP
h. Discharge pressure
i. Suction pressure
j. Total operating head pressure
k. Shut off, discharge and suction pressures
l. Shut off, total head pressure

7. Heat Exchanger:
   a. Identification/number
   b. Location
   c. Service
d. Manufacturer
e. Model number
f. Serial number
g. Steam pressure, design and actual
h. Primary water entering temperature, design and actual
i. Primary water leaving temperature, design and actual
j. Primary water flow, design and actual
k. Primary water pressure drop, design and actual
l. Secondary water leaving temperature, design and actual
m. Secondary water leaving temperature, design and actual
n. Secondary water flow, design and actual
o. Secondary water pressure drop, design and actual

8. Cooling Coil Data:
   a. Identification/number
   b. Location
c. Service
d. Manufacturer
e. Air flow, design and actual
f. Entering air DB temperature, design and actual
g. Entering air WB temperature, design and actual
h. Leaving air DB temperature, design and actual
i. Leaving air WB temperature, design and actual
j. Water flow, design and actual
k. Water pressure drop, design and actual
l. Entering water temperature, design and actual
m. Leaving water temperature, design and actual
n. Saturated suction temperature, design and actual
o. Air pressure drop, design and actual

9. Heating Coil Data:
   a. Identification/number
   b. Location
c. Service
d. Manufacturer
e. Air flow, design and actual
f. Water flow, design and actual
g. Water pressure drop, design and actual
h. Entering water temperature, design and actual
i. Leaving water temperature, design and actual
j. Entering air temperature, design and actual
k. Leaving air temperature, design and actual
l. Air pressure drop, design and actual

10. Air Moving Equipment:
a. Location
b. Manufacturer
c. Model number
d. Serial number
e. Arrangement/Class/Discharge
f. Air flow, specified and actual
g. Return air flow, specified and actual
h. Outside air flow, specified and actual
i. Total static pressure (total external), specified and actual
j. Inlet pressure
k. Discharge pressure
l. Sheave Make/Size/Bore
m. Number of Belts/Make/Size
n. Fan RPM

11. Return Air/Outside Air Data:
a. Identification/location
b. Design air flow
c. Actual air flow
d. Design return air flow
e. Actual return air flow
f. Design outside air flow
g. Actual outside air flow
h. Return air temperature
i. Outside air temperature
j. Required mixed air temperature
k. Actual mixed air temperature
l. Design outside/return air ratio
m. Actual outside/return air ratio

12. Exhaust Fan Data:
a. Location
b. Manufacturer
c. Model number
d. Serial number
e. Air flow, specified and actual
f. Total static pressure (total external), specified and actual
g. Inlet pressure
h. Discharge pressure
i. Sheave Make/Size/Bore
j. Number of Belts/Make/Size
k. Fan RPM

13. Duct Traverse:
a. System zone/branch
b. Duct size
c. Area
d. Design velocity
e. Design air flow
f. Test velocity
g. Test air flow
h. Duct static pressure
i. Air temperature
j. Air correction factor

14. Air Monitoring Station Data:
   a. Identification/location
   b. System
c. Size
d. Area
e. Design velocity
f. Design air flow
g. Test velocity
h. Test air flow

15. Air Distribution Test Sheet:
   a. Air terminal number
   b. Room number/location
c. Terminal type
d. Terminal size
e. Area factor
f. Design velocity
g. Design air flow
h. Test (final) velocity
i. Test (final) air flow
j. Percent of design air flow
k. Damper position (full open, adjusted)

END OF SECTION 230593
SECTION 230713 – DUCT INSULATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Ductwork Insulation.
B. Duct Liner.
C. Sound Lagging Insulation.
D. Insulation jackets.

1.2 RELATED SECTIONS

A. Division 09 Section “Painting”: Painting insulation jackets.
B. Division 23 Section “Identification for HVAC Piping and Equipment.”
C. Division 23 Section “Metal Ducts”: Factory-insulated flexible ductwork.
D. Division 23 Section “Metal Ducts”: Ductwork.

1.3 REFERENCES

A. Division 01 Section “References”: Requirements for references and standards.


W. NAIMA - National Insulation Standards.


Y. SMACNA - HVAC Duct Construction Standards - Metal and Flexible.

Z. UL 94 - Tests for Flammability of Plastic Materials for Parts in Devices and Appliances.

AA. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials.

1.4 SUBMITTALS

A. Division 01 Section “Submittal Procedures”.

B. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.
1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this Section with minimum 3 years’ experience.

B. Applicator Qualifications: Company specializing in performing the work of this Section with minimum 3 years’ experience.

1.6 REGULATORY REQUIREMENTS

A. Materials: Flame spread/smoke developed rating of 25/50 in accordance with ASTM E84, NFPA 255 and UL 723. For elastomeric foam insulation, rating shall apply for thicknesses up to 2 inches (50 mm).

B. Insulation materials shall be asbestos free. No fibers with dimensions similar to asbestos fibers shall be released from any material.

1.7 DELIVERY, STORAGE, AND PROTECTION

A. Division 01 Section “Product Requirements”: Transport, handle, store, and protect products.

B. Accept materials on site in original factory packaging, labeled with manufacturer's identification, including product density and thickness.

C. Protect insulation from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original wrapping.

1.8 ENVIRONMENTAL REQUIREMENTS

A. Division 01 Section “Product Requirements”: Environmental conditions affecting products on site.

B. Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics, and insulation cements.

C. Maintain temperature during and after installation for minimum period of 24 hours.

1.9 EXISTING DUCTWORK

A. Insulate existing ductwork as indicated on the Drawings. Contractor shall be responsible to field-verify quantities and sizes. Provide access to existing ductwork as required for complete insulation. Remove existing finishes and existing insulation as required.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Glass and Mineral Fiber Products:
   1. Knauf Insulation.
   2. Certainteed Corporation.
4. Owens Corning.
5. No substitutions.

B. Polyisocyanurate Foam Board Products:
1. The Dow Chemical Company.
3. Rmax, Inc.

C. Sound Lagging Insulation:
1. Sound Seal - Industrial Division Lag Series.

D. Glass Fiber Insulation Sealing Tapes:
1. Venture Tape Corporation.
2. 3M Company.
3. Ideal Tape Co., division of American Biltrite Inc.
4. Nashua Tape Products, division of Berry Plastics Corp.
5. No substitutions.

E. Accessories:
2. Foster Products, division of Specialty Construction Brands, Inc., a subsidiary of H.B. Fuller (mastics, sealants, reinforcing membranes, and accessories).

2.2 GLASS FIBER, FLEXIBLE

A. Insulation: ASTM C553; flexible, noncombustible blanket.
1. 'K' ('Ksi') value: ASTM C518, 0.27 at 75°F (0.039 at 24°C).
2. Maximum service temperature: 250°F (121°C) faced and 350°F (176°C) unfaced.
3. Maximum moisture absorption: 0.20 percent by volume.
4. Minimum density: 1.0 lb/cu.ft (16 kg/m³).

B. Vapor Barrier Jacket:
1. ASTM C1136, Kraft paper reinforced with glass fiber yarn and bonded to vapor barrier film. Facing as required for the application. Integral staple flap on one edge.
   b. White Faced: PSK (polypropylene-scrim-kraft) construction.
2. Moisture vapor transmission: ASTM E96; 0.02 perm.
3. Suitable for insulation surface temperatures up to 150°F (66°C).
4. Overlap longitudinal laps and butt strips.
5. Secure with outward clinch expanding staples and vapor barrier mastic and pressure sensitive tape.
C. Vapor Barrier Tape: See article “Glass Fiber Insulation Sealing Tape” in this Section.

D. Outdoor Vapor Barrier Mastic: Vinyl emulsion type acrylic or mastic, compatible with insulation, black color.

E. Tie Wire: Annealed steel, 16 gage (1.5 mm).

2.3 GLASS FIBER, RIGID

A. Insulation: ASTM C612; rigid, noncombustible blanket. Supplied in board form.
   1. 'K' ('Ksi') value: ASTM C518, 0.24 at 75°F (0.036 at 24°C).
   3. Maximum moisture absorption: 1.0 percent by volume.
   4. Density: 3.0 lb/cu ft (48 kg/cu m).

B. Vapor Barrier Jacket:
   1. ASTM C1136, kraft paper reinforced with glass fiber yarn and bonded to aluminized film. Facing as required for the application.
      a. Aluminum Faced: FSK (foil-scrim-kraft) construction
      b. White Faced: ASJ (all-service jacket) construction.
   2. Moisture vapor transmission: ASTM E96; 0.02 perm.
   3. Suitable for insulation surface temperatures up to 150°F (66°C).
   4. Overlap longitudinal laps and butt strips.
   5. Secure insulation with mechanical fasteners to substrate, and seal jacket with pressure sensitive tape.

C. Vapor Barrier Tape: See article “Glass Fiber Insulation Sealing Tape” in this Section.

D. Indoor Vapor Barrier Finish:
   1. Cloth: Untreated; 9 oz/sq yd (305 g/sq m) weight, glass fabric.
   2. Vinyl emulsion type acrylic, compatible with insulation, [black] [white] color.

2.4 GLASS FIBER, SEMI-RIGID

A. Insulation: ASTM C612; semi-rigid, noncombustible blanket, with fibers oriented perpendicular to insulation surface to provide compressive strength while maintaining flexibility. Supplied in roll form, suitable for application on rounded shapes such as pipes, tanks, ducts, vessels, and other similar round and irregular shapes.
   1. 'K' ('Ksi') value: ASTM C518, 0.24 at 75°F (0.036 at 24°C).
   3. Maximum moisture absorption: 1.0 percent by volume.
   4. Density: 2.5 lb/cu ft (40 kg/cu m).

B. Vapor Barrier Jacket:
   1. ASTM C1136, kraft paper with glass fiber yarn and bonded to aluminized film. Facing as required for the application.
      a. Aluminum Faced: FSK (foil-scrim-kraft) construction
      b. White Faced: ASJ (all-service jacket) construction.
   2. Moisture vapor transmission: ASTM E96; 0.02 perm.
   3. Suitable for insulation surface temperatures up to 150°F (66°C).
   4. Overlap longitudinal laps and butt strips.
5. Secure with outward clinch expanding staples and vapor barrier mastic and pressure sensitive tape.

C. Vapor Barrier Tape: See article “Glass Fiber Insulation Sealing Tape” in this Section.

D. Indoor Vapor Barrier Finish:
1. Cloth: Untreated; 9 oz/sq yd (305 g/sq m) weight, glass fabric.
2. Vinyl emulsion type acrylic, compatible with insulation, [black] [white] color.

2.5 GLASS FIBER, PREFORMED PIPE COVERING

A. Insulation: ASTM C547; rigid molded, noncombustible.
1. ‘K’ (‘Ksi’) value: ASTM C177, 0.24 Btu-in/(hr-sq.ft-°F) at 75°F (0.035 W/m-K at 24°C).
3. Maximum moisture absorption: 0.2 percent by volume.

B. Vapor Barrier Jacket:
1. ASTM C1136, White kraft paper with glass fiber yarn, bonded to aluminized film.
2. Moisture vapor transmission: ASTM E96; 0.02 perm-inches.

C. Vapor Barrier Lap Adhesive: Compatible with insulation.

D. Vapor Barrier Tape: Provide self-adhesive butt strips furnished by the insulation manufacturer, with finish to match the insulation outer finish.

E. Insulating Cement/Mastic: ASTM C195; hydraulic setting on mineral wool.

F. Indoor Vapor Barrier Finish:
1. Cloth: Untreated; 9 oz/sq yd (305 g/sq m) weight.
2. Vinyl emulsion type acrylic, compatible with insulation, white color.

G. Insulating Cement: ASTM C449/C449M.

2.6 GLASS FIBER INSULATION SEALING TAPE

A. Self-adhesive tape with integral vapor barrier, pressure sensitive acrylic-based or rubber-based adhesive, and release liner strip. Width 3 in. (76 mm) nominal.

B. Manufactured by VentureTape, by the insulation manufacturer, or by one of the other tape manufacturers listed in the article “Manufacturers” in this Section.

C. Types:
1. For rigid and semi-rigid insulations, tape shall be reinforced type. For flexible “duct wrap” insulation, tape shall be either reinforced or non-reinforced.
2. White or aluminum outer surface to match the insulation.
3. Reinforced: Kraft paper reinforced with glass fiber yarn and bonded to vapor barrier layer.
   a. Aluminum Finish with FSK: VentureTape 1525CW.
   b. White Finish with ASJ: VentureTape 1540CW
   c. White Finish with PSK: VentureTape 1531CW.
4. Non-Reinforced: Foil insulation tape. Dead-soft temper 2 mil (0.05 mm) thick aluminum foil, without reinforcement. Hand-tearable.
   a. Venture Tape 3520CW.

5. Performance:
   a. Peel Adhesion: PSTC-101 with 20 minute dwell, 45 oz/in. (12.5 N / 25 mm).
   b. Shear Adhesion: PSTC-107, 2.2 psi (15.2 kPa) after 24 hours.
   c. Tensile Strength: PSTC-131:
      1) Reinforced Types: 40 lb/in. (180.8 N / 25 mm).
      2) Non-reinforced Types: 21 lb/in. (94.9 N / 25 mm).
   d. Elongation: PSTC 131, 6 percent maximum.
   e. Service Temperature: -40 to 240°F (-40 to 116°C).
   f. UL 723 listed or classified (flame/smoke rating).

2.7 POLYISOCYANURATE FOAM DUCT BOARD FOR OUTDOOR USE

A. General: Due to its high flame/smoke ratings, polyisocyanurate foam board may only be used outdoors, which means outside the building envelope and includes above roofs. It must be protected from weather with a watertight, UV-resistant jacketing or membrane system as specified. It must be protected from exposure to fire hazards indoors with continuous building construction such as metal roof deck, sealed smoke-tight, and in accordance with the manufacturer’s requirements. The duct must be fire-resistant metal (galvanized steel or stainless steel), and must be sealed airtight before insulating.

B. Approved Products:
   1. Dow Chemical Co.: Thermax Heavy-Duty.
   3. RMax: Thermasheath-3.

C. Insulation: ASTM C 1289, Type I, Class 2, foil-faced, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, per ASTM E84.
   1. 'K' ('Ksi') value: ASTM C518; 0.169 Btu-in/(h-ft²-ºF) at 75ºF (0.03 W/m-K at 24ºC).
   5. Moisture vapor transmission: ASTM E96; 1.0 perm (85 ng/(s-m-Pa)).
   7. Density: ASTM D1622, 2.0 lb/cu ft (32 kg/cu m).
   8. Compressive Strength: 25 psi (172 kPa) at 10% deformation.
   9. Accessories:
      b. Fastening Pins: Cupped head type with no protruding points, may be welded or bonded with field-applied adhesive. Self-adhesive peel-and-stick type is not allowed.

D. Jacket:
   1. Manufacturers:
      a. Venture Tape Corporation - VentureClad Plus 1579CW.
   2. Heavy-duty zero permeability, absolute weather and vapor barrier for insulation cladding and jacketing applications. 13 ply, self adhesive material. Maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E 84.
3. Material Thickness, PSTC-133:
   a. Flat: 15.5 mils (0.39 mm).
   b. Embossed: 24.0 mils (0.61 mm).
4. Peel Adhesion: PSTC-101, 20 minute dwell, 100 oz/inch width (27.7 N/25 mm).
5. Tensile Strength: PSTC-131, 188 lbs/inch width (330 N/25 mm).
6. Elongation: PSTC-131, 33%.
8. Emittance: ASTM C1371, 0.03.
9. Permeability: ASTM E 96, 0.00 perms.
10. Service Temperature: -40 to 248°F (-40 to 120°C).
12. Materials and installation shall maintain the roofing warranty.

2.8 GLASS FIBER DUCT LINER, RIGID BOARD

   A. Insulation: ASTM C612; rigid, noncombustible board with acrylic polymer impregnated surface and edge coat meeting ASTM G21.
      1. 'K' ('Ksi') value, ASTM C1071 or ASTM C518: Maximum 0.23 at 75ºF (0.032 at 24ºC).
      3. Maximum velocity on coated air side: 5,000 fpm (25.4 m/s).
      4. Density: 3.0 lb/cu ft (48 kg/cu m).
      5. Minimum sound absorption coefficients, ASTM C423, Type A mounting:
         a. 250 Hz center band frequency: 0.24 for 1 inch (25 mm) thickness, 0.41 for 1-1/2 inches (40 mm) thickness, 0.67 for 2 inch (50 mm) thickness.
         b. 500 Hz center band frequency: 0.56 for 1 inch (25 mm) thickness, 0.89 for 1-1/2 inches (40 mm) thickness, 1.07 for 2 inch (50 mm) thickness.
         c. NRC: 0.65 for 1 inch (25 mm) thickness.

   B. Adhesive: Waterproof, ASTM E162 fire-retardant type.


2.9 SOUND LAGGING INSULATION

   A. Acoustical lagging and thermal insulation, in blanket form shipped in rolls, consisting of a loaded vinyl noise barrier with a scrim-reinforced aluminum foil vapor retarder facing on one side, with a quilted fiberglass decoupler. Service temperatures: -10 to 180ºF (-23 to 82ºC) for outer lag layer, -20 to 350ºF (-28 to 176ºC) for decoupler layer. Thermal insulation values: R-factor 1.0 h-ft²-°F/Btu (0.176 m²-K/W) for outer lag layer, 4.0 h-ft²-°F/Btu-inch (0.704 m-K/W) for decoupler layer. Passes UL-94. Class A flame/smoke rating 25/50 or better per ASTM E-84.

   B. Model B-20 LAG/QFA-3: Sound transmission class (STC) 32 per ASTM E90, 2 lb/sq.ft (9.76 kg/m2) lag layer, 0.2 lb/sq.ft (0.98 kg/m2) decoupler layer, 0.23-inch (5.8 mm) thick lag layer, 1-inch (25 mm) nominal thickness decoupler layer.

   C. Model B-20 LAG/QFA-9: Sound transmission class (STC) 34 per ASTM E90, 2 lb/sq.ft (9.76 kg/m2) lag layer, 0.4 lb/sq.ft (1.95 kg/m2) decoupler layer, 0.23-inch (5.8 mm) thick lag layer, 2-inch (50 mm) nominal thickness decoupler layer.
D. Model B-20 LAG: Sound transmission class (STC) 31 per ASTM E90, 2 lb/sq.ft (9.76 kg/m2) lag layer, 0.23-inch (5.8 mm) thick lag layer, no decoupler layer. For use only where other external thermal insulation provides decoupling.

E. Provide matching lag tape.

F. Where sound lagging insulation is indicated, provide a minimum of 1-inch (25 mm) thick decoupling layer. Thickness of thermal insulation required may be reduced by taking credit for the insulating value of the sound lagging. At Contractor’s option, where other external thermal insulation is indicated, the sound lagging may be Model B-20 LAG furnished without the integral decoupling layer.

2.10 ALUMINUM JACKET

A. ASTM B209.
   1. Thickness: 0.032 inch (0.81 mm) sheet.
   2. Finish: Smooth.
   3. Joining: Longitudinal slip joints and 2 inch (50 mm) laps.
   4. Fittings: 0.032 inch (0.81 mm) thick die shaped fitting covers with factory attached protective liner.
   5. Metal Jacket Bands: 3/8 inch (10 mm) wide; 0.032 inch (0.81 mm) thick aluminum.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Division 01 Section “Project Management and Coordination”: Verification of existing conditions before starting work.

B. Verify that ductwork has been tested before applying insulation materials.

C. Verify that surfaces are clean, foreign material removed, and dry.

D. Verify that insulation materials are clean and dry. Discard any materials that exhibit signs of moisture damage, contamination, mold, mildew, or other biological growth. Discard any materials used in the air handling airstream if they have been exposed to water.

3.2 INSTALLATION

A. Division 01 Section “Quality Requirements”: Manufacturer's instructions.

B. Install in accordance with NAIMA National Insulation Standards.

C. In addition to new ductwork, provide insulation for surfaces of existing ductwork that is uninsulated. Repair damaged insulation on existing ductwork to provide continuous vapor barrier. Field-verify scope of existing ductwork.

D. Provide insulation for surfaces of ductwork, as indicated and specified. Insulation values shall meet or exceed the requirements of ASHRAE 90.1-2010, State Energy Codes, and Table I, whichever is greater. In addition, comply with the other requirements of this Section.
E. Insulated Ductwork Conveying Air Below Ambient Temperature:
   1. Provide insulation with vapor barrier jackets.
   2. Finish with tape and vapor barrier jacket.
   3. Continue insulation through walls, sleeves, hangers, and other duct penetrations.
   4. Insulate entire system including fittings, joints, flanges, fire dampers, flexible connections, and expansion joints.

F. Insulated Ductwork Conveying Air Above Ambient Temperature:
   1. Provide with or without standard vapor barrier jacket.
   2. Insulate fittings and joints. Where service access is required, bevel and seal ends of insulation.

G. Ductwork Exposed in Finished Spaces: Provide glass fiber rigid insulation with vapor barrier jacket, with white ASJ finish. Exposed outdoor air intake ductwork, such as the ductwork at unit ventilators, shall be finished with aluminum jacketing.

H. Where rigid glass fiber insulation is scheduled, semi-rigid glass fiber insulation may be used on round and flat oval ducts and irregular shapes, and preformed pipe insulation may be used on small diameter round ducts.

I. External Duct Insulation Application:
   1. Secure insulation with vapor barrier with wires and seal jacket joints with vapor barrier adhesive or tape to match jacket.
   2. Secure insulation without vapor barrier with staples, tape, or wires.
   3. Install without sag on underside of ductwork. Use adhesive or mechanical fasteners where necessary to prevent sagging. Lift ductwork off trapeze hangers and insert spacers.
   4. Seal vapor barrier penetrations by mechanical fasteners with vapor barrier adhesive.
   5. Stop and point insulation around access doors and damper operators to allow operation without disturbing wrapping.

J. Outdoor and Above-Roof Applications:
   1. Seal positive-pressure ductwork completely airtight to prevent air bubbles.
   2. Provide polyisocyanurate insulation with integral vapor barrier jacket.
   3. Provide watershed slope on horizontal surfaces.
   4. Fasten to duct with pins, welded to duct or adhered with field-applied adhesive (self-adhesive type not allowed). Pins shall not protrude beyond the surface of the insulation, so that finish jacket lies smooth without possibility of puncture. Space fasteners as recommended by the manufacturer, to prevent sagging, and to support weight of both insulation and jacket.
   5. Seal insulation vapor barrier with reinforced foil tape on seams, joints, and penetrations.
   6. Cover with self-adhesive cladding jacket, with seams located on bottom side of horizontal duct sections where possible. Overlap edges as recommended by the manufacturer.
   7. At required access points such as access doors and damper actuators, provide a watertight seal and removable weatherproof covers.

K. Duct and Plenum Liner Application:
   1. Duct dimensions indicated are net inside dimensions required for air flow. Increase duct size to allow for insulation thickness.
2. Provide duct liner where:
   b. Specified.
3. Install duct liner in accordance with SMACNA standards.
4. Install elastomeric foam duct liner in accordance with manufacturer’s recommendations.
5. Adhesive: Apply to duct sheet metal for 90 percent coverage. Clean the duct before applying adhesive.
6. Mechanical Fastening: In addition to adhesive, provide mechanical fastening devices meeting the following requirements:
   a. Are spaced in accordance with SMACNA Standards and Manufacturer’s recommendations.
   b. When installed, are as corrosion-resistant as G60 coated galvanized steel.
   c. Will not adversely affect the fire-resistant classification of liner and adhesives.
   d. Do not damage the liner when applied as recommended by the manufacturer.
   e. Do not cause leakage in the duct.
   f. Do not project more than nominally into the airstream.
   g. Will indefinitely sustain a 50 lb (222 N) tensile dead load test perpendicular to the duct wall.
   h. Have a permanent, waterproof bond to the duct wall.
   i. Are the correct length for the specified liner thickness.
7. Seal and smooth liner airstream surface penetrations, cuts, tears, edges, and transverse and longitudinal joints with adhesive or acrylic polymer repair coating, compatible with liner surface coating.
8. Corners: Cut and fit liner in the corners of rectangular duct sections to assure butted edge overlapping. Longitudinal joints in duct liner shall not occur except at the corners of ducts unless the size of the duct and standard liner product dimensions make joints necessary.
10. Provide securely-installed metal nosings that are either channel or zee profile or are integrally-formed from the duct wall over transversely oriented liner edges facing the airstream at fan discharge, at access doors, and at any interval of lined duct preceded by unlined duct. In addition, where velocities exceed 2,000 fpm (10.2 mps), provide metal nosing on upstream edges of liner at every transverse joint.
11. For edges of lining exposed to the airstream that are not protected by metal nosings, coat with adhesive or acrylic polymer repair coating. Cover raw insulation such that no fibers are released.
12. Where dampers, turning vane assemblies or other devices are placed inside of lined duct or fittings, install to not damage the liner or cause erosion of the liner. The use of metal hat sections or other buildout means is optional; when used, secure buildouts to the duct wall with bolts, screws, rivets or welds.
13. Do not install duct liner in fresh air intake ductwork between the outside intake opening and the fan or other air moving device, or within 10 feet (3 m) downstream of a cooling coil or humidifier.

L. Inspection Plates and Test Holes: Provide, where required, in ductwork or casings for balance measurements. Test holes shall be factory fabricated, airtight, and noncorrosive with screw cap and gasket. Extend cap through insulation.

M. Install insulation after ductwork and equipment have been tested and approved.
N. Ensure that surface is clean and dry prior to installation. Ensure that insulation is dry before and during application. Finish with system at operating conditions.

O. Ensure that insulation is continuous through inside walls. Pack around ducts with fireproof self-supporting insulation material, properly sealed.

P. Finish insulation neatly at hangers, supports and other protrusions.

Q. Locate insulation or cover seams in least visible locations.

R. Repair separation of joints or cracking of insulation due to thermal movement or poor workmanship.

S. Do not insulate exposed ductwork in conditioned spaces, unless otherwise specified or indicated on the Drawings.

T. Do not insulate ductwork that is acoustically lined, unless additional external insulation is required to meet the total insulation thickness specified or scheduled, or unless otherwise specified or indicated on the Drawings.

U. Wherever exposed ductwork for air conditioned systems passes through non air conditioned spaces, insulate ductwork with glass fiber rigid insulation with vapor barrier, to prevent condensation.

V. Standing seams, supporting angles and flanges on insulated ductwork shall be insulated with thickness equal to the duct and edges shall be finished and vapor sealed.

W. Mechanical fasteners shall not be riveted or screwed to the duct and shall not penetrate the metalwork.

X. For supply or return ductwork which is required to be insulated, insulation shall be continuous and shall include the insulating of register, grille and diffuser connection plenums/boots.

3.3 SOUND LAGGING INSULATION

A. Provide sound lagging insulation with at least 1-inch (25 mm) thick decoupling layer (or the equivalent or greater external duct thermal insulation) on the supply and return ductwork serving rooftop air conditioning unit AC-3, from the roof penetration to and including the first duct elbow turning to the horizontal ductwork above the ceiling.

B. Provide acoustic sealant at the roof penetrations. Finish the ends of the sound lagging to seal to the underside of the roof.

3.4 PAINTING AND IDENTIFICATION

A. Paint in accordance with Division 09 Section “Painting.”

3.5 FIELD INSPECTION

A. Visually inspect to ensure that materials used conform to Specifications. Inspect installations progressively for compliance with requirements.
<table>
<thead>
<tr>
<th>DUCTWORK TYPE</th>
<th>INSULATION MATERIAL</th>
<th>VAPOR BARRIER REQUIRED</th>
<th>INSULATION WALL THICKNESS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ductwork located outdoors, including above roofs</td>
<td>Polyisocyanurate Foam Board, Rigid, with Waterproof Jacket</td>
<td>Yes</td>
<td>2 layers of 1” (25.4mm) with staggered joints</td>
</tr>
<tr>
<td>Combustion air rectangular ductwork</td>
<td>Glass Fiber, Rigid</td>
<td>Yes</td>
<td>2 layers of 1” (25.4mm) with staggered joints</td>
</tr>
<tr>
<td>Exhaust ductwork from exterior building openings (such as louvers and roof</td>
<td>Glass Fiber, Flexible (only if ductwork is concealed)</td>
<td>Yes</td>
<td>1 1/2” (38.1 mm)</td>
</tr>
<tr>
<td>hoods) to 4 feet (1.2 m) interior of motorized damper or backdraft damper</td>
<td>Glass Fiber, Rigid</td>
<td>Yes</td>
<td>1 1/2” (38.1 mm)</td>
</tr>
<tr>
<td>Outside air intake ductwork</td>
<td>Glass Fiber, Flexible (only if ductwork is concealed)</td>
<td>Yes</td>
<td>2 layers of 1 1/2” (38.1 mm) with staggered joints</td>
</tr>
<tr>
<td>Mixed air ductwork</td>
<td>Glass Fiber, Flexible (only if ductwork is concealed)</td>
<td>Yes</td>
<td>2 layers of 1 1/2” (38.1 mm) with staggered joints</td>
</tr>
<tr>
<td>Supply Ductwork for heating and cooling systems with heating supply air</td>
<td>Glass Fiber, Flexible</td>
<td>Yes</td>
<td>2” (50.8 mm)</td>
</tr>
<tr>
<td>temperatures greater than or equal to 100ºF (37.7ºC)</td>
<td>Glass Fiber, Rigid</td>
<td>Yes</td>
<td>2 layers of 1” (25.4 mm) with staggered joints</td>
</tr>
<tr>
<td>Supply ductwork for heating and cooling systems with heating supply air</td>
<td>Glass Fiber, Flexible</td>
<td>Yes</td>
<td>1 1/2” (38.1 mm)</td>
</tr>
<tr>
<td>temperatures less than 100ºF (37.7ºC)</td>
<td>Glass Fiber, Rigid</td>
<td>Yes</td>
<td>1” (25.4 mm)</td>
</tr>
<tr>
<td>Exposed supply ductwork for cooling systems that pass through non air-</td>
<td>Glass Fiber, Rigid</td>
<td>Yes</td>
<td>1” (25.4 mm)</td>
</tr>
<tr>
<td>conditioned spaces</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Supply, return and exhaust ductwork in cold attic spaces, crawl spaces or</td>
<td>Glass Fiber, Flexible</td>
<td>No for heating only</td>
<td>2” (50.8 mm)</td>
</tr>
<tr>
<td>any space outside of the building insulation envelope but within the building</td>
<td>Glass Fiber, Rigid</td>
<td>systems, Yes for</td>
<td></td>
</tr>
<tr>
<td>shell and protected from weather</td>
<td></td>
<td>cooling systems</td>
<td></td>
</tr>
<tr>
<td>Transfer ducts</td>
<td>Glass Fiber Duct Liner, Rigid</td>
<td>--</td>
<td>1” (25.4 mm)</td>
</tr>
</tbody>
</table>
Ductwork 10 feet upstream and downstream from a fan, or through the first elbow, whichever is longer (excluding fresh air intake ductwork and ductwork within 10 feet downstream of a cooling coil or humidifier) | Glass Fiber Duct Liner, Rigid | -- | 1” (25.4 mm)

Ductwork indicated on Drawings to be acoustically lined | Glass Fiber Duct Liner, Rigid | -- | 1” (25.4 mm)

END OF SECTION 230713
SECTION 230716 – HVAC EQUIPMENT INSULATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Equipment insulation.
B. Covering.
C. Shields, Inserts, and Saddles.

1.2 RELATED SECTIONS

A. Division 09 Section “Painting”: Painting insulation covering.
B. Division 23 Section “Hangers and Supports for HVAC Piping and Equipment”: Placement of hangers and hanger inserts.
C. Division 23 Section “Identification for HVAC Piping and Equipment.”

1.3 REFERENCES

A. Division 01 Section “References”: Requirements for references and standards.


X. NAIMA National Insulation Standards.


1.4 SUBMITTALS

A. Division 01 Section “Submittal Procedures.”

B. Product Data: Provide product description, thermal characteristics, list of materials and thickness for equipment scheduled.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this Section with minimum 3 years’ experience.
B. Applicator Qualifications: Company specializing in performing the work of this Section with minimum 3 years’ experience.

1.6 REGULATORY REQUIREMENTS
A. Conform to maximum flame spread/smoke developed rating of 25/50 in accordance with ASTM E84, NFPA 255 and UL 723. For elastomeric foam insulation, rating shall apply for thicknesses up to 2 inches (50 mm).
B. Insulation materials and accessories shall be asbestos-free. No fibers with dimensions similar to asbestos fibers shall be released from any material.

1.7 DELIVERY, STORAGE, AND PROTECTION
A. Division 01 Section “Product Requirements”: Transport, handle, store, and protect products.
B. Accept materials on site in original factory packaging, labeled with manufacturer's identification, including product density and thickness.
C. Protect insulation from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original wrapping.

1.8 ENVIRONMENTAL REQUIREMENTS
A. Division 01 Section “Product Requirements”: Environmental conditions affecting products on site.
B. Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics, and insulation cements.
C. Maintain temperature during and after installation for minimum period of 24 hours.

1.9 EXISTING EQUIPMENT
A. Insulate existing equipment as indicated on the Drawings. Contractor shall be responsible to field-verify quantities and sizes. Provide access to existing equipment as required for complete insulation. Remove existing finishes and existing insulation as required.

PART 2 - PRODUCTS

2.1 MANUFACTURERS
A. Cellular Glass Products:
   1. Pittsburgh Corning USA. Foamglas product line.
   2. No substitutions.
B. Elastomeric Foam Products:
   1. Armacell LLC.
   2. K-Flex USA.
   3. No substitutions.
C. Glass and Mineral Fiber Products:
1. Knauf Insulation.
2. Certainteed Corporation.
4. Owens Corning.
5. No substitutions.

D. Hydrous Calcium Silicate Products:
1. IIG Industrial Insulation Group LLC, a Calsilite/Johns Manville joint venture. Thermo-12 Gold product line.
2. Johns Manville.
3. No substitutions.

E. Industrial Mineral Wool Products:
1. IIG Industrial Insulation Group LLC, a Calsilite/Johns Manville joint venture. MinWool 1200 product line.
2. Johns Manville.
3. No substitutions.

F. Removable, Reusable Insulation Covers:
1. Advance Thermal Corp.
2. Pacor, Inc.
4. Thermaxx LLC.
5. No substitutions.

G. Glass Fiber Insulation Sealing Tapes:
1. Venture Tape Corporation.
2. 3M Company.
3. Ideal Tape Co., division of American Biltrite Inc.
4. Nashua Tape Products, division of Berry Plastics Corp.
5. No substitutions.

H. Accessories:
2. Foster Products, division of Specialty Construction Brands, Inc., a subsidiary of H.B. Fuller (mastics, sealants, reinforcing membranes, and accessories).

2.2 CELLULAR GLASS

A. Insulation: ASTM C552 and ASTM 1639; soda-lime silicate glass foam, noncombustible. Formed from sintered powdered glass and carbon black, heated in a “cellulation” process which creates carbon dioxide gas, which forms the bubbles and is permanently trapped in the cells. No “blowing agents” are used in its manufacturing.
1. ‘K’ (KSI) Value: ASTM C177 or ASTM C518, 0.29 at 75°F (0.042 at 24°C).
3. Maximum Moisture Absorption: ASTM C240, 0.2 percent by volume.
4. Water Vapor Permeability: ASTM E96 Wet Cup Procedure B, 0.00 perm-in. (0.00 perm-cm).
5. Flexural Strength, Block: ASTM C203 or C240, 70 psi (480 kPa).
6. Density: 7.5 lb/cu ft (12024 kg/cu m).

B. Accessories:

2.3 ELASTOMERIC FOAM

A. Products:
1. Armacell, AP Armaflex and AP Armaflex FS pipe and sheet insulation.
2. K-Flex USA: Insul-Tube or K-Flex LS pipe insulation, and Insul-Sheet S2S or K-Flex LS sheet insulation.
3. No substitutions.

B. Insulation: ASTM C534; flexible, cellular elastomeric, molded or sheet.
1. 'K' ('Ksi') value: ASTM C177; 0.277 Btu-in/(h-ft²-°F) at 75°F (0.04 W/m-K at 24°C).
2. Minimum service temperature: -70°F (-57°C) (flexible to -40°F (-40°C)).
4. Maximum moisture absorption: ASTM C209, 0.2% by volume; or ASTM D1056, 5% by weight.
5. Moisture vapor transmission: ASTM E96; 0.08 perm-inches (0.116 ng/(s-m-Pa)).

C. Elastomeric Foam Adhesive: Air dried, contact adhesive, compatible with insulation.

2.4 GLASS FIBER, FLEXIBLE

A. Insulation: ASTM C553; flexible, noncombustible.
1. 'K' (KSI) Value: ASTM C177 or ASTM C518, 0.24 at 75°F (0.035 at 24°C).
3. Maximum Moisture Absorption: 0.2 percent by volume.
4. Density: 1.5 lb/cu ft (24 kg/cu m).

B. Vapor Barrier Jacket:
1. ASTM C1136, Kraft paper reinforced with glass fiber yarn and bonded to vapor barrier film. Facing as required for the application. Integral staple flap on one edge.
   b. White Faced: PSK (polypropylene-scrim-kraft) construction.
2. Moisture vapor transmission: ASTM E96; 0.02 perm.
3. Suitable for insulation surface temperatures up to 150°F (66°C).
4. Overlap longitudinal laps and butt strips.
5. Secure with outward clinch expanding staples and vapor barrier mastic and pressure sensitive tape.

C. Vapor Barrier Lap Adhesive: Compatible with insulation.

D. Vapor Barrier Tape: See article “Glass Fiber Insulation Sealing Tape” in this Section.

E. Insulating Cement/Mastic: ASTM C195; hydraulic setting on mineral wool.

F. Tie Wire: 0.048 inch (1.22 mm) stainless steel with twisted ends on maximum 12 inch (300 mm) centers.

2.5 GLASS FIBER, RIGID

A. Insulation: ASTM C612 or ASTM C592; rigid, noncombustible.
   1. ‘K’ (KSI) Value: ASTM C177 or ASTM C518, 0.24 at 75°F (0.035 at 24°C).
   3. Maximum Moisture Absorption: 0.1 percent by volume.
   4. Density: 3.0 lb/cu ft (48 kg/cu m).

B. Vapor Barrier Jacket:
   1. ASTM C1136, kraft paper reinforced with glass fiber yarn and bonded to aluminized film. Facing as required for the application.
      a. Aluminum Faced: FSK (foil-scrim-kraft) construction
      b. White Faced: ASJ (all-service jacket) construction.
   2. Moisture vapor transmission: ASTM E96; 0.02 perm.
   3. Suitable for insulation surface temperatures up to 150°F (66°C).
   4. Overlap longitudinal laps and butt strips.
   5. Secure insulation with mechanical fasteners to substrate, and seal jacket with pressure sensitive tape.

C. Facing: 1 inch (25 mm) galvanized steel hexagonal wire mesh stitched on one face of insulation.

D. Vapor Barrier Lap Adhesive: Compatible with insulation.

E. Vapor Barrier Tape: See article “Glass Fiber Insulation Sealing Tape” in this Section.

F. Insulating Cement/Mastic: ASTM C195; hydraulic setting on mineral wool.

2.6 GLASS FIBER, SEMI-RIGID

A. Insulation: ASTM C612; semi-rigid, noncombustible blanket, with fibers oriented perpendicular to insulation surface to provide compressive strength while maintaining flexibility. Supplied in roll form, suitable for application on rounded shapes such as pipes, tanks, ducts, vessels, and other similar round and irregular shapes.
   1. ‘K’ (Ksi) value: ASTM C518, 0.24 at 75°F (0.036 at 24°C).
   3. Maximum moisture absorption: 1.0 percent by volume.
   4. Density: 2.5 lb/cu ft (40 kg/cu m).
B. Vapor Barrier Jacket:
1. ASTM C1136, kraft paper with glass fiber yarn and bonded to aluminized film. Facing as required for the application.
   a. Aluminum Faced: FSK (foil-scrim-kraft) construction
   b. White Faced: ASJ (all-service jacket) construction.
2. Moisture vapor transmission: ASTM E96; 0.02 perm.
3. Suitable for insulation surface temperatures up to 150°F (66°C).
4. Overlap longitudinal laps and butt strips.
5. Secure with outward clinch expanding staples and vapor barrier mastic and pressure sensitive tape.

C. Vapor Barrier Tape: See article “Glass Fiber Insulation Sealing Tape” in this Section.

D. Indoor Vapor Barrier Finish:
1. Cloth: Untreated; 9 oz/sq yd (305 g/sq m) weight, glass fabric.
2. Vinyl emulsion type acrylic, compatible with insulation, [black] [white] color.

2.7 GLASS FIBER, PREFORMED PIPE COVERING

A. Insulation: ASTM C547; rigid molded, noncombustible.
1. 'K' ('Ksi') value: ASTM C177, 0.24 Btu-in/(hr-sq.ft-°F) at 75°F (0.035 W/m-K at 24°C).
3. Maximum moisture absorption: 0.2 percent by volume.

B. Vapor Barrier Jacket:
1. ASTM C1136, ASJ (all-service jacket) construction, white kraft paper with glass fiber yarn, bonded to aluminized film.
2. Moisture vapor transmission: ASTM E96; 0.02 perm-inches.

C. Tie Wire: 0.048 inch (1.22 mm) stainless steel with twisted ends on maximum 12 inch (300 mm) centers.

D. Vapor Barrier Lap Adhesive: Compatible with insulation.

E. Vapor Barrier Tape: Provide self-adhesive butt strips furnished by the insulation manufacturer, with finish to match the insulation outer finish.

F. Insulating Cement/Mastic: ASTM C195; hydraulic setting on mineral wool.

G. Indoor Vapor Barrier Finish:
1. Cloth: Untreated; 9 oz/sq yd (305 g/sq m) weight.
2. Vinyl emulsion type acrylic, compatible with insulation, white color.

H. Outdoor Vapor Barrier Mastic: Vinyl emulsion type acrylic or mastic, compatible with insulation, black color.

I. Outdoor Breather Mastic: Vinyl emulsion type acrylic or mastic, compatible with insulation, black color.

J. Insulating Cement: ASTM C449/C449M.
2.8 GLASS FIBER INSULATION SEALING TAPE

A. Self-adhesive tape with integral vapor barrier, pressure sensitive acrylic-based or rubber-based adhesive, and release liner strip. Width 3 in. (76 mm) nominal.

B. Manufactured by VentureTape, by the insulation manufacturer, or by one of the other tape manufacturers listed in the article “Manufacturers” in this Section.

C. Types:
1. For rigid and semi-rigid insulations, tape shall be reinforced type. For flexible “duct wrap” insulation, tape shall be either reinforced or non-reinforced.
2. White or aluminum outer surface to match the insulation.
3. Reinforced: Kraft paper reinforced with glass fiber yarn and bonded to vapor barrier layer.
   a. Aluminum Finish with FSK: VentureTape 1525CW.
   b. White Finish with ASJ: VentureTape 1540CW
   c. White Finish with PSK: VentureTape 1531CW.
4. Non-Reinforced: Foil insulation tape. Dead-soft temper 2 mil (0.05 mm) thick aluminum foil, without reinforcement. Hand-tearable.
   a. Venture Tape 3520CW.
5. Performance:
   a. Peel Adhesion: PSTC-101 with 20 minute dwell, 45 oz/in. (12.5 N / 25 mm).
   b. Shear Adhesion: PSTC-107, 2.2 psi (15.2 kPa) after 24 hours.
   c. Tensile Strength: PSTC-131:
      1) Reinforced Types: 40 lb/in. (180.8 N / 25 mm).
      2) Non-reinforced Types: 21 lb/in. (94.9 N / 25 mm).
   d. Elongation: PSTC 131, 6 percent maximum.
   e. Service Temperature: -40 to 240°F (-40 to 116°C).
   f. UL 723 listed or classified (flame/smoke rating).

2.9 HYDROUS CALCIUM SILICATE

A. Insulation: ASTM C533; rigid molded, asbestos free, gold color.
1. ‘K’ (KSI) Value: ASTM C177, C518, and C335; 0.45 Btu-in/(hr-sq.ft-°F) at 300°F (0.065 W/m-K at 148°C).
3. Density: ASTM C302; at least 14 lb/cu ft (230 kg/cu m).
4. Compressive Strength: ASTM C165; at least 100 psi (690 kPa) at 5% compression.
5. Flexural Strength: ASTM C203; at least 50 psi (450 kPa).

B. Tie Wire: 0.048 inches (1.22 mm) stainless steel with twisted ends on maximum 12 inch (300 mm) centers.

C. Insulating Cement: ASTM C449. Apply with fibrous glass cloth reinforcement.

2.10 INDUSTRIAL MINERAL WOOL

A. Insulation: ASTM C547 Types I, II, and IV; rigid molded, asbestos free, basaltic rock fiber, off-white or darker color.
1. ‘K’ (KSI) Value: ASTM C335; 0.22 Btu-in/(hr-sq.ft-°F) at 75°F (0.032 W/m-K at 24°C).
3. Water Vapor Sorption: ASTM C1104 at 120°F (50°C) and 95% RH; <1% by weight, <0.02% by volume.
4. Recovery after 10% compression: 100%.
5. Density: 3.0 lb/cu ft (48 kg/cu m).

B. Tie Wire: 0.048 inches (1.22 mm) stainless steel with twisted ends on maximum 12 inch (300 mm) centers.

C. Insulating Cement/Mastic: ASTM C195; hydraulic setting on mineral wool.

2.11 REMOVABLE, REUSABLE INSULATION COVERS

A. Insulation:
1. Fiberglass mat insulation.
2. Insulation thickness shall be as required to limit exterior temperature to 120°F (49°C).

B. Jacket:
1. PTFE-fiberglass composite jacketing, industrial grade, 13.5 oz/sq. yd. (458 g/m²) minimum. Room-side surface in well-vented indoor locations, or cold-equipment-side surface of jacketing may be either PTFE-fiberglass or silicone-fiberglass.
2. Breather vents and drain orifices, brass or stainless steel.
4. Insulation shall be sewn integral to jacket to prevent shifting.
5. Insulating mat shall be placed in overlapping pattern to minimize convection currents.
6. Jacket shall completely encapsulate insulation.
7. Cut jacket material edges shall be folded under and concealed.
8. Provide a permanently attached Aluminum or stainless steel nameplate on each jacket to identify its location, size and tag number.

C. Fastening:
1. Jackets shall be fastened using hook and loop (“Velcro” type) straps and 1-inch (25 mm) slide buckles. Hog rings, staples, wires, and other devices are not acceptable.
2. Jacket pieces which match mating seams shall include an extended 2-inch (50 mm) flap constructed from the exterior fabric and shall be secured using hook and loop closure parallel to the seam.

D. Box Shape: Covers for steam traps and associated piping assemblies, and for steam pressure reducing valves, shall be constructed in a box shape for ease of removal and replacement inspection.

E. Service Rating: Maximum equipment temperature 700°F (371°C).

F. Warranty: 5-year materials and labor.

2.12 JACKETS

A. PVC Plastic:
   c. Moisture Vapor Transmission: ASTM E96; 0.002 perm-inches.
2. Covering Adhesive Mastic: Compatible with insulation.

B. Canvas Jacket: UL listed.
   1. Fabric: 6 oz/sq yd (220 g/sq m), plain weave cotton treated with dilute fire retardant lagging adhesive.
   2. Lagging Adhesive: Compatible with insulation.

C. Fibrous Glass Fabric:
   1. Cloth: Heat treated to remove most organic binders. May be factory-impregnated with an inorganic fire-retardant rewetable adhesive, at Contractor’s option.
   2. Weight: 9 oz/sq yd (305 g/sq m) minimum.
   3. Blanket: 1.0 lb/cu ft (16 kg/cu m) density.
   4. Weave: 10x20 per inch (390x780 per meter).
   5. Service Temperature: 1000°F (538°C).

   1. Thickness: 0.032 inch (0.80 mm) sheet.
   2. Finish: Smooth.
   3. Joining: Longitudinal slip joints and 2 inch (50 mm) laps.
   4. Metal Jacket Bands: 3/8 inch (10 mm) wide; 0.032 inch (.81mm) thick aluminum.

E. Stainless Steel Jacket: ASTM A167 Type 304 stainless steel.
   1. Thickness: 0.016 inch (0.45 mm).
   2. Finish: Smooth.
   3. Metal Jacket Bands: 3/8 inch (10 mm) wide; 0.010 inch (0.25 mm) thick stainless steel.

2.13 SHIELDS, INSERTS, AND SADDLES:

A. Shields: Galvanized steel formed in at least a 90-degree arc. Minimum 18-gauge (1.2 mm) thickness. Minimum 12 inches (300 mm) long.

B. Inserts:
   1. Configuration: Minimum 6 inches (150 mm) long, of same thickness and contour as adjoining insulation; may be factory fabricated.
   2. Insert Material: Hydrous calcium silicate insulation or other heavy density insulating material suitable for the planned temperature range.

C. Saddles:
   1. Factory fabricated of curved carbon steel plate, of same overall thickness and contour as adjoining insulation. Sides designed for welding to pipe. Center support plate for pipe sizes 12 inches (300 mm) and larger.
PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that equipment has been tested before applying insulation materials.

B. Verify that surfaces are clean and dry, with foreign material removed.

3.2 INSTALLATION

A. Division 01 Section “Quality Requirements”: Manufacturer's instructions.

B. Install in accordance with NAIMA National Insulation Standards where applicable.

C. Insulation values shall meet or exceed the requirements of ASHRAE 90.1-2010, applicable State Energy Codes, and Table I, whichever is greater. In addition, comply with the other requirements of this Section.

D. Factory Insulated Equipment: Do not insulate.

E. Exposed Equipment: Locate insulation and cover seams in least visible locations.

F. Where rigid glass fiber insulation is scheduled, semi-rigid glass fiber insulation may be used on round and flat oval and irregular shapes, and preformed pipe insulation may be used on small diameter round items.

G. Insulated equipment containing fluids below ambient temperature: Insulate entire system.

H. For hot equipment containing fluids 140°F (60°C) or less, do not insulate flanges and unions, but bevel and seal ends of insulation.

I. For hot equipment containing fluids over 140°F (60°C), insulate flanges and unions with removable sections and jackets.

J. Fiber glass insulated equipment containing fluids below ambient temperature: Provide vapor barrier jackets, factory-applied or field-applied. Finish with glass cloth and vapor barrier adhesive.

K. Fiber glass insulated equipment containing fluids above ambient temperature: Provide standard jackets, with or without vapor barrier, factory-applied or field-applied. Finish with glass cloth and adhesive.

L. Shields, Inserts, and Saddles:
   1. Application: Provide shields at hangers. Provide inserts for equipment 1-1/2 inches (40 mm) diameter or larger. Provide saddles for equipment 6 inches (150 mm) and larger.
   2. Shield location: Between insulation jacket and hanger.
   3. Insert location: Between support shield and equipment and under the finish jacket.
   4. Saddle location: Between support shield and equipment.
   5. Tack-weld saddles to the equipment. Fill air spaces within the saddle with insulation material.
6. Glue shields to outside of insulation after system is filled and run at operating temperature.
7. Align mid-length of shields, inserts, and saddles with the hanger centerline.

M. Finish insulation at supports, protrusions, and interruptions.

N. Equipment Exposed in Mechanical Equipment Rooms or Finished Spaces: Finish with PVC or aluminum jacket and fitting covers.

O. Apply insulation close to equipment by grooving, scoring, and beveling insulation. Fasten insulation to equipment with studs, pins, clips, adhesive, wires, or bands.

P. Fill joints, cracks, seams, and depressions with bedding compound to form smooth surface. On cold equipment, use vapor barrier cement.

Q. Nameplates and ASME Stamps: Bevel and seal insulation around; do not insulate over.

R. Equipment Requiring Access for Maintenance, Repair, or Cleaning: Install insulation so it can be easily removed and replaced without damage. Provide removable, reusable insulation covers.

S. Insulate equipment after system tests have been completed and surfaces to be insulated have been cleaned of dirt, rust and scale, and dried. Ensure full range of motion of equipment actuators. Modify insulation to avoid obstruction with valve handles, safety reliefs, and other components requiring movement. Install insulation with jackets drawn tight and cement down on longitudinal and end laps. Do not use scrap pieces where a full length section will fit. Extend surface finishes to protect surfaces, ends, and raw edges of insulation. Apply coatings and adhesives at the manufacturer’s recommended coverage per gallon. Provide a moisture and vapor seal where insulation terminates against metal hangers, anchors and other projections through the insulation on surfaces for which a vapor seal is specified. Keep insulation dry during the application of any finish. Bevel and seal the edges of exposed insulation. Unless otherwise indicated, do not insulate the following:
1. Nameplate labels.
2. Valve hand wheels.
3. ASME stamps.

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

U. Heating Equipment (Except Pumps):
1. On equipment with ribs such as boiler flue gas connection, draft fans, and fly ash or soot collectors, apply insulation over 6- by 6- by 12-gauge welded wire fabric spot welded to
the equipment over the ribs. Secure insulation to the fabric with J hooks and 2- by 2 washers or wire loop insulation to the fabric. Use 16-gauge galvanized steel wire or 3/4 inch (19 mm) wide 20 gauge stainless steel bands spaced on 12-inch (305 mm) centers.

2. Seal joints with bedding compound for cellular glass or for mineral fiber with ASTM C195 insulating cement and cover insulation with a smoothing coat of insulating cement. Apply two coats of adhesive with a layer of glass cloth embedded between coats. The dry film thickness of the finish shall be 1/32-inch (0.79 mm) minimum.

3. Insulate shell and tube heat exchangers for the temperature of the shell medium indicated on the drawings. Insulation on heads of heat exchangers shall be removable. Fabricate a male-female shiplap type joint for the removable section.

V. Cold Equipment (except Pumps):
   1. Secure insulation with 16-gauge galvanized steel or copper clad wire or with 3/4 inch wide 20-gauge stainless steel bands spaced on 12-inch centers. Seal joints with joint sealer. Cover non-removable irregular surfaces such as corner angles with a smoothing coat of insulating cement. Apply two coats of vapor barrier coating with a layer of glass cloth embedded between coats. The dry film thickness of the finish shall be 1/32-inch (0.79 mm) minimum.

   2. Provide removable heat exchanger head covers with a male-female shiplap type joint.

W. Removable Reusable Equipment Covers:
   1. Provide on equipment requiring periodic or frequent service, including but not limited to plate-and-frame heat exchangers, and large valves and fittings as referenced in Division 23 Section “HVAC Piping Insulation.”

   2. Equipment Nameplates: It is acceptable to insulate over nameplates with this type cover.

   3. Field-verify installed dimensions prior to ordering covers.

   4. Insulation covers may be shop-fabricated from aluminum sheet metal with adhesive-adhered rigid insulation.

X. For equipment which may operate at a range of temperatures (for example, heat recovery and heat exchange equipment), provide insulation and vapor barriers as are suitable for the entire range of operation.

Y. Insulate equipment and accessories as specified in Table I. In outside locations, provide insulation one inch thicker than that specified in Table I. In addition, comply with the other requirements of this Section.

3.3 PAINTING AND IDENTIFICATION

A. Paint in accordance with Division 09 Section “Painting.”

3.4 FIELD INSPECTION

A. Visually inspect to ensure that materials used conform to Specifications. Inspect installations progressively for compliance with requirements.
# TABLE I
EQUIPMENT INSULATION MATERIAL AND WALL THICKNESS

<table>
<thead>
<tr>
<th>EQUIPMENT</th>
<th>INSULATION MATERIAL</th>
<th>VAPOR BARRIER REQUIRED</th>
<th>INSULATION WALL THICKNESS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heat Exchangers with fluids above room temperature</td>
<td>Glass Fiber, Rigid</td>
<td>No</td>
<td>2” (51 mm)</td>
</tr>
<tr>
<td>Heat Exchangers with fluids at or below room temperature</td>
<td>Glass Fiber, Rigid</td>
<td>Yes</td>
<td>2” (51 mm)</td>
</tr>
<tr>
<td></td>
<td>Elastomeric Foam</td>
<td>N/A</td>
<td>2” (51 mm)</td>
</tr>
<tr>
<td>Air Separators with fluids above room temperature</td>
<td>Glass Fiber, Rigid</td>
<td>No</td>
<td>2” (51 mm)</td>
</tr>
<tr>
<td>Air Separators with fluids at or below room temperature</td>
<td>Glass Fiber, Rigid</td>
<td>Yes</td>
<td>2” (51 mm)</td>
</tr>
<tr>
<td></td>
<td>Elastomeric Foam</td>
<td>N/A</td>
<td>2” (51 mm)</td>
</tr>
<tr>
<td>Heating Water Pumps</td>
<td>Glass Fiber, Rigid</td>
<td>No</td>
<td>2” (51 mm)</td>
</tr>
<tr>
<td>Hot Water Duct Mounted Coils</td>
<td>Glass Fiber, Flexible</td>
<td>Yes</td>
<td>2” (51 mm)</td>
</tr>
<tr>
<td>Drain Pans for Chilled Water Systems</td>
<td>Elastomeric Foam</td>
<td>N/A</td>
<td>2” (51 mm)</td>
</tr>
</tbody>
</table>

END OF SECTION 230716
SECTION 230719 – HVAC PIPING INSULATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Piping insulation.
B. Jackets and accessories.
C. Shields, Inserts, and Saddles.

1.2 RELATED SECTIONS

A. Division 07 Section “Through-Penetration Firestop Systems.”
B. Division 09 Section “Painting”: Painting insulation jacket.
C. Division 23 Section “Identification for HVAC Piping and Equipment.”
D. Division 23 Section “Hangers and Supports for HVAC Piping and Equipment”: Placement of hangers and hanger inserts.
E. Division 23 Section “HVAC Equipment Insulation”: Removable, reusable insulation covers.

1.3 REFERENCES

A. Division 01 Section “References”: Requirements for references and standards.
V. NAIMA National Insulation Standards.

1.4 SUBMITTALS
A. Submit under provisions of Division 01 Section “Submittal Procedures”.
B. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.

1.5 QUALITY ASSURANCE
A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this Section with minimum 3 years’ experience.
B. Applicator Qualifications: Company specializing in performing the work of this Section with minimum 3 years’ experience.

1.6 REGULATORY REQUIREMENTS
A. Conform to maximum flame spread/smoke developed rating of 25/50 in accordance with ASTM E84, NFPA 255 and UL 723. For elastomeric foam insulation, rating shall apply for thicknesses up to 2 inches (50 mm).

B. Insulation materials and accessories shall be asbestos-free. No fibers with dimensions similar to asbestos fibers shall be released from any material.

1.7 DELIVERY, STORAGE, AND PROTECTION

A. Division 01 Section “Product Requirements”: Transport, handle, store, and protect products.

B. Accept materials on site, labeled with manufacturer's identification, product density, and thickness.

1.8 ENVIRONMENTAL REQUIREMENTS

A. Division 01 Section “Product Requirements”: Environmental conditions affecting products on site.

B. Maintain ambient conditions required by manufacturers of each product.

C. Maintain temperature before, during, and after installation for minimum of 24 hours.

1.9 EXISTING PIPING

A. Insulate existing piping at locations of piping modifications indicated on the Drawings. Contractor shall be responsible to field-verify quantities and sizes. Provide access to existing piping as required for complete insulation. Remove existing finishes and existing insulation as required.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Cellular Glass Products:
   1. Pittsburgh Corning USA. Foamglas product line.
   2. No substitutions.

B. Elastomeric Foam Products:
   1. Armacell LLC.
   2. K-Flex USA.
   3. No substitutions.

C. Glass and Mineral Fiber Products:
   1. Knauf Insulation.
   2. Certainteed Corporation.
   4. Owens Corning.
   5. No substitutions.
D. Hydrous Calcium Silicate Products:
   1. IIG Industrial Insulation Group LLC, a Calsilite/Johns Manville joint venture. Thermo-12 Gold product line.
   2. Johns Manville.

E. Industrial Mineral Wool Products:
   1. IIG Industrial Insulation Group LLC, a Calsilite/Johns Manville joint venture. MinWool 1200 product line.
   2. Johns Manville.

F. Accessories:
   1. Cee-Co division of Johns Manville (product: plastic jacket systems).
   2. Foster Products, division of Specialty Construction Brands, Inc., a subsidiary of H.B. Fuller (mastics, sealants, reinforcing membranes, and accessories).
   5. Pittsburgh Corning (product: cellular glass insulation for high-density inserts).

2.2 CELLULAR GLASS

A. Insulation: ASTM C552 and ASTM 1639; soda-lime silicate glass foam, noncombustible. Formed from sintered powdered glass and carbon black, heated in a “cellulation” process which creates carbon dioxide gas, which forms the bubbles and is permanently trapped in the cells. No “blowing agents” are used in its manufacturing.
   1. 'K' (KSI) Value: ASTM C177 or ASTM C518, 0.29 at 75°F (0.042 at 24°C).
   3. Maximum Moisture Absorption: ASTM C240, 0.2 percent by volume.
   4. Water Vapor Permeability: ASTM E96 Wet Cup Procedure B, 0.00 perm-in. (0.00 perm-cm).
   5. Flexural Strength, Block: ASTM C203 or C240, 70 psi (480 kPa).
   6. Density: 7.5 lb/cu ft (12024 kg/cu m).

B. Accessories:

2.3 ELASTOMERIC FOAM

A. Products:
1. Armacell: AP Armaflex and AP Armaflex FS pipe and sheet insulation.
3. No substitutions.

B. Insulation: ASTM C534; flexible, cellular elastomeric, molded or sheet.
   1. 'K' ('Ksi') value: ASTM C177; 0.277 Btu-in/(hr-sq.ft-°F) at 75°F (0.04 W/m-K at 24°C).
   2. Minimum service temperature: -70°F (-57°C) (flexible to -20°F (-29°C)).
   4. Maximum moisture absorption: ASTM C209, 0.2% by volume; or ASTM D1056, 5% by weight.
   5. Moisture vapor transmission: ASTM E96; 0.08 perm-inches (0.116 ng/(s-m-Pa)).

C. Elastomeric Foam Adhesive: Air dried, contact adhesive, compatible with insulation.

D. Insulated Hanger Inserts: At Contractor’s option, Armacell Armafix IPH insulated pipe hanger inserts may be used at hanger locations.
   1. Engineered from Armaflex insulation, with inserts of CFC-free PPUR/PIR polyurethane foam insulation bearing segments.
   2. Outer shell of 30 mils (0.76 mm) -thick painted aluminum.
   4. Provide Armaflex insulation tape, wrapped around the IPH prior to placing in the hanger.

2.4 GLASS FIBER

A. Insulation: ASTM C547; rigid molded, noncombustible.
   1. 'K' ('Ksi') value: ASTM C177, 0.24 Btu-in/(hr-sq.ft-°F) at 75°F (0.035 W/m-K at 24°C).
   3. Maximum moisture absorption: 0.2 percent by volume.

B. Vapor Barrier Jacket:
   1. ASTM C1136, White kraft paper with glass fiber yarn, bonded to aluminized film.
   2. Moisture vapor transmission: ASTM E96; 0.02 perm-inches.

C. Tie Wire: 0.048 inch (1.22 mm) stainless steel with twisted ends on maximum 12 inch (300 mm) centers.

D. Vapor Barrier Lap Adhesive: Compatible with insulation.

E. Insulating Cement/Mastic: ASTM C195; hydraulic setting on mineral wool.

F. Indoor Vapor Barrier Finish:
   1. Cloth: Untreated; 9 oz/sq yd (305 g/sq m) weight.
   2. Vinyl emulsion type acrylic, compatible with insulation, white color.

G. Outdoor Vapor Barrier Mastic: Vinyl emulsion type acrylic or mastic, compatible with insulation, black color.

H. Outdoor Breather Mastic: Vinyl emulsion type acrylic or mastic, compatible with insulation, black color.
I. Insulating Cement: ASTM C449/C449M.

2.5 HYDROUS CALCIUM SILICATE

A. Insulation: ASTM C533; rigid molded, asbestos free, gold color.
   1. 'K' (ksi) Value: ASTM C177, C518, and C335; 0.45 Btu-in/(hr-ft-°F) at 300°F (0.065 W/m-K at 148°C).
   3. Density: ASTM C302; at least 14 lb/cu ft (230 kg/cu m).
   4. Compressive Strength: ASTM C165; at least 100 psi (690 kPa) at 5% compression.
   5. Flexural Strength: ASTM C203; at least 50 psi (450 kPa).

B. Tie Wire: 0.048 inches (1.22 mm) stainless steel with twisted ends on maximum 12 inch (300 mm) centers.

C. Insulating Cement: ASTM C449. Apply with fibrous glass cloth reinforcement.

2.6 INDUSTRIAL MINERAL WOOL

A. Insulation: ASTM C547 Types I, II, and IV; rigid molded, asbestos free, basaltic rock fiber, off-white or darker color.
   1. 'K' (ksi) Value: ASTM C335; 0.22 Btu-in/(hr-ft-°F) at 75°F (0.032 W/m-K at 24°C).
   3. Water Vapor Sorption: ASTM C1104 at 120ºF (50ºC) and 95% RH; <1% by weight, <0.02% by volume.
   4. Recovery after 10% compression: 100%.
   5. Density: 3.0 lb/cu ft (48 kg/cu m).

B. Tie Wire: 0.048 inches (1.22 mm) stainless steel with twisted ends on maximum 12 inch (300 mm) centers.

C. Insulating Cement/Mastic: ASTM C195; hydraulic setting on mineral wool.

2.7 JACKETS

A. PVC Plastic.
   1. Jacket: ASTM D1784, One piece molded type fitting covers and sheet material, off-white color.
      a. Minimum service temperature: 0°F (-18°C).
      c. Moisture vapor transmission: ASTM E96; 0.002 perm-inches.
      d. Thickness: 30 mil (0.76 mm).
      e. Connections: Brush on welding adhesive, tacks (for heating systems only) or pressure sensitive color matching vinyl tape.
   2. Covering Adhesive Mastic: Compatible with insulation.

B. ABS Plastic:
   1. Jacket: One piece molded type fitting covers and sheet material, off-white color.
      a. Minimum service temperature: -40°F (-40°C).
b. Maximum service temperature of 180°F (82°C).
c. Moisture vapor transmission: ASTM E96; 0.012 perm-inches.
d. Thickness: 30 mil (0.76 mm).
e. Connections: Brush on welding adhesive.

C. Canvas Jacket: UL listed.
   1. Fabric: 6 oz/sq yd (220 g/sq m), plain weave cotton treated with dilute fire retardant lagging adhesive.
   2. Lagging Adhesive: Compatible with insulation.

D. Fibrous Glass Fabric:
   1. Cloth: Heat treated to remove most organic binders. May be factory-impregnated with an inorganic fire-retardant rewetable adhesive, at Contractor’s option.
   2. Weight: 9 oz/sq yd (305 g/sq m) minimum.
   3. Blanket: 1.0 lb/cu ft (16 kg/cu m) density.
   4. Weave: 10x20 per inch (390x780 per meter).
   5. Service Temperature: 1000°F (538°C).

E. Aluminum Jacket: ASTM B209, ASTM B209M.
   1. Thickness: 0.016 inch (0.40 mm) sheet.
   2. Finish: Smooth.
   3. Joining: Longitudinal slip joints and 2 inch (50 mm) laps.
   4. Fittings: 0.016 inch (0.4 mm) thick die shaped fitting covers with factory attached protective liner.
   5. Metal Jacket Bands: 3/8 inch (10 mm) wide; 0.015 inch (0.38 mm) thick aluminum.

F. Stainless Steel Jacket: ASTM A167 Type 304 stainless steel.
   1. Thickness: 0.010 inch (0.25 mm).
   2. Finish: Smooth.
   3. Metal Jacket Bands: 3/8 inch (10 mm) wide; 0.010 inch (0.25 mm) thick stainless steel.

2.8 SHIELDS, INSERTS, AND SADDLES

A. Shields:
   1. Carpenter and Paterson Figure 265GS, or equal.
   2. Galvanized or electro-galvanized steel, minimum 12 inch length, minimum 120-degree arc, minimum 18 gauge.
   3. Provide contact adhesive to glue shields to the insulation.

B. Snap-On Shields:
   1. Cooper B-Line "Snap’N Shield".
   2. Snap-N Shield is an acceptable substitute for metal shields when installed with strut trapeze hangers on horizontal piping.
   3. Paintable polypropylene plastic 12-inch long preformed shields, snap-on design for attachment to strut.
   4. Gluing is not required with Snap-N Shield.
   5. Provide black or white color to match the insulation in areas exposed to public view.

C. Inserts:
   1. Configuration: Minimum 6 inches (150 mm) long, of same thickness and contour as adjoining insulation; may be factory fabricated.
2. Insert Material: Hydrous calcium silicate insulation or other heavy density insulating material suitable for the planned temperature range.

D. Saddles:
1. Factory fabricated of curved carbon steel plate, of same overall thickness and contour as adjoining insulation. Sides designed for welding to pipe. Center support plate for pipe sizes 12 inches (300 mm) and larger.

2.9 MANUFACTURER’S STAMP OR LABEL

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

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that piping has been tested before applying insulation materials.

B. Verify that surfaces are clean and dry, with foreign material removed.

3.2 INSTALLATION

A. Division 01 Section “Quality Requirements”: Manufacturer's instructions.

B. Install in accordance with NAIMA National Insulation Standards where applicable.

C. Provide insulation for surfaces of new piping and for surfaces of existing piping at piping modifications, as indicated and specified.

D. Insulation values shall meet or exceed the requirements of ASHRAE 90.1-2010, applicable State Energy Codes, and Table I, whichever is greater. In addition, comply with the other requirements of this Section.
   1. International Energy Conservation Code (IECC): Chapter 5 of the Code allows the use of ASHRAE 90.1 insulation thicknesses instead of the Minimum Pipe Insulation table which is in Chapter 5 of the IECC. This Specification does not reference the table in IECC.

E. Piping systems requiring insulation, types of insulation required, and insulation thickness shall be as listed in Table I herein. For piping not listed in Table 1, insulate to meet Code requirements, using suitable specified materials, subject to Architect’s approval. Except for flexible unicellular insulation, insulation thicknesses as specified in Table I shall be one inch (25 mm) greater for insulated piping systems located outside the building and in unconditioned spaces. Unless otherwise specified, insulate fittings, flanges, and valves, except valve stems, hand wheels, and operators. Use factory pre-molded, precut, or field-fabricated insulation of the same thickness and conductivity as used on adjacent piping. Insulation exterior shall be factory cleanable, grease resistant, non-flaking, and non-peeling.
F. Exposed Piping: Locate insulation and cover seams in least visible locations.

G. Insulated Pipes Conveying Fluids Below Ambient Temperature: Insulate entire system including fittings, valves, unions, flanges, strainers, flexible connections, and expansion joints.

H. Glass Fiber Insulated Pipes Conveying Fluids below Ambient Temperature:
   1. Provide vapor barrier jackets, factory-applied or field-applied. Secure with self-sealing longitudinal laps and butt strips with pressure sensitive adhesive. Secure with outward clinch expanding staples and vapor barrier mastic.
   2. Insulate fittings, joints, and valves with molded insulation of like material and thickness as adjacent pipe. Finish with glass cloth and vapor barrier adhesive or PVC fitting covers.

I. For hot piping conveying fluids 140°F (60°C) or less, do not insulate flanges and unions at equipment, but bevel and seal ends of insulation.

J. For hot piping conveying fluids over 140°F (60°C), insulate flanges and unions at equipment.

K. Glass Fiber Insulated Pipes Conveying Fluids above Ambient Temperature:
   1. Provide standard jackets, with or without vapor barrier, factory-applied or field-applied. Secure with self-sealing longitudinal laps and butt strips with pressure sensitive adhesive. Secure with outward clinch expanding staples.
   2. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe. Finish with glass cloth and adhesive or PVC fitting covers.

L. For piping which may operate at a range of temperatures (for example, heat recovery and heat exchange piping), provide insulation and vapor barriers as are suitable for the entire range of operation.

M. Large Valve Bodies and Other Fittings: Large valves and other fittings requiring service access may be insulated with removable, reusable equipment covers with “Velcro” closures. Refer to Division 23 Section “HVAC Equipment Insulation.”

N. Branches to Expansion Tanks: For hot water systems, insulate from the connection at the main to at least 10 feet (3 m) toward the tank.

O. Branches to Gauges, Sensors, Drains, and Vents: Insulate branches to gauges, sensors, drains, and vents as for active sections of piping. For piping with operating temperatures above ambient, insulate to at least 6 inches (150 mm) from the active main. For temperature devices, insulate to include the sensing bulb or other element.

P. Shields, Inserts, and Saddles:
   1. Application: Provide shields at hangers. Provide inserts for piping 2 in. (50 mm) nominal size or larger. Provide saddles for piping 6 in. (150 mm) nominal size and larger and for generator exhaust piping and muffler.
   2. Shield location: Between insulation jacket and hanger.
   3. Insert location: Between support shield and piping and under the finish jacket.
   4. Saddle location: Between support shield and piping.
   5. Tack-weld saddles to the pipe or muffler. Fill air spaces within the saddle with insulation material.
6. Glue shields to outside of insulation after system is filled and run at operating temperature.
7. Align mid-length of shields, inserts, and saddles with the hanger centerline.

Q. Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations. Finish at supports, protrusions, and interruptions. At fire separations, refer to Division 07.

R. Pipe Exposed in Mechanical Equipment Rooms 10 feet (3 meters) or Less Above Finished Floor:
1. Finish with PVC or ABS jacket and fitting covers.

S. Pipe Exposed in Finished Spaces 8 feet (2.44 meters) or Less Above Finished Floor: Finish with PVC or ABS jacket and fitting covers. Finished spaces shall include data server closets in addition to finish space definitions elsewhere in the Specifications.
1. Pipe Exposed in Toilet Rooms: Finish with stainless steel jacket and fitting covers.

T. Exterior Applications:
1. Provide vapor barrier jacket. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe, and finish with glass-mesh-reinforced vapor barrier cement.
2. Hot Water and Glycol Piping: Cover with aluminum or stainless steel jacket and fitting covers with seams located on bottom side of horizontal piping.
3. Other Piping: Cover with PVC jacket and fitting covers with seams located on bottom side of horizontal piping.

3.3 UNIFORM INSTALLATION
A. Systems shall use a single insulation type throughout the installation.

3.4 PREPARATION
A. Insulate piping after system tests have been completed and surfaces to be insulated have been cleaned of dirt, rust, and scale and dried. Ensure full range of motion of equipment actuators. Modify insulation to avoid obstruction of valve handles, safety reliefs, and other components requiring movement. Allow adequate space for pipe expansion. Install insulation with jackets drawn tight and cement down on longitudinal and end laps. Do not use scrap pieces where a full length section will fit. Insulation shall be continuous through sleeves, wall and ceiling openings. Extend surface finishes to protect surfaces, ends, and raw edges of insulation. Apply coatings and adhesives at the manufacturer’s recommended coverage per gallon. Individually insulate piping. Provide a moisture and vapor seal where insulation terminates against metal hangers, anchors and other projections through the insulation on surfaces for which a vapor seal is specified. Keep insulation dry during the application of any finish. Bevel and seal the edges of exposed insulation. Unless otherwise indicated, do not insulate the following:
1. Piping in radiation enclosures, or within cabinets of unit heaters.
2. Valve hand wheels.
4. Adjacent insulation.
5. ASME stamps.
3.5 PIPING INSULATION

A. Pipe Insulation (Except Elastomeric and Hydrous Calcium Silicate Insulation): Place sections of insulation around the pipe and joints tightly butted into place. The jacket laps shall be drawn tight and smooth. Secure jacket with fire resistant adhesive, factory applied self sealing lap. Cover circumferential joints with butt strips, not less than 3-inches (76 mm) wide, of material identical to the jacket material. Overlap longitudinal laps of jacket material not less than 1-1/2 inches (38 mm). Adhesive used to secure the butt strip shall be the same as used to secure the jacket laps. When a vapor barrier jacket is required, as indicated in Table I, or on the ends of sections of insulation that butt against flanges, unions, valves, fittings, and joints, use a vapor-barrier coating conforming to manufacturer's weatherproof coating for outside service. Apply this vapor barrier coating at longitudinal and circumferential laps. Patch damaged jacket material by wrapping a strip of jacket material around the pipe and cementing, and coating as specified for butt strips. Extend the patch not less than 1-1/2 inches (38 mm) past the break in both directions. At penetrations by pressure gauges and thermometers, fill the voids with the vapor barrier coating for outside service. Seal with a brush coat of the same coating. Where penetrating roofs, insulate piping to a point flush with the top of the flashing and seal with the vapor barrier coating. Butt tightly the exterior insulation to the top of the flashing and interior insulation. Extend the exterior metal jacket 2 inches (51 mm) down beyond the end of the insulation. Seal the flashing and counterflashing underneath with the vapor barrier coating.

B. Elastomeric Foam Insulation: Bond cuts, butt joints, ends, and longitudinal joints with adhesive. Miter 90-degree turns and elbows, tees, and valve insulation. Where pipes penetrate fire walls, provide mineral-fiber insulation inserts and sheetmetal sleeves. Insulate flanges, unions, valves, and fittings in accordance with manufacturer’s published instructions. Apply two coats of vinyl lacquer finish to elastomeric foam insulation before applying PVC jacket in outside locations.

C. Hydrous Calcium Silicate Pipe Insulation: Secure insulation with stainless steel metal bands on 12-inch maximum centers. For high temperature piping (above 600°F (315°C)), apply insulation in two layers with the joints tightly butted and staggered a minimum of 3-inches (76 mm). Secure the inner layer of insulation with 14 gauge soft annealed stainless steel wire on 12-inch (305 mm) maximum centers. The outer layer shall be secured with stainless steel metal bands on 12-inch (305 mm) maximum centers. Apply a skim coat of hydraulic setting cement directly to the insulation. When dry, apply a flooding coat of adhesive over the hydraulic setting cement. Press a layer of glass cloth or tape into adhesive and seal laps and edges with adhesive. Coat cloth with adhesive cut at a ratio of one part water to five parts adhesive in color other than white for the purpose of visual inspection to ensure sizing of entire surface. At Contractor's option, secure 0.016-inch (0.4 mm) thick metal jacket to surface of insulation.

D. Seal surfaces of fibrous insulation to prevent release of fibers.

E. Sleeves and Wall Chases: Where penetrating interior walls, extend a metal jacket 2 inches (51 mm) out on either side of the wall and secure on each end with a band. Where penetrating floors, extend a metal jacket from a point below the back-up material to a point 10 inches (254 mm) above the floor with one band at the floor and one not more than one inch from end of metal jacket. Where penetrating exterior walls, extend the metal jackets through the sleeve to a point 2 inches (51 mm) beyond the interior surface of the wall.
3.6 PAINTING AND IDENTIFICATION

A. Paint in accordance with Division 09 Section “Painting”. Piping identification shall be as specified in other sections.

3.7 FIELD INSPECTION

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

### TABLE I
PIPING INSULATION MATERIAL AND WALL THICKNESS

<table>
<thead>
<tr>
<th>SERVICE</th>
<th>INSULATION MATERIAL</th>
<th>VAPOR BARRIER REQUIRED</th>
<th>&lt;1&quot;</th>
<th>1&quot; to &lt;1.5&quot;</th>
<th>1.5&quot; to &lt;4&quot;</th>
<th>4&quot; to &lt;8&quot;</th>
<th>8&quot; or Greater</th>
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</thead>
<tbody>
<tr>
<td>Heating Systems (Hot Water and Glycol Supply and Return)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fluid Design Operating Temperature Range</td>
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<td></td>
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<td></td>
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<td></td>
<td></td>
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<tr>
<td>201°F to 250°F</td>
<td>Glass Fiber</td>
<td>No</td>
<td>2.5&quot;</td>
<td>2.5&quot;</td>
<td>2.5&quot;</td>
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<tr>
<td>141°F to 200°F</td>
<td>Glass Fiber</td>
<td>No</td>
<td>1.5&quot;</td>
<td>1.5&quot;</td>
<td>2&quot;</td>
<td>2&quot;</td>
<td>2&quot;</td>
</tr>
<tr>
<td>105°F to 140°F</td>
<td>Glass Fiber</td>
<td>Yes</td>
<td>1&quot;</td>
<td>1&quot;</td>
<td>1.5&quot;</td>
<td>1.5&quot;</td>
<td>1.5&quot;</td>
</tr>
<tr>
<td>Air Conditioning Condensate Drain Located Inside Building</td>
<td>Elastomeric Foam</td>
<td>N/A</td>
<td>0.75&quot;</td>
<td>0.75&quot;</td>
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<tr>
<td></td>
<td>Glass Fiber</td>
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<td>0.75&quot;</td>
<td>0.75&quot;</td>
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<tr>
<td>Refrigerant Suction Piping Operating Temperature</td>
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<tr>
<td>40°F to 60°F</td>
<td>Elastomeric Foam</td>
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<td>1&quot;</td>
<td>1&quot;</td>
<td>1.5&quot;</td>
<td>2&quot;</td>
</tr>
<tr>
<td>Below 40°F</td>
<td>Elastomeric Foam</td>
<td>N/A</td>
<td>1&quot;</td>
<td>1&quot;</td>
<td>1&quot;</td>
<td>1.5&quot;</td>
<td>2&quot;</td>
</tr>
</tbody>
</table>

END OF SECTION 230719
SECTION 230900 - INSTRUMENTATION AND CONTROL FOR MECHANICAL SYSTEMS

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 control equipment for HVAC systems and components, including control components for terminal heating and cooling units not supplied with factory-wired controls.

B. Related Sections include the following:
   1. Division 23 Section "Meters and Gages for HVAC Piping" for measuring equipment that relates to this Section.

1.3 DEFINITIONS

A. Note: The terms ATC, BAS, and DDC may be used interchangeably in this Section and on the Drawings, to indicate the overall control system.

B. Definitions:
   1. ATC: Automatic temperature control.
   2. BACnet: A control network technology platform for designing and implementing interoperable control devices and networks.
   3. BAS: Building Automation System.
   4. DDC: Direct digital control.
   5. I/O: Input/output.
   6. MS/TP: Master slave/token passing.
   7. PC: Personal computer.
   8. PID: Proportional plus integral plus derivative.

1.4 SYSTEM PERFORMANCE

A. Comply with the following performance requirements:
   1. Graphic Display: Display graphic with minimum 20 dynamic points with current data within 10 seconds.
   2. Graphic Refresh: Update graphic with minimum 20 dynamic points with current data within 8 seconds.
   3. Object Command: Reaction time of less than two seconds between operator command of a binary object and device reaction.
   4. Object Scan: Transmit change of state and change of analog values to control units or workstation within six seconds.
   5. Alarm Response Time: Annunciate alarm at workstation within 45 seconds. Multiple workstations must receive alarms within five seconds of each other.
6. Program Execution Frequency: Run capability of applications as often as five seconds, but selected consistent with mechanical process under control.

7. Performance: Programmable controllers shall execute DDC PID control loops, and scan and update process values and outputs at least once per second.

8. Reporting Accuracy and Stability of Control: Report values and maintain measured variables within tolerances as follows:
   a. Water Temperature: Plus or minus 1 deg F (0.5 deg C).
   b. Water Flow: Plus or minus 5 percent of full scale.
   c. Water Pressure: Plus or minus 2 percent of full scale.
   d. Space Temperature: Plus or minus 1 deg F (0.5 deg C).
   e. Ducted Air Temperature: Plus or minus 1 deg F (0.5 deg C).
   f. Outside Air Temperature: Plus or minus 2 deg F (1.0 deg C).
   g. Dew Point Temperature: Plus or minus 3 deg F (1.5 deg C).
   h. Temperature Differential: Plus or minus 0.25 deg F (0.15 deg C).
   i. Pressure Differential: Plus or minus 1 percent of full scale.
   j. Relative Humidity: Plus or minus 5 percent.
   k. Airflow (Pressurized Spaces): Plus or minus 3 percent of full scale.
   l. Airflow (Measuring Stations): Plus or minus 5 percent of full scale.
   m. Airflow (Terminal): Plus or minus 10 percent of full scale.
   n. Air Pressure (Space): Plus or minus 0.01-inch wg (2.5 Pa).
   o. Air Pressure (Ducts): Plus or minus 0.1-inch wg (25 Pa).
   p. Carbon Monoxide: Plus or minus 5 percent of reading.
   q. Carbon Dioxide: Plus or minus 50 ppm.
   r. Electrical: Plus or minus 5 percent of reading.

1.5 SUBMITTALS

A. Product Data: Include manufacturer's technical literature for each control device. Indicate dimensions, capacities, performance characteristics, electrical characteristics, finishes for materials, and installation and startup instructions for each type of product indicated.
   1. DDC System Hardware: Bill of materials of equipment indicating quantity, manufacturer, and model number. Include technical data for operator workstation equipment, interface equipment, control units, transducers/transmitters, sensors, actuators, valves, relays/switches, control panels, and operator interface equipment.
   2. Control System Software: Include technical data for operating system software, operator interface, color graphics, and other third-party applications.
   3. Controlled Systems: Instrumentation list with element name, type of device, manufacturer, model number, and product data. Include written description of sequence of operation including schematic diagram.

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
   1. Bill of materials of equipment indicating quantity, manufacturer, and model number.
   2. Schematic flow diagrams showing fans, pumps, coils, dampers, valves, and control devices.
   4. Details of control panel faces, including controls, instruments, and labeling.
   5. Written description of sequence of operation.
   6. Schedule of dampers including size, leakage, and flow characteristics.
   7. Schedule of valves including size and flow characteristics.
8. DDC System Hardware:
   a. Wiring diagrams for control units with termination numbers.
   b. Schematic diagrams and floor plans for field sensors and control hardware.
   c. Schematic diagrams for control, communication, and power wiring, showing trunk data conductors and wiring between operator workstation and control unit locations.

9. Control System Software: List of color graphics indicating monitored systems, data (connected and calculated) point addresses, output schedule, and operator notations.

10. Controlled Systems:
   a. Schematic diagrams of each controlled system with control points labeled and control elements graphically shown, with wiring.
   b. Scaled drawings showing mounting, routing, and wiring of elements including bases and special construction.
   c. Written description of sequence of operation including schematic diagram.
   d. Points list.

C. Data Communications Protocol Certificates: Certify that each proposed DDC system component complies with ASHRAE Standard 135 (BACnet).

D. Software and Firmware Operational Documentation: Include the following:
   1. Software operating and upgrade manuals.
   2. Program Software Backup: On a magnetic media or compact disc, complete with data files.
   3. Device address list.
   4. Printout of software application and graphic screens.
   5. Software license required by and installed for DDC workstations and control systems.

E. Software Upgrade Kit: For Owner to use in modifying software to suit future systems revisions or monitoring and control revisions.

F. Qualification Data: For Installer and manufacturer.

G. Field quality-control test reports.

H. Operation and Maintenance Data: For mechanical instrumentation and control system to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
   1. Maintenance instructions and lists of spare parts for each type of control device.
   2. Interconnection wiring diagrams with identified and numbered system components and devices.
   4. Inspection period, cleaning methods, cleaning materials recommended, and calibration tolerances.
   5. Calibration records and list of set points.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Automatic control system manufacturer's authorized representative who is trained and approved for installation of system components required for this Project.
B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with ASHRAE Standard 135 (BACnet) for DDC system components.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Factory-Mounted Components: Where control devices specified in this Section are indicated to be factory mounted on equipment, provide shipping of control devices to equipment manufacturer, in a timely manner coordinated with the equipment manufacturer.

B. Components to be Installed Under Other Sections: For components to be installed under other Sections of the Specifications, provide delivery of components to appropriate Subcontractors, provide installation instructions, and supervise their installation.

C. System Software: Update to latest version of software at Project completion.

1.8 COORDINATION

A. Coordinate location of thermostats and other exposed control sensors with plans and room details before installation.

B. Coordinate equipment with Division 26 to achieve compatibility with equipment that interfaces with that system.

C. Coordinate equipment with Division 26 to achieve compatibility with starter coils and annunciation devices.

D. Coordinate line-voltage power supplies with Division 26. Power controls from designated emergency-power circuits in coordination with Alternate #1.

1.9 EXTRA MATERIALS

A. (Not Used.)

PART 2 - PRODUCTS

2.1 ALTERNATE ACCEPTABLE SUPPLIERS

A. Acceptable Manufacturers and Installers:
   1. Control Technologies Inc., 70 Zachary Road, Manchester, NH 03109, Phone: 603-626-6070.
   2. No substitutions.

B. System components shall generally be the products of a single one of the manufacturer(s) listed above. Where manufacturers are listed in paragraphs below, those lists shall apply to their specific products only. Miscellaneous components which the control system manufacturer doesn’t manufacture such as cabling, conduits, transformers, and ice cube relays may be products of other manufacturers, subject to approval.
C. Control system shall consist of sensors, indicators, actuators, final control elements, interface equipment, other apparatus, accessories, and software connected to distributed controllers operating in a multi-user, multitasking environment on a token-passing network and programmed to control mechanical systems. An operator workstation permits interface with the network via dynamic color graphics with each mechanical system, building floor plan, and control device depicted by point-and-click graphics.

2.2 UNACCEPTABLE BIDDERS

A. Bids by wholesalers, contractors or franchised dealers or any other firm whose principal business is not that of manufacturing or installing automatic temperature control systems or of those not listed above shall not be acceptable. Bid documents that are not complete in their response to these documents or take exception to any of the capabilities defined within these documents will be rejected.

2.3 DDC EQUIPMENT

A. Operator Workstation: Existing on the college campus.

B. Application Software:
   1. Existing operating system shall be upgraded to latest control system.
   2. I/O capability from operator station.
   3. System security for each operator via software password and access levels.
   4. Automatic system diagnostics; monitor system and report failures.
   5. Database creation and support.
   7. Dynamic color graphic displays.
   8. Custom graphics generation and graphics library of Mechanical equipment and symbols.
   9. Alarm processing, messages, and reactions.
   10. Trend logs retrievable in spreadsheets and database programs.
   11. Alarm and event processing.
   12. Object and property status and control.
   13. Automatic restart of field equipment on restoration of power.
   14. Data collection, reports, and logs. Include standard reports for the following:
      a. Current values of objects.
      b. Current alarm summary.
      c. Disabled objects.
      d. Alarm lockout objects.
      e. Logs.
   15. Custom report development.
   16. Utility and weather reports.
   17. Workstation application editors for controllers and schedules.
   18. Maintenance management.

C. Control Units: Modular, comprising processor board with programmable, nonvolatile, random-access memory; local operator access and display panel; integral interface equipment; and backup power source.
   1. Units monitor or control each I/O point; process information; execute commands from other control units, devices, and operator stations; and download from or upload to operator workstation or diagnostic terminal unit.
2. Stand-alone mode control functions operate regardless of network status. Functions include the following:
   a. Global communications.
   b. Discrete/digital, analog, and pulse I/O.
   c. Monitoring, controlling, or addressing data points.
   d. Software applications, scheduling, and alarm processing.
   e. Testing and developing control algorithms without disrupting field hardware and controlled environment.
3. Standard Application Programs:
   a. Electric Control Programs: Demand limiting, duty cycling, automatic time scheduling, start/stop time optimization, night setback/setup, on-off control with differential sequencing, staggered start, antishort cycling, PID control, DDC with fine tuning, and trend logging.
   b. Mechanical Control Programs: Optimal run time, supply-air reset, and enthalpy switchover.
   c. Programming Application Features: Include trend point; alarm processing and messaging; weekly, monthly, and annual scheduling; energy calculations; run-time totalization; and security access.
   d. Remote communications.
   e. Maintenance management.
   f. Units of Measure: Inch-pound and SI (metric).
4. Local operator interface provides for download from or upload to operator workstation or diagnostic terminal unit.
5. ASHRAE 135 (BACnet) Compliance: Control units shall use BACnet protocol and communicate using ISO 8802-3 (Ethernet) datalink/physical layer protocol.

D. I/O Interface: Hardwired inputs and outputs may tie into system through controllers. Protect points so that shorting will cause no damage to controllers.
1. Binary Inputs: Allow monitoring of on-off signals without external power.
2. Pulse Accumulation Inputs: Accept up to 10 pulses per second.
3. Analog Inputs: Allow monitoring of low-voltage (0- to 10-V dc), current (4 to 20 mA), or resistance signals.
4. Binary Outputs: Provide on-off or pulsed low-voltage signal, selectable for normally open or normally closed operation with three-position (on-off-auto) override switches and status lights.
5. Analog Outputs: Provide modulating signal, either low voltage (0- to 10-V dc) or current (4 to 20 mA).
7. Universal I/Os: Provide software selectable binary or analog outputs.

E. Any temperature control panels required shall be powered by the ATC Subcontractor.

F. Wall mounted thermostats and temperature sensors shall be attached either to a wall stud or to blocking, or to an electrical wall box attached to such wall framing. Attaching to gypsum wallboard only shall not be allowed.

G. Aquastats installed on unit heaters and at any location above 5'-0" (1525 mm) above finished floor shall be installed with adjustment knobs facing downward to facilitate adjustment.

H. Outdoor air temperature sensor(s) shall be installed on the North side of the building.
I. Thermostats and temperature sensors are shown on the Drawings for general location. Terminal heat transfer units and fans which control space temperature shall be provided with thermostatic control, whether or not a thermostat or temperature sensor has been shown on the Drawings.

J. Power Supplies: Transformers with Class 2 current-limiting type or overcurrent protection; limit connected loads to 80 percent of rated capacity. DC power supply shall match output current and voltage requirements and be full-wave rectifier type with the following:
   1. Output ripple of 5.0 mV maximum peak to peak.
   2. Combined 1 percent line and load regulation with 100-microsecond response time for 50 percent load changes.
   3. Built-in overvoltage and overcurrent protection and be able to withstand 150 percent overload for at least 3 seconds without failure.

K. Power Line Filtering: Internal or external transient voltage and surge suppression for workstations or controllers with the following:
   1. Minimum dielectric strength of 1000 V.
   3. Minimum transverse-mode noise attenuation of 65 dB.
   4. Minimum common-mode noise attenuation of 150 dB at 40 to 100 Hz.

2.4 SPARE POINTS

A. Provide a minimum of 10% spare points or 16 spare points, whichever is greater, in each ATC control panel for future use. Spare points shall be equally distributed among analog input, analog output, digital input and digital output. It is not intended that spare points be provided in unitary control panels which serve room duct reheat coils and fintube heating. It is intended that spare points be provided in master control panels and in panels which serve boiler rooms and air handling units.

2.5 THERMOSTATS

A. Freezestat safety low limit shall be duct-mounted manual reset 20 foot limited fill type responsive to the coolest section of its length.

2.6 ELECTRONIC SENSORS

A. Description: Vibration and corrosion resistant; for wall, immersion, or duct mounting as required.

   B. Thermistor Temperature Sensors and Transmitters:
      1. Accuracy: Plus or minus 0.5 deg F (0.3 deg C) at calibration point.
      2. Wire: Twisted, shielded-pair cable.
      3. Insertion Elements in Ducts: Single point, 8 inches (200 mm) long; use where not affected by temperature stratification or where ducts are smaller than 9 sq. ft. (0.84 sq. m).
      4. Averaging Elements in Ducts: 36 inches (915 mm) long, flexible; use where prone to temperature stratification or where ducts are larger than 10 sq. ft. (1 sq. m).
      5. Insertion Elements for Liquids: Brass or stainless-steel socket with minimum insertion length of 2-1/2 inches (64 mm).
      6. Room Sensor Cover Construction: See below.
      7. Outside-Air Sensors: Watertight inlet fitting, shielded from direct sunlight.

C. Humidity Sensors: Bulk polymer sensing element.
   1. Accuracy: 2 percent full range with linear output.
   2. Room Sensor Range: 20 to 80 percent relative humidity.
   3. Room Sensor Cover Construction: See below.

D. Pressure Transmitters/Transducers:
   1. Static-Pressure Transmitter: Nondirectional sensor with suitable range for expected input, and temperature compensated.
      a. Accuracy: 2 percent of full scale with repeatability of 0.5 percent.
      b. Output: 4 to 20 mA.
      c. Duct Static-Pressure Range: 0- to 5-inch wg (0 to 1240 Pa).
   2. Water Differential-Pressure Transducers: Stainless-steel diaphragm construction, suitable for service; minimum 150-psig (1034-kPa) operating pressure and tested to 300-psig (2070-kPa); linear output 4 to 20 mA.
   3. Differential-Pressure Switch (Air or Water): Snap acting, with pilot-duty rating and with suitable scale range and differential.

E. Room Sensor Cover Construction: Manufacturer's standard locking covers.
   1. Set-Point Adjustment: Concealed.
   2. Set-Point Indication: Concealed.
   3. Thermometer: Concealed.
   4. Communications Port: Standard phone-type jack for connection of portable laptop computer and other devices. Provide at each room sensor, no exceptions.
   5. Override Pushbutton: For timed override of occupied/unoccupied cycle. Provide in normally-occupied rooms such as classrooms, shops, offices, cafeterias, kitchen, lecture hall, band and chorus rooms, and gymnasiums. Do not provide in storage rooms, stairs, entries, vestibules, corridors, elevator machine rooms, electrical rooms, Comm rooms, and mechanical rooms.

F. Room sensor accessories include the following:
   1. Insulating Bases: For sensors located on exterior walls.
   2. Adjusting Key: As required for calibration and cover screws. Furnish to the Owner, at least 5 per sensor type.
   3. Guards: Cast aluminum, with large openings for easy viewing of sensor, rounded surfaces to prevent injury, equivalent to Siemens Model 134-117 thermostat guard. Provide where directed in Part 3 of this Specification Section.
   4. Wall Mounting Box: Recessed, steel, securely fastened to wall framing. Equal to Steel City metallic switch boxes by Thomas & Betts Corp. Box may only be omitted where sensor attaches directly to masonry construction.

2.7 STATUS SENSORS

A. Status Inputs for Fans: Differential-pressure switch with pilot-duty rating and with adjustable range of 0- to 5-inch wg (0 to 1240 Pa).

B. Status Inputs for Pumps: Differential-pressure switch with pilot-duty rating and with adjustable pressure-differential range of 8 to 60 psig (55 to 414 kPa), piped across pump.
C. Status Inputs for Electric Motors: Comply with ISA 50.00.01, current-sensing fixed- or split-core transformers with self-powered transmitter, adjustable and suitable for 175 percent of rated motor current.

D. Voltage Transmitter (100- to 600-V ac): Comply with ISA 50.00.01, single-loop, self-powered transmitter, adjustable, with suitable range and 1 percent full-scale accuracy.

E. Current Switches: Self-powered, solid-state with adjustable trip current, selected to match current and system output requirements.

F. Electronic Valve/Damper Position Indicator: Visual scale indicating percent of travel and 2- to 10-V dc, feedback signal.

G. Water-Flow Switches: Bellows-actuated mercury or snap-acting type with pilot-duty rating, stainless-steel or bronze paddle, with appropriate range and differential adjustment, in NEMA 250, Type 1 enclosure.

2.8 GAS DETECTION EQUIPMENT

A. Carbon Dioxide Sensor and Transmitter: Single detectors using solid-state infrared sensors; suitable over a temperature range of 23 to 130 deg F (minus 5 to plus 55 deg C) and calibrated for 0 to 2 percent, with continuous or averaged reading, 4- to 20-mA output; for wall mounting or duct mount, depending on application.

B. Occupancy Sensor: Provided by Division 26.

2.9 ACTUATORS

A. Electric Motors: Size to operate with sufficient reserve power to provide smooth modulating action or two-position action.
   1. Comply with requirements in Division 23 Section "Motors, Drives, and Accessories."
   2. Permanent Split-Capacitor or Shaded-Pole Type: Gear trains completely oil immersed and sealed. Equip spring-return motors with integral spiral-spring mechanism in housings designed for easy removal for service or adjustment of limit switches, auxiliary switches, or feedback potentiometer.
   3. Nonspring-Return Motors for Valves Larger Than NPS 2-1/2 (DN 65): Size for running torque of 150 in. x lbf (16.9 N x m) and breakaway torque of 300 in. x lbf (33.9 N x m).
   4. Spring-Return Motors for Valves Larger Than NPS 2-1/2 (DN 65): Size for running and breakaway torque of 150 in. x lbf (16.9 N x m).
   5. Nonspring-Return Motors for Dampers Larger Than 25 Sq. Ft. (2.3 sq. m): Size for running torque of 150 in. x lbf (16.9 N x m) and breakaway torque of 300 in. x lbf (33.9 N x m).
   6. Spring-Return Motors for Dampers Larger Than 25 Sq. Ft. (2.3 sq. m): Size for running and breakaway torque of 150 in. x lbf (16.9 N x m).

B. Electronic Actuators: Direct-coupled type designed for minimum 60,000 full-stroke cycles at rated torque.
   1. Manufacturers:
      a. Belimo.
   2. Valves: Size for torque required for valve close off at maximum pump differential pressure.
3. Dampers: Size for running torque calculated as follows:
   a. Parallel-Blade Damper with Edge Seals: 7 inch-lb/sq. ft. (86.8 kg-cm/sq. m) of damper.
   b. Opposed-Blade Damper with Edge Seals: 5 inch-lb/sq. ft. (62 kg-cm/sq. m) of damper.
   c. Dampers with 2- to 3-Inch wg (500 to 750 Pa) of Pressure Drop or Face Velocities of 1000 to 2500 fpm (5 to 13 m/s): Increase running torque by 1.5.
   d. Dampers with 3- to 4-Inch wg (750 to 1000 Pa) of Pressure Drop or Face Velocities of 2500 to 3000 fpm (13 to 15 m/s): Increase running torque by 2.0.
5. Overload Protection: Electronic overload or digital rotation-sensing circuitry.
7. Power Requirements (Two-Position Spring Return): 24-V ac.
8. Power Requirements (Modulating): Maximum 10 VA at 24-V ac or 8 W at 24-V dc.
9. Proportional Signal: 2- to 10-V dc or 4 to 20 mA, and 2- to 10-V dc position feedback signal.
10. Temperature Rating: 40 to 104 deg F (5 to 40 deg C).
    a. In addition, valve actuators shall be suitable for the anticipated ambient temperature and fluid temperature. For example, actuators located within heating equipment terminal enclosures will experience higher temperatures.
11. Temperature Rating (Smoke Dampers): Minus 22 to plus 250 deg F (Minus 30 to plus 121 deg C).
12. Run Time: 30 seconds.
13. Actuator Housing: Molded or die-cast zinc or aluminum. Terminal unit actuators may be high-impact plastic with ambient temperature rating of 50 to 140 deg F (10 to 60 deg C) unless located in return-air plenums.
14. Damper actuators shall be provided with end switches.

2.10 CONTROL VALVES

A. Control Valves: Factory fabricated, of type, body material, and pressure class based on maximum pressure and temperature rating of piping system, unless otherwise indicated.
   1. Globe-type valves are required except for those applications where terminal-unit control valves or butterfly valves are specified or detailed.
   2. Ball-type valves may be substituted for other types, and shall be manufactured by Belimo, with Belimo actuators (no substitutions).
   3. Valves shall be suitable for water with up to 50% inhibited ethylene or propylene glycol.
   4. 3-way valves shall be mixing pattern, except where diverting pattern is specified, or where manufacturer requires use of diverting pattern.
   5. Rubber-paddle or ball-plug type control valves such as, but not limited to, Honeywell Fan-Coil Valves or the TAC Erie product line (division of Schneider Electric) are not allowed.
   6. Valves with thermal-wax motors are not allowed.
   7. Valves requiring cartridge replacement for service are not allowed.
   8. Valves requiring special water treatment such as 50-micron filtration are not allowed.

B. Sizing: Maximum pressure drop determined with valve full-open at design flow rate and the following:
2. Two-Way Modulating: Between one-half and one times the variable-flow load pressure drop, but not to exceed 3 psig (21 kPa).
3. Three-Way Modulating: Between one-half and one times the variable-flow load pressure drop, but not to exceed 1.5 psig (10.5 kPa).
4. Note: For modulating valves, the load pressure drop is that across the modulated portion of the system. For example, for a 3-way valve providing reset-water control at a boiler, the modulated flow is across the boiler and accessories, whereas the building loop to terminal equipment is considered constant-flow for the purposes of this valve’s sizing. For a 3-way valve modulating the flow thru a coil, the coil and its pipe fittings comprise the variable-flow load. For a 3-way valve in a primary-secondary loop to a coil, where the flow thru the coil is a constant pumped flow, the variable load is in the primary-secondary bridge.

C. Hydronic system globe valves shall have the following characteristics:
1. NPS 2 (DN 50) and Smaller: Class 125 bronze (or red brass) body, bronze or brass seat, bronze trim, rising stainless steel stem, renewable brass or composition disc or plug, screwed ends, with backseating capacity, repackable under pressure. Valve may have integral union ends. Valves with ends other than threaded or factory-integral unions are not allowed.
2. NPS 2-1/2 (DN 65) and Larger: Class 125 iron body, bronze trim, rising stem, plug-type disc, flanged ends, and renewable seat and disc.
3. Internal Construction: Replaceable plugs and stainless-steel or brass seats.
   a. Single-Seated Valves: Cage trim provides seating and guiding surfaces for plug on top and bottom.
   b. Double-Seated Valves: Balanced plug; cage trim provides seating and guiding surfaces for plugs on top and bottom.
4. Flow Characteristics: Two-way valves shall have equal percentage characteristics; three-way valves shall have linear characteristics through one of the ports, equal percentage through the other.
5. Close-Off (Differential) Pressure Rating: Combination of actuator and trim shall provide minimum close-off pressure rating of 150 percent of total system (pump) head for 2-way valves, and 100 percent of pressure differential across valve or 100 percent of total system (pump) head for 3-way valves.

D. Terminal Unit Control Valves: Bronze body, bronze trim, two or three ports as indicated, replaceable plugs and seats, and union and threaded ends. Valves with ends other than threaded or factory-integral unions are not allowed.
1. Applications: Duct-mounted reheat coils, and fintube radiation. For other applications, see globe valve specifications above.
2. Honeywell "small linear control valves" with "linear valve actuators" (or equal) may be used only for VAV box coils and hot water duct coils; they may not be used for other coil or equipment types.
3. Rating: Class 125 for service at 125 psig (860 kPa) and 250 deg F (121 deg C) operating conditions.
4. Close-Off (Differential) Pressure Rating: Combination of actuator and trim shall provide minimum close-off pressure rating sufficient to close against pump shutoff head.
5. Flow Characteristics: Two-way valves shall have equal percentage characteristics; three-way valves shall have linear characteristics.
2.11 DAMPERS

A. Manufacturers:
1. Non-Insulated Dampers:
   a. Ruskin - Model CD60.
   b. American Warming & Ventilating.
   c. Arrow.
   d. Greenheck.
   e. Tamco (T.A. Morrison & Co., Inc.).
2. Insulated-Blade Dampers:
   a. T.A. Morrison & Co., Inc.; Tamco Series 9000 SC “Severe Cold Option” dampers.
   b. Ventex, Inc. - Series 3965 SC.

B. Non-Insulated Dampers:
1. AMCA-rated, parallel (two-position) or opposed-blade (modulating) design.
2. Frames shall be 16 ga. (1.6 mm) thick galvanized steel, reinforced to equivalent strength of 11 ga. (3 mm) galvanized steel; or 0.125 inch (3.2 mm) minimum thickness extruded-aluminum.
3. Blades shall be airfoil type of not less than 14 ga. (2 mm) equivalent thickness galvanized steel or heavy gauge extruded aluminum, with maximum blade width of 8 inches (200 mm) and length of 48 inches (1220 mm).
4. Secure blades to 1/2 inch (13 mm) diameter, hex-profile, zinc-plated axles using zinc-plated hardware, with oil-impregnated sintered bronze or nylon blade bearings, blade-linkage hardware of zinc-plated steel and brass, ends sealed against spring-stainless-steel blade bearings, and thrust bearings at each end of every blade.
5. Operating Temperature Range: From -40 to 200 deg F (-40 to 93 deg C).
6. Edge Seals, Low-Leakage Applications: Replaceable, inflatable blade edging of Ruskiprene, neoprene, vinyl, or rubber, and spring-loaded stainless-steel side seals, rated for leakage at less than 10 cfm per sq. ft (50 L/s per sq. m) of damper area, at differential pressure of 4-inch wg (1 kPa) when damper is held by torque of 50 in.-lbf (5.6 N-m); when tested according to AMCA 500D-98.

C. Insulated Dampers: Dampers which are located in or 4 ft (1.2 m) or less from outside walls or roof lines, and are 8 sq. ft (0.74 sq. m) or larger, shall be thermally insulated type.
1. Frame: Extruded aluminum, externally insulated with polystyrene foam.
2. Blades: Double wall extruded aluminum, with internal injected polyurethane foam, thermally broken. Extruded silicone frame and blade seals, secured in slots in the aluminum extrusions. R-value of complete blade shall be 2.29 hr-sq. ft-deg F/Btu (0.39 sq. m-deg K/W).
3. Leakage shall not exceed 4.9 cfm per sq. ft (25 L per sq. m) against 4-inch wg (1 kPa) differential static pressure at -40 deg F (-40 deg C).
4. Bearings: Celcon inner bearing fixed to a 7/16” (11.1 mm) aluminum hexagon blade pin, rotating within a polycarbonate outer bearing inserted in the frame, resulting in no metal-to-metal or metal-to-plastic contact.
5. Linkage Hardware: Installed in the frame side, constructed of aluminum and corrosion-resistant, zinc-plated steel, with cup-point trunnion screws for a slip-proof grip.
6. Operating Temperatures: -40 to 155 deg F (-40 to 68 deg C).
7. For dampers less than 12 inches (305 mm) in one dimension, provide “flanged-to-duct” mounting style for maximum free area.
D. Automatic dampers at exterior wall louvers shall be 4 inches (100 mm) shorter in vertical dimension (height) than the louver they serve, to allow sloping of bottom of duct to drain outward.

2.12 CONTROL CABLE

A. Electronic and fiber-optic cables for control wiring are specified in Division 26, provided under this Section.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that power supply and data outlet is available to control units and operator workstation.

3.2 INSTALLATION

A. Install software in control units and operator workstation(s). Implement features of programs to specified requirements and as appropriate to sequence of operation.

B. Connect and configure equipment and software to achieve sequence of operation specified.

C. Provide interconnecting wiring to the communications jack on each room temperature sensor to allow full access to the ATC system from each room sensor.

D. Verify location of room temperature sensors and other exposed control sensors with Drawings and room details before installation.
   1. Install devices 54 inches (1.37 m) above the floor where side approach is possible, and 48 inches (1.22 m) above the floor where front approach is required. Verify mounting heights with authorities having jurisdiction to comply with requirements of the Americans with Disabilities Act (ADA).
   2. Locate in the general location indicated, and coordinate to group together with room light switches and other devices of similar height, to minimize disruption of open wall space.
   3. Locate to not be above electrical dimmers.
   4. Locate to avoid heat-generating equipment such as computers, copiers, cooking equipment, coffee makers, vending machines, and refrigerators. Where electrical outlets are indicated near sensors, verify whether equipment is intended.
   5. Locate to avoid heating piping which may be concealed in partitions.
   6. Locate away from windows and exterior doors.
   7. Locate to avoid other false sources of heat such as strong sunlight.

E. Install averaging elements in ducts and plenums in crossing or zigzag pattern.

F. Provide guards on room sensors and thermostats in the following locations:
   1. Public areas other than classrooms and offices, including but not limited to: Corridors, hallways, entrances, lobbies, vestibules, stairwells, and storage rooms.
   2. Locations vulnerable to traffic.
   3. Where indicated.
G. For components to be installed under other Sections of the Specifications, provide delivery of components to appropriate Subcontractors, provide installation instructions, and supervise their installation.

H. Install hydronic instrument wells, valves, and other accessories according to Division 23 Section "Hydronic Piping."
   1. Sensors shall be immersion type in wells unless otherwise specified or indicated.
   2. Enlarge piping at wells to prevent excess interference with flow.
   3. Locate wells to ensure insertion in active flowing section of piping or tank.
   4. Fill sensor wells with Honeywell thermal heat transfer paste to ensure good conduction.

I. Install refrigerant instrument wells, valves, and other accessories according to Division 23 Section "Refrigerant Piping."

J. Install automatic dampers according to Division 23 Section "Air Duct Accessories."

K. Install damper motors on outside of duct in warm areas, not in locations exposed to outdoor temperatures. Provide stand-off brackets of depth to meet or exceed specified thickness of duct insulation.

L. Install duct volume-control dampers according to Division 23 Sections specifying air ducts.

M. Install labels and nameplates to identify control components according to Division 23 Section "Identification for HVAC Piping and Equipment."

N. Install electronic and fiber-optic cables according to Division 26 and/or 27 as applicable.

O. Unless otherwise indicated, actuators shall be spring loaded and shall, upon a loss of power, actuate their device to an appropriate fail safe position.
   1. Hot water valves - fail safe to fully open.
   2. Outside and exhaust air dampers - fail safe to fully closed.
   3. Supply air dampers at rooftop units - fail safe to fully closed.
   4. Return air dampers - fail safe to fully open.
   5. Boiler Room combustion air damper at upturned duct - fail safe to full open.
   6. Boiler Room combustion air damper at down turned duct - fail safe to fully closed.

P. For actuators that are required to fail safe provide spring return actuators. “Floating point” actuators shall not be allowed for these applications. “Floating point” actuators shall be allowed for actuators that are not required to “fail safe”.

3.3 INTERFACE WITH FIRE ALARM SYSTEM SHUT DOWN

A. For equipment that is required to shut down upon a fire alarm condition, ensure that equipment is wired through input contacts within the starter enclosure to interface with the building’s fire alarm system. Upon receipt of a signal from the building’s fire alarm system, power to the load side of the starter shall be turned off. Provide circuitry to ensure that power is off whether the starter is in the “AUTO”, “HAND” or “BYPASS” mode. If this feature is not available from the starter manufacturer, provide a contactor on the line side of the starter to accomplish the same function. The contractor shall meet the requirements of Division 26.
3.4 ELECTRICAL WIRING AND CONNECTION INSTALLATION

A. Provide electrical materials and installation under this Section. Requirements and standards shall be as specified in other Sections and Divisions of the Specifications, as indicated in paragraphs below.

B. Install raceways, boxes, and cabinets according to Division 26.

C. Install building wire and cable according to Division 26.

D. Provide interface wiring (line and low voltage) as required to complete ATC system installation.

E. Install signal and communication cable according to Division 27.
   1. Conceal cable, except in mechanical rooms and areas where other conduit and piping are exposed.
   2. Install exposed cable in raceway.
   3. Install concealed cable in raceway.
   4. Bundle and harness multi-conductor instrument cable in place of single cables where several cables follow a common path.
   5. Fasten flexible conductors, bridging cabinets and doors, along hinge side; protect against abrasion. Tie and support conductors.
   6. Number-code or color-code conductors for future identification and service of control system, except local individual room control cables.
   7. Install wire and cable with sufficient slack and flexible connections to allow for vibration of piping and equipment.

F. Connect manual-reset limit controls independent of manual-control switch positions. Automatic duct heater resets may be connected in interlock circuit of power controllers.

G. Connect hand-off-auto selector switches to override automatic interlock controls when switch is in hand position.

H. Connect lead-lag controls to lock out the failed or non-selected motor, to prevent simultaneous operation.

I. Connect lead-lag controls so that only one motor can run in starter “hand” position.

J. Connect fire alarm shutdown of motors on the load side of controls and hand-off-auto switches, to prevent motor from running in any switch position during fire alarm.

3.5 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.

B. Perform the following field tests and inspections and prepare test reports:
   1. Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation. Remove and replace malfunctioning units and retest.
   2. Test and adjust controls and safeties.
C. DDC Verification:
1. Verify that instruments are installed before calibration, testing, and loop or leak checks.
2. Check instruments for proper location and accessibility.
3. Check instrument installation for direction of flow, elevation, orientation, insertion depth, and other applicable considerations.
4. Check flow instruments. Inspect tag number and line and bore size, and verify that inlet side is identified and that meters are installed correctly.
5. Check pressure instruments, piping slope, installation of valve manifold, and self-contained pressure regulators.
6. Check temperature instruments and material and length of sensing elements.
7. Check control valves. Verify that they are in correct direction.
8. Check DDC system as follows:
   a. Verify that DDC controller power supply is from emergency power supply, if applicable.
   b. Verify that wires at control panels are tagged with their service designation and approved tagging system.
   c. Verify that spare I/O capacity has been provided.
   d. Verify that DDC controllers are protected from power supply surges.

D. Replace damaged or malfunctioning controls and equipment and repeat testing procedures.

3.6 ADJUSTING

A. Calibrating and Adjusting:
1. Calibrate instruments.
2. Make three-point calibration test for both linearity and accuracy for each analog instrument.
3. Calibrate equipment and procedures using manufacturer's written recommendations and instruction manuals. Use test equipment with accuracy at least double that of instrument being calibrated.
4. Control System Inputs and Outputs:
   a. Check analog inputs at 0, 50, and 100 percent of span.
   b. Check analog outputs using milliampere meter at 0, 50, and 100 percent output.
   c. Check digital inputs using jumper wire.
   d. Check digital outputs using ohmmeter to test for contact making or breaking.
   e. Check resistance temperature inputs at 0, 50, and 100 percent of span using a precision-resistant source.
5. Flow:
   a. Set differential pressure flow transmitters for 0 and 100 percent values with 3-point calibration accomplished at 50, 90, and 100 percent of span.
   b. Manually operate flow switches to verify that they make or break contact.
6. Pressure:
   a. Calibrate pressure transmitters at 0, 50, and 100 percent of span.
   b. Calibrate pressure switches to make or break contacts, with adjustable differential set at minimum.

7. Temperature:
   a. Calibrate resistance temperature transmitters at 0, 50, and 100 percent of span using a precision-resistance source.
   b. Calibrate temperature switches to make or break contacts.
8. Stroke and adjust control valves and dampers without positioners, following the manufacturer's recommended procedure, so that valve or damper is 100 percent open and closed.
9. Stroke and adjust control valves and dampers with positioners, following manufacturer's recommended procedure, so that valve and damper is 0, 50, and 100 percent closed.
10. Provide diagnostic and test instruments for calibration and adjustment of system.
11. Provide written description of procedures and equipment for calibrating each type of instrument. Submit procedures review and approval before initiating startup procedures.

B. Adjust initial temperature set points.

C. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to three visits to Project during other than normal occupancy hours for this purpose.

3.7 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain Mechanical instrumentation and controls. Refer to Division 01 Section "Demonstration and Training."

3.8 TRAINING

A. Training shall be by the ATC Subcontractor and shall utilize specified manuals and as-built documentation. The Owner may choose to video record the training.

B. Operator training shall include 2 four-hour sessions encompassing:
   1. Sequence of Operation review.
   2. Selection of displays and reports.
   3. Use of the specified functions.
   4. Setting and adjusting of occupancy schedules.
   5. Troubleshooting of sensors.
   6. Owner questions/concerns.

C. 1 training session shall be conducted at project substantial completion, and the other shall be conducted at the Owner's request and in accordance with the Owner's schedule within a period of 6 months after substantial completion of the project.

D. At 6 months after substantial completion, unused training hours shall be, at the Owner's discretion, used for future training of new personnel or reimbursed to the Owner at the Subcontractor’s current hourly service rate.

PART 4 - SEQUENCES OF OPERATION

4.1 GENERAL

A. Setpoints shall be adjustable by the building operator through the graphic interface on the operator’s workstation desktop PC, and through a portable laptop computer plugged into the system at locations throughout the building.
B. Provide the ability for the Testing and Balancing Agent to connect to the system and change setpoints, to temporarily override setpoints, and to override modes of operation, as may be required for their work.

4.2 ALARMS

A. Provide the capability to generate alarms, complete with individualized per point alarm message. Disable alarms when their associated system has been disabled as part of a standard control function. For example, when hot water system is inactive during the summer months and hot water temperature drops below the low water temperature alarm set point, do not generate an alarm.

B. Environmental Alarms: Provide a digital output point to deliver an environmental alarm signal to the building's security system. Provide digital output point and associated wiring to the security panel. Final connection to security panel shall be by Division 26 (coordinate with Division 26). The environmental alarm shall be a single point. The following alarm conditions shall activate the environmental alarm:
1. Pump failure (hot water pumps and glycol pumps)
2. Low temperature (below 50 deg F) at each room temperature sensor
3. Low heating water system supply temperature
4. Fan failure on air handling units and exhaust fans
5. Freezestat alarm for air handling units

4.3 EXISTING HOT WATER CIRCULATING PUMPS (HWP-1 & 2)

A. Existing controls provide lead-lag and variable-speed control of the pumps.

B. Piping system differential-pressure sensors, provided under this Section and installed in piping mains on 2nd and 3rd floors where indicated, provide input signals to control the pumps’ variable-frequency drive. The variable frequency drive modulates pump speed to maintain system differential pressures.
1. Differential pressure setpoints are determined by the Testing and Balancing (TAB) Agent and are the value at which design water flow is achieved at each sensor.
2. The system has the capability to operate on a single sensor selected by the operator; It is also able to operate on 2 or more sensors selected by the operator, responding to the sensor which has the greatest deviation from setpoint.
3. When the differential pressure sensor(s) call for increased pressure, the variable frequency drive for the lead pump modulates the pump motor speed from minimum to maximum to maintain the differential pressure setpoint.
4. The ATC system monitors VFD status, and other data. If a VFD indicates trouble, an alarm is generated. If the lead-pump VFD indicates trouble, the lead pump and its VFD are locked out and the lag pump is energized.

C. Operator Station Display: At a minimum, indicate the following on operator workstation display terminal, in addition to existing displays:
1. Circulating Pumps HWP-1 & 2:
   a. Heating system and pump demand on/off.
   b. Lead/lag pump selection status.
   c. VFD reference speed.
   d. VFD actual speed output.
   e. Alarm silencing.
2. Building piping loop:
   a. Differential pressure setpoint at each remote sensor.
   b. Differential pressure reading at each remote sensor.
   c. Selection of one or more remote DP sensors to control pump speed.

4.4 GLYCOL CIRCULATING PUMPS (GP-1 & 2) AND HEAT EXCHANGER (HX-1)

   A. The hot water supply has existing controls which reset its temperature based on outside air temperature. The heat exchanger glycol outlet supply temperature is indirectly reset because the incoming hot water side of the heat exchanger is reset.

   B. Temperature sensors in the supply and return piping monitor the fluid temperatures. An alarm is generated if either temperature is above or below a setpoint range.

   C. The pumps operate in lead/lag mode. The selection of lead pump is alternated based on runtime hours. If the lead pump fails, the lag pump is energized, the lead pump is locked out, and an alarm is generated. If both pumps fail, a critical environmental alarm is generated.

   D. The lead pump is energized whenever the outside air temperature is at or below setpoint (initial setpoint 55°F, adjustable). When the outside air temperature is above setpoint, the pump cycles on a call for heating from AC-3. After the pump starts, a time delay keeps the pump energized for a minimum of 15 minutes (adjustable).

   E. Differential pressure analog sensors monitor pump status.

   F. Operator Station Display: At a minimum, indicate the following on operator workstation display terminal:
      1. Circulating Pumps GP-1 & 2:
         a. Pump demand on/off.
         b. Lead/lag pump selection status.
         c. Lead pump manual selection.
         d. Pump differential pressure and setpoint.
         e. Outside air temperature.
         f. AC-3 call for heating.
         g. Time delay time remaining.
         h. Alarms.
         i. Alarm silencing.
      2. Building piping loop:
         a. Supply and return temperatures.
         b. Temperature range setpoints.
         c. Temperature alarms.

4.5 FINTUBE RADIATION

   A. See Line Item Pricing on Bid Form for 3rd floor corridors.

   B. Space Sensor:
      1. Offices: Wall-mounted, with setpoint adjustment.
      2. Toilet Room and Corridors: Wall-mounted, with guard and blank cover.
C. Space sensor cycles 2-position control valve to maintain room temperature (setpoint 70°F occupied/60°F unoccupied, adjustable).

D. Operator Station Display: At a minimum, indicate the following on operator workstation display terminal:
1. Space temperature.
2. Valve on/off command.

4.6 DUCT-MOUNTED REHEAT COILS

A. Space Sensor: Wall-mounted, with setpoint override and occupied override button.

B. The space served by the reheat coil is controlled in Occupied and Unoccupied modes as follows:
1. The control valve modulates to maintain room setpoint (70°F occupied/60°F unoccupied, adjustable).
2. In the unoccupied mode, if any room served by only a reheat coil calls for heating, the rooftop air conditioning unit is energized in heating-only mode.
3. If the occupied override button is pressed, the associated reheat coil setpoint and fan operation changes to occupied mode for a preset time period (adjustable), while other reheat coils remain in unoccupied mode.
4. The space temperature setpoint override allows the occupant to temporarily adjust the room setpoint up or down. The range of adjustment is limited by the programming. The range limits are individually adjustable for each room. At the end of each day, when the room enters unoccupied mode, the space temperature setpoint returns to its centrally programmed value.

C. Operator Station Display: At a minimum, indicate the following on operator workstation display terminal:
1. Coil valve position command.
2. Space temperature set point.
3. Space temperature.
4. Occupied/unoccupied status.
6. Override time setpoint adjustment.

4.7 EXISTING BLOWER COIL AIR HANDLING UNITS (AH-1 TO 5) AND CONDENSING UNITS (CU-1 TO 5) AND PUMPS (SHWP-1 TO 5)

A. The units are DDC controlled using existing controllers and setpoints.

B. The units have minimum outside air setpoints and economizer cooling. The economizer cooling is reprogrammed to be locked out on AH-3 as indicated on the Drawings, to prevent excessive intake velocity at the associated louver.

C. The existing control sequences are modified to add relief damper control in economizer mode:
1. When the economizer opens to 30% (adjustable) above minimum outside air position, the relief motorized damper modulates open. The counterbalanced damper in the relief duct maintains room pressure. The counterbalance weights are set as directed by the Testing and Balancing Agent.
4.8 BLOWER COIL AIR HANDLING UNIT (AH-3A) AND CONDENSING UNIT (CU-3A) AND PUMP (SWHP-3A)

A. See Line Item Pricing on Bid Form.

B. The unit is DDC controlled using electric actuation. Salvaged controllers and actuators removed in the demolition of AH-3 to AH-6 may be reused as applicable.

C. Heating:
1. The unit has a hot water coil with pump and control valve. The control valve is 3-way modulating type.
2. When the outside air temperature is 40°F or above, the pump cycles on a call for heating and the control valve modulates to maintain room heating setpoint. On no call for heating, the pump is deenergized and the valve spring-returns to full coil position.
3. When the outside air temperature is below 40°F, the pump runs continuously, and the control valve modulates to maintain discharge heating setpoint. On no call for heating, the valve spring-returns to full return position.

D. Cooling:
1. A 0-100% differential-enthalpy economizer control is the first stage of cooling.
2. When the economizer opens to 30% (adjustable) above minimum outside air position, the relief motorized damper modulates open. The counterbalanced damper in the relief duct maintains room pressure. The counterbalance weights are set as directed by the Testing and Balancing Agent.
3. The condensing unit and DX cooling coil are the second stage of cooling.
4. Economizer cooling is enabled simultaneously with mechanical cooling whenever the outside air is suitable for cooling.
5. Condensing unit integral controls cycle the liquid-line solenoid valve, and cycle the compressor and condenser fan to maintain refrigeration system pressures.

E. The unit is scheduled for automatic operation on a time of day basis for Occupied and Unoccupied modes.
1. Within the Occupied mode, the system can enter:
   a. Warm-Up mode:
      1) When zone space temperature is below set point.
      2) The system stays in the Warm-Up mode until the mode set point is satisfied.
   b. Cool-Down mode:
      1) When zone space temperature is above set point.
      2) The system stays in the Cool-Down mode until the mode set point is satisfied.
2. Within the Unoccupied mode, Night Heating is available when the space temperature drops below space unoccupied heating set point. The latest start time is the scheduled occupancy for the space.
   a. After the fan starts, a time delay keeps the pump energized for a minimum of 15 minutes (adjustable).

F. The unit operates in Warm-Up, Cool-Down, Occupied, Unoccupied, Night Heating, and Safety modes as follows (suggested set points and settings are Owner-adjustable)
1. Optimum Start
   a. The warm-up mode begins at a time calculated by the DDC system based on trends of outdoor temperature, time required to warm up/cool down, and current outdoor temperature.

2. Warm-Up Mode
   a. The supply fan starts. The return air and outside air dampers are positioned for 100% return air. The heating coil valve opens 100% and remains open until the return air temperature reaches 70°F. If time reaches the latest start time during the Warm-up mode, the outdoor air damper opens to the minimum position. The system is prevented from entering the Warm-up mode more than once per day.

3. Cool-Down Mode
   a. Cool Down Mode: The supply fan starts. The return and outside air dampers are positioned for 100% return air or economizer as applicable. Cooling is enabled and operates until return air temperature reaches 74°F. If time reaches the latest start time during the Cool-Down mode, the outdoor air damper (if closed) opens to its minimum position. The system is prevented from entering the Cool-Down mode more than once per day.

4. Occupied Mode
   a. The fan starts or continues to run. Return air damper and outside air damper open to minimum position. The heating coil valve modulates, and cooling cycles, to maintain the discharge temperature set point between 65°F and 55 ºF. Set point shall be based on the zone with the highest cooling demand.

5. Unoccupied Mode (Normal Off)
   a. The supply fan stops. The outside air damper closes, the return damper opens, and the heating coil valve opens to 20% supply position (Owner-adjustable) if outside air temperature is below 45 ºF. Heating coil valve closes to full return position if outside air temperature is above 45 ºF.

6. Night Heating
   a. The air handling unit operates when the zone falls below night setback temperature. The supply fan starts, and the pump runs with the heating coil valve in full supply position for maximum heating. The air handling unit shall remain on until the zone is satisfied. The outside air and relief dampers remain closed.

7. Night Cooling: Mechanical cooling is de-energized during the unoccupied mode.

G. Safeties
1. A manual reset freezestat with capillary tube serpentined across the downstream face of the heating coil, upon sensing an air temperature at or below setpoint (36°F, adjustable), closes the outside air damper, opens the return air damper, deenergizes the fan, starts the pump, and opens the control valve to full supply position.

2. An automatic reset, capillary tube type freezestat is installed downstream of the heating coil. This freezestat is set to trip at a temperature which is 5 degrees F higher than the manual reset freezestat located downstream of the heating coil. When this freezestat is tripped, the air dampers are placed in 100% recirculation air mode for a period of 15 minutes (Owner-adjustable). After 15 minutes have elapsed, the outside/ mixed air dampers are allowed to modulate open to normal control.

3. A current switch monitors the supply fan motor. The DDC system uses the switch to confirm the fan is in the desired state (on or off) and generates an environmental alarm if status deviates from DDC start/stop control.

4. A differential pressure switch monitors filter pressure drop and signals when changeout is recommended.
H. Operator Station Display: At a minimum, indicate the following on operator workstation display terminal:
1. Supply and return fan status
2. Supply and return fan command status
3. Damper command status
4. Modulating return and outside air damper and relief damper status
5. Outdoor, return, mixed, and supply air temperature
6. Heating valve position and command status
7. Condensing unit command status
8. Automatic and manual freeze stat status
9. Occupied override status
10. Room setpoint
11. Room setpoint override
12. Night warmup and cool-down setpoints
13. Warm up status
14. Cool down status
15. Filter switch status

4.9 ROOFTOP AIR CONDITIONING UNIT (AC-3)

A. The unit is DDC controlled using electric actuation.

B. Heating:
1. The unit has a hot water coil with a control valve. The control valve is 3-way modulating type. At Contractor’s option, the control valve may be furnished factory-installed in the unit.
2. The control valve modulates to maintain discharge setpoint. On no call for heating, the valve is closed.
3. The heating control is interlocked with the pumps and heat exchanger; see pump and heat exchanger sequence of operation.

C. Cooling:
1. A 0-100% differential-enthalpy economizer control is the first stage of cooling.
2. The unit’s integral condensing unit and DX cooling coil are the second stage of cooling.
3. Economizer cooling is enabled simultaneously with mechanical cooling whenever the outside air is suitable for cooling.
4. Condensing unit integral controls cycle the liquid-line solenoid valves, and cycle the compressors and condenser fans to maintain refrigeration system pressures.

D. The unit is scheduled for automatic operation on a time of day basis for Occupied and Unoccupied modes.
1. Within the Occupied mode, the system can enter:
   a. Warm-Up mode:
      1) When zone space temperatures are below set point.
      2) The system stays in the Warm-Up mode until the mode setpoint is satisfied.
   b. Cool-Down mode:
      1) When zone space temperatures are above set point.
      2) The system stays in the Cool-Down mode until the mode setpoint is satisfied.
2. Within the Unoccupied mode, Night Heating is available when any space temperature drops below space unoccupied heating set point. The latest start time is the scheduled
occupancy for the spaces.
a. After the fan starts, a time delay keeps the pump energized for a minimum of 15 minutes (adjustable).

E. Supply Damper: The supply damper located in the unit duct connection opens fully whenever the fan is called to run. Upon proof by the damper actuator auxiliary switch that the supply damper is open, supply and return fans start.

F. The unit operates in Warm-Up, Cool-Down, Occupied, Unoccupied, Night Heating, and Safety modes as follows (suggested set points and settings are Owner-adjustable)
1. Optimum Start
   a. The warm-up mode begins at a time calculated by the DDC system based on trends of outdoor temperature, time required to warm up/cool down, and current outdoor temperature.
2. Warm-Up Mode
   a. The supply damper opens, and supply and return fans start. The return air mixed air dampers are positioned for 100% return air. The heating coil valve opens 100% and remains open until the return air temperature reaches 70°F (adjustable). If time reaches the latest start time during the Warm-up mode, the outdoor air damper opens to the minimum position. The system is prevented from entering the Warm-up mode more than once per day.
3. Cool-Down Mode
   a. The supply damper opens, and supply and return fans start. The return and mixed air dampers are positioned for 100% return air (or economizer as applicable). Cooling is enabled and operates until return air temperature reaches 74°F. If time reaches the latest start time during the Cool-Down mode, the outdoor air damper opens to its minimum position. The system is prevented from entering the Cool-Down mode more than once per day.
4. Occupied Mode
   a. The fans start or continue to run. Return air damper and the mixed air damper open and the relief damper and the outdoor air damper open to minimum position. The heating coil valve modulates, and cooling cycles, to maintain the discharge temperature setpoint. Supply setpoint is reset between 65°F and 54°F based on the zone with the highest cooling demand.
5. Unoccupied Mode (Normal Off)
   a. The supply and return fans stop. The supply air, outside air, and relief dampers close, return damper closes, and the heating coil valve opens to 10% (Owner-adjustable) if outside air temperature is below 40°F. Heating coil valve closes if outside air temperature is above 40°F.
6. Night Heating
   a. The unit is energized when any zone temperature falls below night setback setpoint. The supply and return fans start with the heating coil valve modulating to maintain a 70°F discharge air temperature. The unit remains running until the zone is satisfied. The outside air and relief dampers remain closed. When the zones are satisfied, the supply temperature setpoint resets to 60°F, and a time delay keeps the fans energized until they have run at least 15 minutes since they were started.
7. Night Cooling: Mechanical cooling is de-energized during the unoccupied mode.
8. Supply and Return Fan Control:
   a. The supply and return fan VFDs vary the fan speeds as required to provide soft starting.
   b. Upon initial startup of the air handling unit, the supply and return fans slowly ramp to full speed. Upon shutdown of the air handling unit, the supply and return fans slowly stop and the speed reset signal goes to zero speed.

G. Safeties
1. Smoke detectors in the unit supply, and field-installed in the return ductwork, deenergize the fans and close supply, return, outside, and relief dampers upon the detection of smoke. Each return detector is wired individually so that it can be determined which floor of the building the smoke comes from.
2. High limit static pressure sensor (set at 1 inch wc static pressure higher than scheduled external static pressure) in both supply and return mains shall de-energize the supply and return fans upon activation and shall activate an alarm.
3. A manual reset freezestat with capillary tube serpented across the downstream face of the heating coil, upon sensing an air temperature at or below setpoint (36°F, adjustable), closes the outside air damper, opens the return air damper, deenergizes the fan, starts the pump, and opens the control valve to full supply position.
4. An automatic reset, capillary tube type freezestat is installed downstream of the heating coil. This freezestat is set to trip at a temperature which is 5 degrees F higher than the manual reset freezestat located downstream of the heating coil. When this freezestat is tripped, the air dampers are placed in 100% recirculation air mode for a period of 15 minutes (Owner-adjustable). After 15 minutes have elapsed, the outside/ mixed air dampers are allowed to modulate open to normal control.
5. Air flow switches are installed in the ductwork for each supply and return fan. The DDC system uses the switches to confirm the fans are in the desired state (on or off) and generates an environmental alarm if status deviates from DDC start/stop control.
6. A differential pressure switch monitors filter pressure drop and signals when changeout is recommended.

H. Operator Station Display: At a minimum, indicate the following on operator workstation display terminal:
1. Supply and return fan status
2. Supply and return fan air flow
3. Supply and return fan VFD status
4. Supply and return fan VFD reference speeds
5. Supply and return fan VFD output speeds
6. Supply and return fan VFD current and kW
7. VFD trouble alarm
8. Supply duct static pressure status and setpoint
9. Return duct static pressure status and set point
10. High limit supply and return static status
11. Modulating return, exhaust, and mixing air damper status
12. 2-position supply air damper status
13. Supply and return smoke detector status
14. Outdoor, return, mixed, and supply air temperature
15. Supply air set point temperature
16. Night warmup and cool-down setpoints
17. Heating valve position
18. Cooling mode (economizer, mechanical)
19. Condensing unit command status
20. Automatic and manual freeze stat status
21. Occupied override status
22. Warm up status
23. Cool down status
24. Filter status
25. Fire alarm shutdown of the unit
26. Smoke detector status for each detector
27. Alarms

4.10 COMBUSTION AIR
A. The existing domestic water heater is monitored. Whenever the water heater calls for heating, the upper combustion air damper opens.
B. The existing boilers are monitored. Whenever a boiler calls for heating, the upper combustion air damper opens. This function is Owner-selectable on the operator workstation to disable it.
C. The room temperature is monitored. Whenever the room temperature is above setpoint (initial 80°F), both the upper and lower combustion air dampers open. If the room temperature falls below a low-temperature limit (initial setpoint 45°F) an alarm is generated.
D. Auxiliary switches on the actuators monitor damper status. If damper status is not in the desired state (open or closed) an alarm is generated.
E. Operator Station Display: At a minimum, indicate the following on operator workstation display terminal:
   1. Water heater call for heating.
   2. Boiler call for heating.
   3. Room temperature and setpoints.
   5. Damper status.
   7. Alarms.

4.11 SERVER ROOM DUCTLESS SPLIT AIR CONDITIONERS AND HEAT PUMPS
A. The wall-mounted controller cycles the indoor evaporator fan on a call for cooling or heating. The outdoor condensing unit compressor and fan cycle to maintain system refrigerant pressure.
B. A DDC room temperature sensor with blank cover monitors room temperature. The sensor is located to avoid being blown on by supply air from the indoor fan. An alarm is generated if room temperature rises above a high-limit setpoint (initial setpoint 85°F).
C. Operator Station Display: At a minimum, indicate the following on operator workstation display terminal:
   1. Room temperatures.
   2. Alarms.
4.12 FIRE ALARM SYSTEM SHUT-DOWN INTERFACE

A. For starters that are associated with equipment that is required to be shut down upon a fire alarm condition, provide input contacts within the starter enclosure to interface with the building’s fire alarm system. Upon receipt of a signal from the building’s fire alarm system, power to load side of the starter is turned off. Circuitry is provided to ensure that power is off whether the starter is in the “AUTO”, “HAND” or “BYPASS” mode. If this feature is not available from the starter manufacturer, provide a contactor on the line side of the starter to accomplish the same function. The contactor shall meet the requirements of Division 26.

4.13 RE-START PHASING AFTER POWER INTERRUPTION

A. Upon a power interruption, a loss of power, or at morning start-up, equipment of electrical power greater than or equal to 1.0 HP is started in a staged manner which allows a time delay of 30 seconds between the start of each device.

END OF SECTION 230900
SECTION 232113 – HYDRONIC PIPING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Pipe and Pipe Fittings For:
   1. Heating water piping system.
   2. Glycol water piping system.
   3. Equipment drains and overflows.

B. Valves:
   1. Gate valves.
   2. Globe or angle valves.
   3. Ball valves.
   5. Check valves.

1.2 PRODUCTS FURNISHED BUT NOT INSTALLED UNDER THIS SECTION

A. Access Doors.

1.3 RELATED SECTIONS

A. Division 08 Section “Access Doors and Frames.”

B. Division 09 Section “Painting.”

C. Division 23 Section “Expansion Fittings and Loops for HVAC Piping.”

D. Division 23 Section “Sleeves and Escutcheons for HVAC Piping.”

E. Division 23 Section “Hangers and Supports for HVAC Piping and Equipment.”

F. Division 23 Section “Identification for HVAC Piping and Equipment.”

G. Division 23 Section “Vibration and Seismic Controls for HVAC Piping and Equipment.”

H. Division 23 Section “HVAC Piping Insulation.”

I. Division 23 Section “Hydronic Specialties.”

J. Division 23 Section “HVAC Water Treatment”: Pipe cleaning.

1.4 REFERENCES


B. ASME B16.3 - Malleable Iron Threaded Fittings Class 50 and 300.
C. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings.
D. ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
E. ASME B31.5 - Refrigeration Piping.
F. ASME B31.9 - Building Services Piping.
G. ASME B36.10M - Welded and Seamless Wrought Steel Pipe.
H. ASTM A53 - Pipe, Steel, Black and Hot-Dipped, Zinc Coated Welded and Seamless.
I. ASTM A234 - Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures.
M. ASTM B32 - Solder Metal.
N. ASTM B88 - Seamless Copper Water Tube.
O. AWS A5.8 - Brazing Filler Metal.
P. AWS D1.1 - Structural Welding Code.
Q. AWWA C110 - Ductile - Iron and Grey-Iron Fittings 3 in. through 48 in. (75 mm through 1200 mm), for Water and Other Liquids.
S. AWWA C151 - Ductile-Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds, for Water or Other Liquids.

1.5 SUBMITTALS
A. Submit under provisions of Division 01 Section “Submittal Procedures.”
B. Product Data: Include data on pipe materials, pipe fittings, valves, and accessories. Provide Manufacturers catalogue information. Indicate valve data and ratings.
D. Manufacturer's Installation Instructions: Indicate hanging and support methods, joining procedures.
1.6 PROJECT RECORD DOCUMENTS
A. Submit under provisions of Division 01 Section “Closeout Procedures.”
B. Record actual locations of valves.

1.7 OPERATION AND MAINTENANCE DATA
A. Submit under provisions of Division 01 Section “Operation and Maintenance Data.”
B. Maintenance Data: Include installation instructions, spare parts lists, exploded assembly views.

1.8 QUALIFICATIONS
A. Manufacturer: Company specializing in manufacturing the products specified in this Section with minimum 3 years’ experience.
B. Installer: Company specializing in performing the work of this Section with minimum 3 years’ experience.
C. Welders: Certify in accordance with ASME SEC 9 and AWS D1.1.
D. Pressed Pipe Fittings: Submit documentation of fitting-manufacturer training of installers or their on-site supervisors, with names of individuals.

1.9 REGULATORY REQUIREMENTS
A. Conform to ASME B31.9 code for installation of piping system.
B. Welding Materials and Procedures: Conform to ASME SEC 9 and applicable state labor regulations.
C. Provide certificate of compliance from authority having jurisdiction indicating approval of welders.

1.10 DELIVERY, STORAGE, AND HANDLING
A. Deliver, store, protect and handle products to site under provisions of Division 01 Section “Product Requirements.”
B. Accept valves on site in shipping containers with labeling in place. Inspect for damage.
C. Provide temporary protective coating on cast iron and steel valves.
D. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
E. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.
PART 2 - PRODUCTS

2.1 HEATING WATER AND GLYCOL PIPING, ABOVE GROUND

A. Steel Pipe: ASTM A53, Schedule 40 for sizes less than 12 inch (300 mm), 0.375 inch (10 mm) wall for sizes 12 inch (300 mm) and over, black.
   1. Fittings: ASTM B16.3, malleable iron or ASTM A234, forged steel welding type fittings.
   2. Joints: Schedule 40 threaded for pipe sizes 2" (50.8 mm) and smaller, and AWS D1.1, welded for pipe sizes 2 1/2" (63.5 mm) and larger.
   3. Grooved and Shouldered Pipe End Couplings: As specified in this Section, with grooved steel pipe, is an acceptable alternate to the above for water service operating at temperatures from -30°F to +230°F, utilizing grade E, EPDM gasket compound.

B. Copper Tubing: ASTM B88, Type L hard drawn.
   1. Allowed only for pipe sizes 2" (50.8 mm) and smaller.
   3. Joints: Solder or braze, or press fittings.

C. Stainless Steel Pipe with Press Fittings: See paragraph titled “Press Fittings and Stainless Steel Piping Systems” in this Section.

2.2 EQUIPMENT DRAINS AND OVERFLOWS

A. Steel Pipe: ASTM A53, Schedule 40 galvanized.
   1. Fittings: Galvanized cast iron, or ASTM B16.3 malleable iron.
   2. Joints: Threaded, or grooved mechanical couplings.

B. Copper Tubing: ASTM B88, Type L, hard drawn.
   1. Fittings: ASME B16.18, cast brass, or ASME B16.22 solder wrought copper.
   2. Joints: Solder or braze, or press fittings.

C. Stainless Steel Pipe with Press Fittings: See paragraph titled “Press Fittings and Stainless Steel Piping Systems” in this Section.

2.3 BRAZING MATERIALS - 15% Silver for copper, brass, and bronze

A. Manufacturers:
   4. No substitutions.

B. Nominal Composition: 5.0% phosphorus, 15.0% silver, 0.15% other elements (total), remainder copper. Cadmium-free.

C. Physical Properties:
   1. Color: Yellow/Gray
   2. Solidus: 1190°F (643°C)
   3. Liquidus: 1480°F (802°C)
   4. Brazing Range: 1300 - 1500°F (704-816°C)
5. Electrical Conductivity: 9.9% IACS
6. Electrical Resistivity: 17.40 Microhm-cm

D. Specification Compliance:
1. ANSI/AWS A5.8, class BCuP-5
2. ASME SFA5.8, class BCuP-5
3. Optional:
   a. QQB 650C, class BCuP-5
   b. QQB 654A, class BCuP-5
   c. QQB 654, class BCuP-5

E. Flux:
1. Harris (Stay-Silv For copper-to-brass joints. No flux required for copper-to-copper joints).

2.4 BRAZING MATERIALS - 35% Silver for brazing to ferrous metals (steel)

A. Manufacturers:
4. No substitutions.

B. Nominal Composition: 35.0% silver, 33% Zinc, 0.15% other elements (total), remainder copper. Cadmium-free.

C. Physical Properties:
1. Color: Yellow/Gray
2. Solidus: 1250°F (677°C)
3. Liquidus: 1410°F (732°C)
4. Electrical Conductivity: 19.8% IACS
5. Electrical Resistivity: 8.2 Microhm-cm

D. Specification Compliance:
1. ANSI/AWS A5.8, class BAg-5
2. ASME SFA5.8, class BCuP-5

E. Flux:
1. Harris (Stay-Silv white flux, or where heating cycles are extended, Stay-Silv black flux).

2.5 SOLDER MATERIALS:

A. Manufacturers:
1. Harris (Product: Stay-Brite).
4. No substitutions.

B. Nominal Composition: Alloy of silver and tin (3-6% Ag, remainder Sn). Antimony-free.
C. Physical Properties:
1. Color: Bright Silver
2. Solidus: 430°F (221°C)
3. Liquidus: 430°F (221°C)
4. Electrical Conductivity: 16.4% IACS
5. Shear Strength: 10,600 psi (73 MPa)
6. Tensile Strength: 14,000 psi (96 MPa)
7. Elongation: 48%

D. Specification Compliance:
1. NSF 51
2. ASTM B32-89, Alloy Grade Sn96
3. Federal Spec. QQ-S-571E, Class Sn 96 with exception to QPL paragraph 3.1
4. J-STD-006, Sn96Ag04A

E. Flux:
1. Harris (Product: Stay Clean Paste Flux, Stay Clean Liquid Flux (used with 4” or larger copper tubing also stainless steels), or Bridgit Water Soluble Paste Flux).

2.6 UNIONS, FLANGES, AND COUPLINGS

A. Unions for Pipe 2 Inches (50 mm) and Under:
1. Ferrous Piping: 150 psig (1034 kPa) malleable iron, threaded.
2. Copper Pipe: Bronze, soldered joints.

B. Flanges for Pipe Over 2 Inches (50 mm):
1. Ferrous Piping: 150 psig (1034 kPa) forged steel, slip-on.
2. Copper Piping: Bronze.
3. Gaskets: 1/16 inch (1.6 mm) thick preformed neoprene or EPDM, reinforced as required for the system operating pressure, up to relief valve setting.

C. Grooved and Shouldered Pipe End Couplings:
1. Approved Manufacturers:
   a. Victaulic Company.
   b. Anvil International (division of Mueller Water Products, Inc.) - Gruvlok product line.
   c. Grinnell Mechanical Products (division of Tyco Fire Suppression & Building Products Co.).
   d. No Substitutions.
2. Products:
   a. Housing Clamps: Malleable iron to engage and lock, designed to permit some angular deflection, contraction, and expansion.
   b. Sealing Gasket: C-shape EPDM elastomer composition for operating temperature range from -30°F (-34°C) to 230°F (110°C). This is the standard gasket material suitable for water and glycol service. For other services, verify material.
   c. Accessories: Steel bolts, nuts, and washers with zinc plating.
3. Note: Grooved couplings are not allowed where concealed above hard ceilings.
D. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.

2.7 PRESS FITTINGS AND STAINLESS STEEL PIPING SYSTEMS

A. Approved Manufacturers:
1. Viega LLC, Wichita, KS - ProPress System with Smart Connect feature.
3. No substitutions.

B. Fitting and Valve Products:
1. Wrought copper and cast copper alloy (brass or bronze) fittings and valves for copper piping.
2. Stainless steel Type 304 or Type 316 fittings and valves for stainless steel piping.
3. Adapter fittings for transition connections to threaded fittings and dissimilar materials.
4. Available sizes: 1/2” to 4” (12.7 mm to 101 mm).

C. Stainless Steel Piping:
2. Stainless steel, Type 304 (with orange stripe) or Type 316 (with print line along its length). Inert gas welded.
3. Pipe outer dimensions conform to ASME B88 (copper tubing sizes). Pipe wall thickness conforms to the requirements of schedule 5S steel pipe per ASME B36.10M, to provide pressure and temperature ratings conforming to ASME B31.9.

D. Features:
1. Seals: O-ring type, factory installed in a fitting bead. Seals in larger sizes shall include a separator ring and a stainless steel grip ring.
2. Seal Materials: EPDM (color shiny black) in copper and stainless steel fittings for hydronic, potable water, and drain systems. FKM (color dull black) field-installed in stainless steel fittings for hydronic, solar, and low pressure steam, HBNR (color yellow) in copper fittings for fuel oil, diesel fuel, fuel gases, and compressed air systems.
3. Colored Identification Dots:
   a. Copper Fittings:
      1) Green for EPDM seal.
      2) Yellow for ProPressG fittings with HNBR seal.
   b. Stainless Steel Fittings:
      1) Orange for Type 304 stainless with EPDM seal.
      2) Green for Type 316 stainless with EPDM seal.
      3) White for FKM seal in Type 304 or Type 316 stainless.
4. Smart Connect feature provides a leakage path to allow water and air to leak past any unpressed connection, for quick identification during pressure testing.

E. Temperature/Pressure ratings (with appropriate type seals):
1. Hydronic Systems: 0 to 250°F (-17 to 121°C) up to 200 psig (1723 kPa), at up to 100% maximum concentration of ethylene or propylene glycol. In solar systems, the FKM seal is suitable for temperature spikes up to 320°F (160°C).
2. Heating Fuel Oil: -40 to 180°F (-40 to 82°C) up to 125 psig (861 kPa).
3. Low Pressure Steam: Up to 15 psig (103 kPa).
4. Fuel Gases: -40 to 160°F (-40 to 71°C) ambient, up to 125 psig (861 kPa).
5. Compressed Air: 0 to 160°F (-17 to 71°C) ambient, up to 200 psig (1379 kPa).
6. Carbon Dioxide or Nitrogen: 0 to 250°F (-17 to 121°C) ambient, up to 140 psig (965 kPa).
7. Oxygen (non-medical): 0 to 160°F (-17 to 71°C) ambient, up to 160 psig (1103 kPa).
8. Vacuum: Ambient temperature, at up to 29.2 in. Hg (741 mm Hg) vacuum.

F. Accessories:
1. Pressing: Use pressing tools, actuator jaws, and pressing rings, Ridgid brand manufactured by Ridge Tool Company, as recommended by the fitting manufacturer for each type of fitting.
2. Lubricants: Do not use. Not recommended by fitting manufacturer.
3. Cutting Tools: For copper or stainless steel pipe, use wheeled cutting tool, or cutting tool approved by the fitting manufacturer. Use deburring tool or reamer after cutting.

2.8 PIPE HANGERS AND SUPPORTS

A. See Division 23 Section “Hangers and Supports for HVAC Piping and Equipment.”

2.9 SLEEVES

A. See Division 23 Section “Sleeves and Escutcheons for HVAC Piping.”

2.10 VALVES

A. Manufacturers:
1. Nibco.
3. Apollo.
5. Crane.
6. Hammond.
7. Jenkins.
8. Keckley Co. – silent and wafer check valves.
10. Victaulic Company.
12. Watts.
13. Wheatley.
14. No substitutions.

B. Gate Valves Over 2 Inches (50 mm):
1. Iron body, bronze trim, bolted bonnet, rising stem, handwheel, outside screw and yoke, solid wedge disc with bronze seat rings, flanged ends.
2. 125 lb S.W.P., 200 lb W.O.G.

C. Globe or Angle Valves:
1. Up To and Including 2 Inches (50 mm):
   a. Bronze body, bronze trim, screwed or union bonnet, rising stem and handwheel, inside screw, renewable composition disc and bronze seat, solder or threaded ends.
   b. 150 lb S.W.P., 300 lb W.O.G.
2. Over 2 Inches (50 mm):
   a. Iron body, bronze trim, bolted bonnet, rising stem, handwheel, outside screw and yoke, rotating plug-type disc with renewable seat ring and disc, flanged ends.
   b. 125 lb S.W.P., 200 lb W.O.G.

D. Ball Valves:
1. Up To and Including 2 Inches (50 mm):
   a. Bronze two piece body, chrome plated brass ball, teflon seats and stuffing box ring, lever handle, solder or threaded ends.
   b. 150 lb S.W.P., 600 lb W.O.G.
2. Over 2 Inches (50 mm):
   a. Cast steel body, chrome plated steel ball, teflon seat and stuffing box seals, lever handle, flanged.
   b. 150 lb S.W.P., 285 lb W.O.G.
3. Stem Extensions: Provide ball valves in insulated piping with stem extensions to allow for continuous thickness of field-installed insulation.

E. Plug Valves:
1. Up To and Including 2 Inches (50 mm):
   a. Bronze body, bronze tapered plug, 70 percent port opening, non-lubricated, teflon packing, threaded ends.
   b. Operator: One plug valve wrench for every ten plug valves minimum of one.
2. Over 2 Inches (50 mm):
   a. Cast iron body and plug, 70 percent port opening, pressure lubricated, teflon packing, flanged ends.
   b. Operator: Each plug valve with a wrench with set screw.

F. Butterfly Valves:
1. Body: Cast or ductile iron with resilient replaceable EPDM seat, wafer or lug ends, extended neck.
2. Disc: Aluminum bronze or chrome plated ductile iron.
3. Operator: 10 position lever handle for shut-off service, infinite position lever handle with memory stop for throttling service, handwheel and gear drive for sizes 8" (203 mm) and larger.
4. Pressure rating shall be 150 PSI at 225ºF (1034 kPa at 107ºC).

G. Swing Check Valves:
1. Up To and Including 2 Inches (50 mm): Bronze body, bronze trim, bronze rotating swing disc, with composition disc, solder or threaded ends.
2. Over 2 Inches (50 mm): Iron body, bronze trim, bronze or bronze faced rotating swing disc, renewable disc and seat, flanged ends.

H. Spring Loaded Check Valves: Iron body, bronze trim, split plate, hinged with stainless steel spring, resilient seal bonded to body, wafer or threaded lug ends.
PART 3 - EXECUTION

3.1 PREPARATION

A. Ream pipe and tube ends. Remove burrs.
B. Remove scale and dirt on inside and outside before assembly.
C. Prepare piping connections to equipment with flanges or unions.
D. Keep open ends of pipe free from scale and dirt. Protect open ends with temporary plugs or caps.
E. After completion, fill, clean, and treat systems. Refer to Division 23 Section “HVAC Water Treatment.”

3.2 INSTALLATION

A. Install in accordance with Manufacturer's instructions.
B. Install heating water and glycol piping to ASME B31.9.
C. Route piping in orderly manner, parallel to building structure, and maintain gradient.
D. Install piping to conserve building space, and not interfere with use of space.
E. Group piping whenever practical at common elevations.
F. Sleeve pipe passing through partitions, walls and floors:
   1. See Division 23 Section “Sleeves and Escutcheons for HVAC Piping.”
   2. Set sleeves in position in advance of concrete work. Provide suitable reinforcing around sleeves.
   3. Extend sleeves through floors as follows: In locations not otherwise indicated, 2 in. (50 mm) above finished floor level. In normally-dry locations such as finished office spaces under fintube and baseboard radiation, 1 in. (25 mm) above finished floor level. Finished floor level includes the thickness of floor finish materials such as carpet and tile. Caulk sleeves full depth and provide floor plate.
   4. Where piping passes through floor, ceiling or wall, close off space between pipe sleeve and construction with non-combustible insulation or with approved firestopping material when penetrating fire rated floors, ceilings or walls. Provide tight fitting metal escutcheons on both ends of sleeves to prevent movement of sleeve during piping expansion. Escutcheons shall be sized slightly larger than outside diameter of piping and smaller than diameter of sleeve. Escutcheons shall be rigidly secured to walls.
   5. Where piping passes through fire rated floors, ceilings or walls, close off space between pipe insulation and sleeve with approved firestopping material
   6. Install chrome-plated escutcheons where piping passes through finished surfaces.
G. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment. Refer to Division 23 Section “Expansion Fittings and Loops for HVAC Piping”
H. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings. Refer to Division 23 Section “HVAC Piping Insulation.”

I. Provide access where valves and fittings are not exposed. Coordinate size and location of access doors with Division 08 Section “Access Doors and Frames.”

J. Slope piping and arrange systems to drain at low points. Use eccentric reducers to maintain top of pipe level.

K. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welds.

L. Prepare unfinished pipe, fittings, supports, and accessories, ready for finish painting. Refer to Division 09 Section “Painting.”

M. Install valves with stems upright or horizontal, not inverted.

N. Where more than one piping system material is specified, ensure system components are compatible and joined to ensure the integrity of the system is not jeopardized. Provide necessary joining fittings. Ensure flanges, union, and couplings for servicing are consistently provided.

O. Grooved Mechanical Couplings:
   1. Use grooved mechanical couplings and fasteners in accessible locations only. Grooved mechanical couplings are not allowed in areas such as behind sheetrock walls and above sheetrock ceilings.
   2. Install in strict accordance with manufacturer’s instructions. Nothing in this Specification is intended to supersede manufacturer’s instructions and recommendations.
   3. Prepare pipe ends properly, and check again before coupling installation.
   4. Lubricate gaskets as recommended. Check gasket before installation.
   5. Do not lubricate coupling mating surfaces (bolt pads) or bolt threads, because this might affect torque readings.
   6. Verify that pipe-end separation (all couplings) and deflection from centerline (flexible couplings only) do not exceed manufacturer’s specifications. For piping which will operate at a colder temperature than installation temperature (for example, chilled water systems), butt pipes together to provide maximum contraction capability. For piping which will operate at a warmer temperature (for example, heating systems), separate pipe ends the maximum allowed amount to provide maximum expansion capability. Some systems operate at mixed temperatures (for example, cooling tower condenser water systems) and may require different spacing for different sections of the system, and/or a spacing somewhere between minimum and maximum in proportion to the need for expansion and contraction.
   7. NOTE: Tighten nuts evenly by alternating sides until tightened to recommended torque. Make sure the housings’ keys completely engage the grooves. Make sure the offsets are equal at the bolt pads, during tightening and when fully tightened. NOTE: It is important to tighten nuts evenly to prevent gasket pinching.
      a. Victaulic Couplings: On rigid couplings with angled bolt pads, pads will be offset when tightened. On flexible couplings, bolt pads will be in contact and aligned when tightened.
b. Anvil and Grinnell Couplings: On rigid couplings, bolt pads will have up to 1/16-inch (1.59 mm) gap when tightened. On flexible couplings, bolt pads will be in contact when tightened.

8. If an impact wrench or other power tool is used to tighten, use extra care. NOTE: Anvil International does not recommend use of impact wrenches with their Gruvlok products.

9. For couplings with manufacturer torque specifications, verify torque on each bolt. Do not exceed torque specification by more than 25%.

P. Use unions, flanges, and couplings downstream of valves and at equipment or apparatus connections. Do not use direct welded or threaded connections to valves, equipment or other apparatus.

Q. Dissimilar Metals: Use non-conducting dielectric connections whenever jointing dissimilar metals. Cast red-brass (not yellow brass) or bronze-bodied fittings such as valves and couplings may be used when joining steel to copper, steel to stainless steel, or copper to stainless steel. Steel and stainless steel may connect directly to iron, but copper may not connect directly to iron.

R. Valve Type Selection:
1. Use gate, ball or butterfly valves for shut-off and to isolate equipment, part of systems, or vertical risers.
2. Use globe, ball or butterfly valves for throttling, bypass, or manual flow control services.
3. Use OS&Y Gate Valves at boiler supply and return connection in accordance with applicable State Boiler Rules and Regulations.
4. Use N.R.S. Gate Valves for general shut-off service in heating system piping 2-1/2" (63.5 mm) and larger.
5. Use Plug Valves for general throttling applications where indicated.
6. Use Bronze Globe Valves in throttling applications at control valve bypasses and in expansion tank connection.
7. Use Bronze Ball Valves for general shut-off service in heating and cooling system piping 2" (50.8 mm) and smaller and at heating terminal units 2" (50.8 mm) and smaller, including fin-tube radiation, unit heaters, convectors and fan coil units.
8. Use Combination Balancing, Flow Measuring and Tight Shut-off Valves at terminal heating and cooling units, zone branches and as indicated.
9. Use Bronze Ball Valves for drain valves with hose connections. Provide valve of size indicated; if size isn’t indicated, provide at least 3/4” (19 mm) valve size. Provide outlet fitting for standard “garden hose” with 3/4” (19 mm) hose threads. Provide brass cap with retainer chain. Compression-type “boiler drain valves” are not allowed.

S. With the exception of valves which must be properly sized to ensure design flow rates (such as balancing valves), valves shall be line sized.

T. For valves located more than 7 feet (2.1 m) above finished floor in equipment room areas, provide chain operated sheaves. Extend chains to 5 feet (1.5 m) above finished floor and hook to clips arranged to clear walking aisles.

U. Install concealed pipes close to building structure to keep furring to a minimum.

V. Slope water piping 1 inch in 40 feet (1:480) and arrange to drain at low points. Slope piping up in direction of water flow.
W. On closed systems, equip low points with 3/4” (19 mm) drain valves and hose nipples. Provide, at high points of mains, collecting chambers and high capacity float operated automatic air vents. Provide, at high points of branches, manual air vents with air chambers.

X. Use main sized saddle type branch connections for directly connecting branch lines to mains in steel piping if main is at least one pipe size larger than the branch for up to 6” (152 mm) mains and if main is at least two pipe sizes larger than branch for 8” (203 mm) and larger mains. Do not project branch pipes inside the main pipe.

Y. Make connections to equipment and branch mains with unions.

Z. Pipe used shall be new material, and threads on piping shall be full length and clean cut with inside edges reamed smooth to full inside bore.

AA. Caulking of threads will not be allowed on any piping.

BB. Pipe joint compound shall be put on male threads only.

CC. In the erection of mains, special care must be used in the support, working into place without springing or forcing, and proper allowance made for expansion.

DD. Pipes shall be anchored, guided, and otherwise supported, where necessary, to prevent vibration or to control expansion.

EE. Make such offsets as are shown and required to place the pipes and risers in proper position to avoid other work.

FF. Install a sufficient number of unions or flanged fittings to facilitate making possible future alterations or repairs.

GG. Erect piping to provide for the easy passage and noiseless circulation of water under working conditions.

HH. Where welded joints are required, steel piping shall be installed by the use of the oxyacetylene or electric welding process, except immediate connections to accessible equipment may be threaded. Piping shall have butt welds with welding fittings, standard factory fabricated tees, elbows, reducers, caps, and accessories. Branch outlets 2” (50.8 mm) and smaller shall be made by the use of approved welding type 1/2 couplings, “Weldolet” or “Threadolet” fittings.

1. Piping smaller than 2” (50.8 mm) may be installed at the Contractor’s option with welding type, or threaded type fittings, except that piping regardless of size concealed in trenches or inaccessible building construction (for example, concealed behind sheetrock walls or concealed above sheetrock ceilings) shall be welded.

2. Offsets shall be installed with long radius welding elbows.

3. Welding shall be executed only by certified welding mechanics in accordance with the best practice of the trade.

II. Take branch lines off bottom of mains or at 45 degree bottom angle, as space permits.

JJ. Minimum pipe size allowed for hydronic piping shall be 3/4” (19 mm). Piping less that 3/4” (19 mm) shall not be allowed for these piping systems.
KK. For isolation valves, control valves and balancing valves located above suspended ceilings and in areas that are not visible to building occupants (for example, mechanical rooms), provide yellow colored surveyors tape. Permanently attach tape to valve handles and run tape down to 10 inches (254 mm) above ceiling or 12 inches (305 mm) below valve handle where ceilings do not exist (for example, mechanical rooms).

LL. Standard details for heating and cooling coils are based on single coil arrangements. For heating and cooling coils that are supplied in a split coil arrangement, with 2 or more individual coils, provide additional piping and balancing valves at each coil to ensure that flow through each coil is proportional to the percentage of total coil face area that the coil occupies.

3.3 CLEANING

A. After satisfactory completion of pressure tests, before permanently connecting equipment, strainers, and the like, clean equipment thoroughly, blow and flush piping for a sufficient length of time as directed, so that interiors will be free of foreign matter. Perform cleaning in the presence of an authorized representative of the Architect. Provide a minimum of 10 days notification to the Architect prior to system cleaning.

B. Fill, vent and circulate the system with approved solution in accordance with equipment (boiler, piping, coils, and others) manufacturer’s recommendation, allowing it to reach design or operating temperatures. After circulating for 6 hours, drain the system completely and remove and clean strainer screens. Perform cleaning in the presence of an authorized representative of the Architect. Provide a minimum of 10 days notification to the Architect prior to system cleaning.

C. Fill and vent system as required.

D. Manually vent heat transfer units and high points of the system.

E. Adjust the pressure reducing valve to provide minimum of 5 psig (35 kPa) pressure at the highest point of the system.

F. After system has been completely filled, start zone pumps and circulate cold water for a short time to dislodge small air bubbles, and return them to air extraction device.

G. Raise water temperature to 200°F (93°C) while operating pumps.

H. Stop pump and vent radiation and high points of the system. Normal operation may now be started at any time.

3.4 TESTING

A. No joint or section of piping shall be left untested.

B. Before testing piping systems, remove, or otherwise protect from damage, control devices, air vents, and other parts which are not designed to stand test pressures.

C. Test piping for leaks under 100 psig (689 kPa) air pressure with soap suds prior to hydrostatic testing.
D. Test piping hydrostatically to 1-1/2 times the maximum systems operating pressure, but in no case to less than 75 psig (517 kPa), for at least 4 consecutive hours, during which time pressure shall remain constant without pumping.

E. Test and obtain Architect’s approval before painting, covering, or concealing piping, including swing joints.

END OF SECTION 232113
SECTION 232118 – HYDRONIC SPECIALTIES

PART 1 - GENERAL

1.1 SECTION INCLUDES
   A. Expansion tanks.
   B. Air vents.
   C. Air separators.
   D. Strainers.
   E. Pump suction fittings.
   F. Combination fittings.
   G. Flexible hose assemblies.
   H. Flow indicators, controls, meters.
   I. Pressure reducing valves for cold water makeup.
   J. Combination valve assemblies.
   K. Relief valves.
   L. Glycol specialties.

1.2 RELATED SECTIONS
   A. Division 23 Section “Meters and Gauges for HVAC Piping”: Test Ports.
   B. Division 23 Section “Hydronic Piping.”
   C. Division 23 Section “HVAC Water Treatment”: Pipe cleaning, and bypass (pot) feeder.

1.3 REFERENCES
   A. ASME - Boilers and Pressure Vessel Codes, SEC 8-D-Rules for Construction of Pressure Vessels.

1.4 SUBMITTALS
   A. Submit under provisions of Division 01 Section “Submittal Procedures.”
B. Product Data: Provide product data for manufactured products and assemblies required for this project. Include component sizes, rough-in requirements, service sizes, and finishes. Include product description, model and dimensions.

C. Submit inspection certificates for pressure vessels from authority having jurisdiction.

D. Manufacturer's Installation Instructions: Indicate hanging and support methods, joining procedures.

1.5 PROJECT RECORD DOCUMENTS

A. Submit under provisions of Division 01 Section “Closeout Procedures.”

1.6 OPERATION AND MAINTENANCE DATA

A. Submit under provisions of Division 01 Section “Operation and Maintenance Data.”

B. Maintenance Data: Include installation instructions, assembly views, lubrication instructions, and replacement parts list.

1.7 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the Products specified in this Section with minimum 3 years experience.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect and handle products to site under provisions of Division 01 Section “Product Requirements.”

B. Accept valves on site in shipping containers with labeling in place. Inspect for damage.

C. Provide temporary protective coating on cast iron and steel valves.

D. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

E. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

1.9 MAINTENANCE SERVICE

A. Furnish service and maintenance of glycol system for 1 year from date of substantial completion.

B. Monthly visit to make glycol fluid concentration analysis on site with refractive index measurement instrument. Detail findings with maintenance personnel in writing of corrective actions needed including analysis and amounts of glycol or water added.
PART 2 - PRODUCTS

2.1 EXPANSION TANKS, DIAPHRAGM TYPE

A. Manufacturers:
   1. Taco.
   2. Amtrol.
   3. Bell & Gossett.
   4. Flexcon Industries.
   5. Wilkins.
   6. Wessels.

B. Construction: Drawn steel, painted finish, with flexible butyl rubber diaphragm sealed into tank. Tanks with less than 10 gallons (37.9 l) shall be of inline design with male pipe thread connection; larger tanks shall have integral floor stand and female thread pipe connection. Rated working pressure 100 psig (689 kPa), maximum working temperature 220°F (104.4°C).

C. Accessories: Schraeder-type air-charging fitting and protective cap, and field-furnished pressure gauge.

2.2 AIR VENTS

A. Manual Type: Short vertical sections of 2 inch (50 mm) diameter pipe to form air chamber, with 1/8 inch (3 mm) brass needle valve at top of chamber.

B. Float Type:
   1. Manufacturers:
      a. Bell & Gossett.
      b. Caleffi.
      c. Taco.
      d. Thrush.
      e. Wheatley.
   2. Brass or semi-steel body, copper, polypropylene, or solid non-metallic float, stainless steel valve and valve seat; suitable for system operating temperature and pressure; with isolating valve.

C. Washer Type:
   1. Manufacturers:
      a. Bell & Gossett.
      b. Caleffi.
      c. Taco.
   2. Brass with hydroscopic fiber discs, vent ports, adjustable cap for manual shut-off, and integral spring loaded ball check valve.

2.3 AIR SEPARATORS

A. In-line Combination Air Separators/Strainers, 2” (50 mm) and Larger Line Size:
   1. Manufacturers:
      a. Taco, Inc. - 4900 and 4900H Series.
      b. Armstrong Pumps Inc. - DAS and DASH Series.
c. Caleffi - Discal ASME NA551 Series (up to 6” (50 mm) line size, up to 500 GPM (1892 liters/minute)).

d. Flamco - Flamcovent Series.
e. Spirotherm - VSR and VHR Series.
f. Thrush Co. - ASF and AHF Series.

2. Steel body, with brass-or-cast-iron-body venting mechanism with components of stainless steel, EPDM, viton, brass, and engineered plastics. Tested and stamped in accordance with ASME SEC 8-D; for 125 psig (860 kPa) operating pressure, 270°F (132°C) maximum temperature, straight-through inlet and outlet connections, top fitting for air vent, bottom fitting for drain, side fitting with ball valve with hose-thread outlet for skimming and purge, with internal stainless steel or copper coalescing medium. Fittings 3-inch and under shall be NPT threaded or flanged, larger fittings shall be flanged. Primer paint finish.

3. Separator shall function on the coalescing principle. Manufacturer shall furnish documentation demonstrating that separator removes air microbubbles as small as 18 microns.

4. Provide a top-mounted automatic air vent with hose-clamp or pipe-thread outlet. Vent shall be serviceable and replaceable. Provide integral or separate valve allowing the vent to be manually closed for its protection during startup and purging.

5. Provide welded steel base support ring for floor mounting on line sizes 8” (203 mm) and larger.

2.4 STRAINERS

A. Manufacturers:
1. Sarco.
2. Armstrong.
3. Barnes and Jones.
4. Bell & Gossett.
5. Flo-Fab.
7. Muesco.
8. Wheatley.

B. Size 2 inch (50 mm) and Under: Screwed brass or iron body for 175 psig (1200 kPa) working pressure, Y pattern with 1/32 inch (0.8 mm) stainless steel perforated screen.

C. Size 2-1/2 inch (65 mm) to 4 inch (100 mm): Flanged iron body for 175 psig (1200 kPa) working pressure, Y pattern with 3/64 inch (1.2 mm) stainless steel perforated screen.

D. Size 5 inch (125 mm) and Larger: Flanged iron body for 175 psig (1200 kPa) working pressure, basket pattern with 1/8 inch (3.2 mm) stainless steel perforated screen.

2.5 PUMP SUCTION FITTINGS

A. Manufacturers:
1. Taco.
2. Armstrong.
3. Bell & Gossett.
4. Flo-Fab.
5. Keckley Co.

B. Fitting: Angle pattern, cast-iron body, flanged or grooved inlet connection to match piping type and size, flanged outlet to match pump size, rated for 175 psig (1200 kPa) working pressure, with outlet vanes or other straightening devices, cylinder strainer with 3/16 inch (5 mm) diameter openings, disposable fine mesh strainer to fit over cylinder strainer, flanged or grooved-coupling cover for strainer access.

C. Accessories: Adjustable foot support with field-furnished pipe as required, blowdown tapping in bottom, gauge tapping on system inlet side.

2.6 COMBINATION PUMP DISCHARGE VALVES

A. Combination valves which include the features of check, shutoff, and flow measuring valves, commonly known as “Triple Duty”, “Multipurpose”, or “Multi-function” valves, are not allowed.

2.7 BALANCING VALVES AND COMBINATION BALANCING/SHUT-OFF VALVES

A. Manufacturers:
   1. Bell & Gossett.
   2. Armstrong.
   5. Griswold Controls.
   7. Nexus Valve.
   8. Taco.
   9. Tour and Andersson.
  10. Watts.

B. Valves shall conform to one of the following:
   1. Fixed-Orifice Manual Balancing Valve: Calibrated, ball type balance valve with precision machined orifice, readout valves equipped with integral check valves and gasketed caps, calibrated nameplate and indicating pointer with memory stop. Readout valves measure the pressure differential across the fixed orifice plate or venturi. Valve shall be designed for positive shut-off.
   2. Variable-Orifice Manual Balancing Valve: Cast iron or bronze, globe style, balance valve with handwheel with vernier type ring setting and memory stop, readout valves equipped with integral check valves and gasketed caps. Readout valves measure the pressure differential across the variable opening between valve plug and valve seat. Valve shall be designed for positive shut-off. Drain valve may be furnished with this valve, and if positioned properly may be substituted for the separate drain valve indicated.

C. Size balancing valves to allow a reading of 2 to 5 ft wg (6 to 15 kPa) pressure drop at design flow rates. Submittals shall include a chart of valve selections, indicating room number, terminal heating device tag, flow rate, pressure drop, and differential pressure reading.
D. Insulation: Valves may be furnished with prefabricated thermal insulation. Flame spread reading shall be 25 or less per ASTM E84. R-value shall be 4 hr-sq.ft- F/Btu or greater. Install in accordance with Division 23 Section “HVAC Piping Insulation.”

2.8 COMBINATION VALVE ASSEMBLIES

A. Manufacturers:
   1. Flow Design, Inc.
   2. Griswold Controls.

B. Assemblies combining valves and accessories may be furnished in lieu of the individual components, provided that the components are in the arrangement indicated on the Drawings and conform to the individual Specifications. Examples include combinations of manual balancing valves, unions, pressure/temperature test ports, strainers, manual air vents, flexible hose connections, and shutoff valves.

2.9 PRESSURE REDUCING VALVES FOR COLD WATER MAKEUP

A. Manufacturers:
   1. Watts.
   2. Bell & Gossett.
   3. Caleffi.
   4. Spence.
   5. Taco.

B. Pressure Reducing Valve (PRV): Bronze body. Stainless steel, EPDM, and plastic internals. Maximum temperature rating 160°F (71°C). Maximum inlet pressure rating 200 psig (1378 kPa). Reduced pressure range suitable for the project. Provide inlet union, integral to the valve or furnished separately. Valve may include an integral inlet strainer. Valve may include a bypass lever or button. Valve internals shall be serviceable and replaceable without removing the body from the piping. Valve shall be line size unless otherwise indicated.

C. Set pressure reducing valve to achieve 5 psi (34.5 kPa) gauge pressure at high point of system. Provide pressure gauge at high point of system, per Division 23 Section “Meters and Gauges for HVAC Piping”. Set pressure reducing valve when the temperature of the water in the system is less than 80°F (27°C).

D. Provide bypass line with full-port ball valve for fast system fill, sized as indicated. Reducing valve may include fast-fill lever, but this is not a substitute for the bypass line and valve.

2.10 RELIEF VALVES

A. Manufacturers:
   1. Bell & Gossett.
   2. Cash Acme.
   4. Taco.
   5. Watts.
B. Bronze body, teflon seat, stainless steel stem and springs, automatic, direct pressure actuated, capacities ASME certified and labeled.

C. Factory set to relieve pressure at 50 psig unless otherwise indicated.

2.11 GLYCOL SYSTEM

A. Glycol Solution:
   1. Manufacturers:
      a. Dow Chemical Co.
      b. No Substitutions.
   2. Heat Transfer Fluid:
      a. Dowfrost corrosion-inhibited propylene glycol, colorless, 96% propylene glycol, 4% performance additives. Recommended use temperature range: -50°F (-45°C) to 250°F (120°C).
      b. Dowfrost HD corrosion-inhibited propylene glycol, dyed bright yellow to aid in leak detection, 94% propylene glycol, 6% performance additives. Recommended use temperature range: -50°F (-45°C) to 325°F (160°C).
   3. Provide a glycol and water solution mixed by volume as follows, unless otherwise indicated on the Drawings:
      a. 35 percent Dowfrost - 65 percent water, providing a freezing point temperature of no higher than -2.4°F (-12°C), a burst point temperature of no higher than -30°F (-34°C), and a boiling point of at least 217°F (102°C) at 101 kPa.
      b. 35 percent Dowfrost HD - 65 percent water, providing a freezing point temperature of no higher than -2.4°F (-12°C), a burst point temperature of no higher than -30°F (-34°C), and a boiling point of at least 217°F (102°C) at 101 kPa.
   4. Water used in solution shall conform to glycol manufacturer’s requirements. Water shall have low levels (less than 25 ppm) of chloride and sulfate, and less than 50 ppm of hard water ions (Ca++, Mg++). Distilled or deionized water is recommended. If good quality water is unavailable, purchase pre-diluted solutions of fluid from the fluid manufacturer or from the distributor.
   5. Provide containers of undiluted inhibited glycol as required to compensate for any water left in the system after initial flushing, testing, and draining.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install specialties in accordance with manufacturer's instructions.

B. Where large air quantities can accumulate, provide enlarged air collection standpipes.

C. Provide manual air vents at system high points and as indicated.

D. For automatic air vents in ceiling spaces or other concealed locations, provide vent tubing to nearest drain.

E. Provide air separator on suction side of system circulation pump and connect to expansion tank.

F. Provide valved drain and hose connection on strainer blow down connection.
G. Provide pump suction fitting on suction side of base mounted centrifugal pumps. Remove fine-mesh temporary startup strainers after flushing and cleaning systems; hang the startup strainer at the pump to demonstrate to the Engineer that it was removed. If strainer’s removable cover is insulated (for example, chilled water systems) the insulation shall be removable and reusable.

H. Suction diffusers shall have adequate space provided for strainer removal.

I. Support pump fittings with floor mounted pipe and flange supports.

J. Provide balancing valves on water outlet from terminal heating units such as radiation, unit heaters, and fan coil units.

K. Ensure that balancing valves are installed with minimum upstream length of straight pipe as recommended by the manufacturer.

L. Ensure that balancing valves are installed with the readout valves fully accessible, including space required for insertion of metering probes.

M. Provide relief valves on pressure tanks, low pressure side of reducing valves, heat exchangers, and expansion tanks.

N. Select system relief valve capacity so that it is greater than make-up pressure reducing valve capacity. Select equipment relief valve capacity to not exceed maximum pressure rating of connected equipment.

O. Pipe relief valve outlet to nearest floor drain.

P. Where one line vents several relief valves, make cross sectional area equal to sum of individual vent areas.

Q. Expansion Tanks (Bladder and Diaphragm Type): Provide pressure gauge per Division 23 Section “Meters and Gauges for HVAC Piping” at point where expansion tank is connected to system, for determining required pre-charge pressure for air side of expansion tank. Isolate expansion tank from system and pre-charge air side of tank to same pressure as static head of system at point where expansion tank is connected to system. Measure static head of system after pressure reducing valve at cold water make-up has been properly set in accordance with this specification section. Pre-charge air side of expansion tank only when the temperature of the water in the system is less than 80°F (27°C). Provide drain valve with hose end connection at point of connection to expansion tank to allow for periodic removal of system pressure in order to check expansion tank’s pre-charge air pressure. Drain valve shall be located closest to expansion tank, isolation valve shall be immediately upstream of drain valve and pressure gauge shall be immediately upstream of isolation valve.

R. Clean and flush glycol system before adding glycol solution. Refer to Division 23 Section “HVAC Water Treatment”

S. Feed glycol solution to system through make-up line with pressure regulator, venting system high points. Set to fill at 12 psig (80 kPa). Pressure system high point cold at 5 psig (35 kPa).

T. Perform tests determining strength of glycol and water solution and submit written test results.
U. Standard details for heating and cooling coils are based on single coil arrangements. For heating and cooling coils that are supplied in a split coil arrangement, with two or more individual coils, provide additional piping and balancing valves at each coil to ensure that flow through each coil is proportional to the percentage of total coil face area that the coil occupies.

V. Install combination valve assemblies to account for small offsets between coils connections and hard pipe connections. Assemblies shall not be installed in a manner that forms bends of more than 90 degrees total.

END OF SECTION 232118
SECTION 232123 – HYDRONIC PUMPS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. In-line circulators.
B. Vertical in-line pumps.

1.2 RELATED SECTIONS

A. Division 23 Section “Motors, Drives, and Accessories.”
B. Division 23 Section “Vibration and Seismic Controls for HVAC Piping and Equipment.”
C. Division 23 Section “HVAC Piping Insulation.”
D. Division 23 Section “HVAC Equipment Insulation”
E. Division 23 Section “Hydronic Piping.”
F. Division 23 Section “Hydronic Specialties”
G. Division 26 Section “Electrical” Electrical characteristics and wiring connections.

1.3 REFERENCES

A. UL 778 - Motor Operated Water Pumps.
B. NFPA 70 - National Electrical Code.

1.4 PERFORMANCE REQUIREMENTS

A. Ensure pumps operate at specified system fluid temperatures without vapor binding and cavitation, are non-overlooding throughout the entire operating range in parallel or individual operation, and operate within 25 percent of midpoint of published maximum efficiency curve.

1.5 SUBMITTALS

A. Submit under provisions of Division 01 Section “Submittal Procedures.”
B. Product Data: Provide certified pump curves showing performance characteristics with pump and system operating point plotted. Include NPSH curve when applicable. Include electrical characteristics and connection requirements.
C. Manufacturer's Installation Instructions: Indicate hanging and support requirements and recommendations.
D. Millwright's Certificate: Certify that base mounted pumps have been aligned.
1.6 OPERATION AND MAINTENANCE DATA
   A. Submit under provisions of Division 01 Section “Operation and Maintenance Data.”
   B. Operation and Maintenance Data: Include installation instructions, assembly views, lubrication
      instructions, and replacement parts list.

1.7 QUALIFICATIONS
   A. Manufacturer: Company specializing in manufacture, assembly, and field performance of
      pumps with minimum 3 years’ experience.
   B. Alignment: Base mounted pumps shall be aligned by a qualified millwright.

1.8 REGULATORY REQUIREMENTS
   A. Products Requiring Electrical Connection: Listed and classified by UL as suitable for the
      purpose specified and indicated.

PART 2 - PRODUCTS

2.1 MANUFACTURERS
   A. Pumps, General:
      1. Taco.
      2. Armstrong.
      3. Bell & Gossett.
      4. Flo-Fab.
      5. Grundfos.
      6. Paco.
      7. Patterson.
      8. Peerless.
     10. Wilo.
   B. No Substitutions.

2.2 GENERAL
   A. Statically and dynamically balance rotating parts.
   B. Construction shall permit complete servicing without breaking piping or motor connections.
   C. Pumps shall operate at 1750 rpm unless indicated or specified otherwise.
   D. Pump connections shall be flanged.
   E. Wetted parts shall be compatible with circulated fluid.
2.3 IN-LINE CIRCULATORS
   A. Existing, or existing relocated as indicated. Bell & Gossett PL-36 permanently lubricated type.
   B. For relocated circulators, provide companion flanges to match piping size, and flange gaskets.

2.4 VERTICAL IN-LINE PUMPS
   A. Type: Vertical, single stage, close coupled, radially or horizontally split casing, for in-line mounting, for 175 psig (1200 kPa) working pressure.
   B. Casing: Cast iron, with suction and discharge gage port, casing wear ring, seal flush connection, drain plug, flanged suction and discharge.
   C. Impeller: Bronze, fully enclosed, keyed directly to motor shaft or extension.
   D. Shaft: Carbon steel with stainless steel impeller cap screw or nut and bronze sleeve.
   E. Seal: Carbon rotating against a stationary ceramic seat, 225°F (107°C) maximum continuous operating temperature.

PART 3 - EXECUTION

3.1 PREPARATION
   A. Verify that electric power is available and of the correct characteristics.

3.2 INSTALLATION
   A. Install in accordance with manufacturer's instructions.
   B. Provide access space around pumps for service. Provide no less than minimum as recommended by manufacturer.
   C. Decrease piping from line size with long radius reducing elbows or reducers.
   D. Pump inlet conditions shall be as recommended by the pump manufacturer to eliminate system effects.
      1. Provide suction diffusers where indicated. Suction diffusers shall have adequate space provided for strainer removal. Remove fine-mesh start-up strainers after system startup, and hang adjacent to the pump for Architect/Engineer’s approval.
      2. Where suction diffusers are not indicated, provide proper straight lengths of inlet piping and long-radius elbows at pump inlets.
   E. Support piping adjacent to pump such that no weight is carried on pump casings. Provide necessary brackets or hanger supports as required to relieve the stress on the pumps and piping. For close coupled or base mounted pumps, provide supports under elbows on pump suction and discharge line sizes 4 inches (102 mm) and over. Refer to Division 23 Section “Vibration and Seismic Controls for HVAC Piping and Equipment”.

HYDRONIC PUMPS
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F. Provide line sized shut-off valve and strainer on pump suction, and properly sized soft seat check valve and balancing/flow-measuring/shutoff valve on pump discharge.

G. Install pumps with a pressure gauge piped to suction and discharge, with shutoff valves.

H. Lubricate pumps before start-up.

I. Check, align, and certify alignment of base mounted pumps prior to start-up.

J. Provide labor and materials required to ensure that pump impellers are adequately sized to provide flow rates as indicated. This shall include, but not be limited to, trimming impellers.

END OF SECTION 232123
SECTION 232300 – REFRIGERANT PIPING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Piping.
B. Refrigerant.
C. Moisture and Liquid Indicators.
D. Valves.
E. Strainers.
F. Check Valves.
G. Pressure Relief Valves.
H. Filter-Driers.
I. Solenoid Valves.
J. Expansion Valves.

1.2 RELATED SECTIONS

A. Division 08 Section “Access Doors and Frames.”
B. Division 09 Section “Painting.”
C. Division 23 Section “Sleeves and Escutcheons for HVAC Piping.”
D. Division 23 Section “Hangers and Supports for HVAC Piping and Equipment.”
E. Division 23 Section “HVAC Piping Insulation.”
F. Division 23 Section “HVAC Equipment Insulation.”
G. Division 23 Section “Packaged Compressor and Condenser Units.”
H. Division 23 Section “Split System Air Conditioners.”
I. Division 23 Section “Instrumentation and Control for Mechanical Systems.”
J. Division 26 Section “Electrical.”
1.3 REFERENCES

A. ARI 495 - Refrigerant Liquid Receivers.
B. ARI 710 - Liquid Line Dryers.
C. ARI 730 - Flow-Capacity Rating and Application of Suction-Line Filters and Filter-Driers
D. ARI 750 - Thermostatic Refrigerant Expansion Valves.
E. ARI 760 - Solenoid Valves for Use With Volatile Refrigerants.
G. ASHRAE 34 - Number Designation of Refrigerants.
I. ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
J. ASME B16.26 - Cast Copper Alloy Fittings For Flared Copper Tubes.
K. ASME B31.5 - Refrigeration Piping.
L. ASME B31.9 - Building Services Piping.
M. ASME SEC 8D - Boilers and Pressure Vessels Code, Rules for Construction of Pressure Vessels.
N. ASTM A53 - Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
O. ASTM A234 - Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures.
P. ASTM B88 - Seamless Copper Water Tube.
Q. ASTM B280 - Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.
R. AWS A5.8 - Brazing Filler Metal.
S. AWS D1.1 - Structural Welding Code, Steel.
T. UL 429 - Electrically Operated Valves.

1.4 SYSTEM DESCRIPTION

A. Where more than one piping system material is specified, ensure system components are compatible and joined to ensure the integrity of the system is not jeopardized. Provide necessary joining fittings. Ensure flanges, unions, and couplings for servicing are consistently provided.
B. Liquid Indicators:
1. Use line size liquid indicators in main liquid line leaving condenser.
2. If receiver is provided, install in liquid line leaving receiver.
3. Use line size on leaving side of liquid solenoid valves.

C. Valves:
1. Use service valves on suction and discharge of compressors.
2. Use gauge taps at compressor inlet and outlet.
3. Use gauge taps at hot gas bypass regulators and at filters and filter driers, inlet and outlet.
4. Use check valves on compressor discharge.
5. Use check valves on condenser liquid lines on multiple condenser systems.

D. Refrigerant Charging (Packed Angle) Valve: Use in liquid line between receiver shut-off valve and expansion valve.

E. Strainers:
1. Use line size strainer upstream of each automatic valve.
2. Where multiple expansion valves with integral strainers are used, use single main liquid line strainer.
3. On steel piping systems, use strainer in suction line.
4. Use shut-off valve on each side of strainer.

F. Permanent Filter-Driers:
1. Use in low temperature systems.
2. Use in systems utilizing hermetic compressors.
3. Use filter-driers for each solenoid valve.

G. Replaceable Cartridge Filter-Driers:
1. Use vertically in liquid line adjacent to receivers.
2. Use with filter elements in suction line. Provide temporary wax removal filter-drier core in low temperature systems and systems where motor failure has occurred.
3. Use filter-driers for each solenoid valve.

H. Solenoid Valves:
1. Use in liquid line of systems operating with single pump-out or pump-down compressor control.
2. Use in liquid line of single or multiple evaporator systems.
3. Use in oil bleeder lines from flooded evaporators to stop flow of oil and refrigerant into the suction line when system shuts down.

1.5 SUBMITTALS

A. Submit under provisions of Division 01 Section “Submittal Procedures.”

B. Shop Drawings: Indicate schematic layout of system, including equipment, critical dimensions, and sizes.

C. Product Data: Provide general assembly of specialties, including manufacturer’s catalog information. Provide manufacturer’s catalog data including load capacity.
D. Pipe Sizing Recommendations of Equipment Manufacturers:
   1. Verify indicated pipe sizes with the manufacturers of the associated equipment. If manufacturer’s recommendations differ from the sizes indicated on the Drawings, submit recommendations to the Architect. The Architect will make the final determination of pipe sizes. Provide sizes per final determination at no additional cost to the Owner. In sizing piping, include modifications as required to affected items including but not limited to piping, valves, filters, other pipeline accessories, insulation, supports, sleeves, conduits, building openings, and building enclosures.
   2. Submission of manufacturer’s recommendations, and equipment performance related to pipe sizing, is the Contractor’s responsibility.
   3. Verify sizing prior to any preparation for piping installation.

E. Test Reports: Indicate results of leak test, acid test.

F. Manufacturer's Installation Instructions: Indicate support, connection requirements, and isolation for servicing.

G. Submit welders’ certifications of compliance with AWS D1.1., and their assigned identification letters, numbers or symbols.

1.6 PROJECT RECORD DOCUMENTS

A. Submit under provisions of Division 01 Section “Closeout Procedures.”

B. Record exact locations of equipment and refrigeration accessories on record drawings.

1.7 OPERATION AND MAINTENANCE DATA

A. Submit under provisions of Division 01 Section “Operation and Maintenance Data.”

B. Maintenance Data: Include instructions for changing cartridges, assembly views, spare parts lists.

1.8 QUALIFICATIONS

A. Installer: Company specializing in performing the work of this Section with minimum 3 years’ experience.

B. Design piping system under direct supervision of a Professional Engineer experienced in design of this work and licensed at the place where the Project is located.

1.9 REGULATORY REQUIREMENTS

A. Conform to ASME B31.9 for installation of piping system.

B. Welding Materials and Procedures: Conform to ASME SEC 9 and applicable state labor regulations.

C. Welders Certification: In accordance with AWS D1.1. and state and local requirements.
D. Products Requiring Electrical Connection: Listed and classified by UL, as suitable for the purpose indicated.

E. Refrigerant Safety: Conform with ASHRAE 15, state and local codes and manufacturer’s requirements for safe handling to avoid exposure to workers or to occupants.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect and handle products to site under provisions of Division 01 Section “Product Requirements.”

B. Deliver and store piping and specialties in shipping containers with labeling in place.

C. Protect piping and specialties from entry of contaminating material by leaving end caps and plugs in place until installation.

D. Dehydrate and charge components such as piping and receivers, seal prior to shipment, until connected into system.

1.11 MAINTENANCE MATERIALS

A. Provide maintenance materials under provisions of Division 01 Section “Closeout Procedures.”

B. Provide 2 refrigeration oil test kits, each containing everything required to conduct one test.

C. Provide 2 filter-dryer cartridges of each type.

PART 2 - PRODUCTS

2.1 PIPING

A. Copper Tubing: ASTM B280, Type ACR hard drawn, degreased, nitrogen charged and sealed. Annealed (soft) tubing may be used only for underfloor or below grade runs or for short (6 feet or less) above-grade connections to valves and equipment.

   a. Fittings shall be packaged and labeled for ACR use.
   b. Elbows: Use long-radius elbows wherever possible. Do not use 45-degree elbows, because they are more likely to break at their inner surface in refrigeration service.

2. Joints:
   a. Braze, 15% silver for copper, brass, and bronze.
   b. Braze, 35% silver, for brazing to ferrous metals (steel).
   c. Solder (for use only at equipment and valve connections where required by the equipment manufacturer).
   d. Other: If a valve or equipment manufacturer recommends a joint material other than those specified, submit it for approval.
   e. Flux: Use as recommended by alloy manufacturer. Should not be needed for copper-to-copper brazed joints.
B. Copper Tubing to 7/8 inch (22 mm) OD: ASTM B88, Type K, annealed.

2.2 PIPE SUPPORTS AND ANCHORS
A. See Division 23 Section “Hangers and Supports for HVAC Piping and Equipment.”

2.3 PIPE SLEEVES
A. See Division 23 Section “Sleeves and Escutcheons for HVAC Piping.”

2.4 BRAZING MATERIALS - 15% Silver
A. Manufacturers:
   4. No substitutions.

B. Nominal Composition: 5.0% phosphorus, 15.0% silver, 0.15% other elements (total), remainder copper. Cadmium-free.

C. Physical Properties:
   1. Color: Yellow/Gray
   2. Solidus: 1190°F (643°C)
   3. Liquidus: 1480°F (802°C)
   4. Brazing Range: 1300 - 1500°F (704-816°C)
   5. Electrical Conductivity: 9.9% IACS
   6. Electrical Resistivity: 17.40 Microhm-cm

D. Specification Compliance:
   1. ANSI/AWS A5.8, class BCuP-5
   2. ASME SFA5.8, class BCuP-5
   3. Optional:
      a. QQB 650C, class BCuP-5
      b. QQB 654A, class BCuP-5
      c. QQB 654, class BCuP-5

E. Flux:
   1. Harris (Stay-Silv For copper-to-brass joints. No flux required for copper-to-copper joints).

2.5 BRAZING MATERIALS - 35% Silver
A. Manufacturers:
   4. No substitutions.
B. Nominal Composition: 35.0% silver, 33% Zinc, 0.15% other elements (total), remainder copper. Cadmium-free.

C. Physical Properties:
1. Color: Yellow/Gray
2. Solidus: 1250°F (677°C)
3. Liquidus: 1410°F (732°C)
4. Electrical Conductivity: 19.8% IACS
5. Electrical Resistivity: 8.2 Microhm-cm

D. Specification Compliance:
1. ANSI/AWS A5.8, class BAg-5
2. ASME SFA5.8, class BCuP-5

E. Flux:
1. Harris (Stay-Silv white flux, or where heating cycles are extended, Stay-Silv black flux).

2.6 SOLDER MATERIALS:

A. Manufacturers:
1. Harris (Product: Stay-Brite).
4. No substitutions.

B. Nominal Composition: Alloy of silver and tin (3-6% Ag, remainder Sn). Antimony-free.

C. Physical Properties:
1. Color: Bright Silver
2. Solidus: 430°F (221°C)
3. Liquidus: 430°F (221°C)
4. Electrical Conductivity: 16.4% IACS
5. Shear Strength: 10,600 psi (73 MPa)
6. Tensile Strength: 14,000 psi (96 MPa)
7. Elongation: 48%

D. Specification Compliance:
1. NSF 51
2. ASTM B32-89, Alloy Grade Sn96
3. Federal Spec. QQ-S-571E, Class Sn 96 with exception to QPL paragraph 3.1
4. J-STD-006, Sn96Ag04A

E. Flux:
1. Harris (Product: Stay Clean Paste Flux, Stay Clean Liquid Flux (used with 4” or larger copper tubing also stainless steels), or Bridgit Water Soluble Paste Flux).
2. Canfield (Product: Aqua-Brite or AB Cream Flux). Glycerin-based, water soluble.
2.7 REFRIGERANTS AND LUBRICANTS

A. Refrigerant: ASHRAE 34;
   5. R-134a: Tetrafluoroethane. Suitable for new equipment and retrofits.

B. Oils and Other Lubricants: Provide as required by the refrigerant manufacturer and the equipment manufacturer(s).

2.8 MOISTURE AND LIQUID INDICATORS

A. Manufacturers:
   1. Sporlan Valve Co, Model “See-All”.
   2. Emerson Climate Technologies.
   3. Henry Technologies.

B. Indicators: Double port type, UL listed, with steel body, flared or copper plated solder ends, leak proof fused sight glass, replaceable color coded paper moisture indicator and plastic cap; for maximum working pressure of 500 psig (3450 kPa) for connection sizes 1-1/8 inch (29 mm) O.D. and smaller, 430 psig (2960 kPa) for sizes 1-3/8 inch (35 mm) O.D. and larger, and maximum temperature of 200ºF (93ºC). Synthetic gaskets are not allowed.

2.9 VALVES

A. Diaphragm Packless Valves:
   1. Manufacturers:
      b. Mueller.
      c. Superior.
   2. UL listed, globe or angle pattern, forged brass body and bonnet, phosphor bronze and stainless steel diaphragms, rising stem and handwheel, stainless steel spring, nylon seat disc, solder or flared ends, with positive backseating; for maximum working pressure of 500 psig (3450 kPa) and maximum temperature of 275ºF (135ºC).

B. Packed Angle Valves:
   1. Manufacturers:
      b. Mueller.
      c. Superior.
   2. Forged brass (or brass and copper), forged brass seal caps with copper gasket, rising stem and seat with backseating, molded stem packing, solder or flared ends; for maximum working pressure of 500 psig (3450 kPa) and maximum temperature of 275ºF (135ºC).
C. Ball Valves:
1. Manufacturers:
   b. Mueller.
   c. Superior.
2. Two piece forged brass body with teflon ball seals and copper tube extensions, brass bonnet and seal cap, chrome plated ball, stem with neoprene ring stem seals; for maximum working pressure of 500 psig (3450 kPa) and maximum temperature of 325ºF (163ºC).

D. Service Valves:
1. Manufacturers:
   b. Mueller.
   c. Superior.
2. Forged brass body with copper stubs, brass caps, removable valve core, integral ball check valve, flared or solder ends, for maximum pressure of 500 psig (3450 kPa).

2.10 CHECK VALVES

A. Globe Type:
1. Manufacturers:
   b. Mueller.
   c. Superior.
2. Cast bronze or forged brass body, forged brass cap with neoprene seal, brass guide and disc holder, phosphor-bronze or stainless steel spring, teflon seat disc; for maximum working pressure of 500 psig (3450 kPa) and maximum temperature of 300ºF (149ºC).

B. Straight Through Type:
1. Manufacturers:
   b. Mueller.
   c. Superior.

C. Brass body and disc, phosphor-bronze or stainless steel spring, neoprene seal; for maximum working pressure of 500 psig (3450 kPa) and maximum temperature of 250ºF (121ºC).

2.11 EXPANSION VALVES

A. Manufacturers:
1. Sporlan.
3. Parker Hannifin.

B. Angle or Straight Through Type: ARI 750; balanced port or two-port design suitable for refrigerant, brass body, flare or solder connections, internal or external equalizer, resealable bleed hole, adjustable superheat setting, replaceable inlet strainer, with replaceable thermostatic power element with capillary tube and remote sensing bulb. Joints to the body at the removable power element and at the strainer shall be knife-edge type not requiring a synthetic seal.
C. Selection: Evaluate refrigerant pressure drop through system to determine available pressure drop across valve. Select valve for maximum load at design operating pressure and minimum 10°F (6°C) superheat. Select to avoid being undersized at full load and excessively oversized at part load. Select thermostatic charge for the particular application.

2.12 SOLENOID VALVES

A. Manufacturers:
1. Sporlan.
3. Parker Hannifin.

B. Valve: ARI 760, pilot operated, brass or steel body and internal parts, teflon seat, stainless steel stem and plunger assembly, with flared, solder, or threaded ends; for maximum working pressure of 500 psig (3450 kPa). Stem shall have a knife-edge joint to the body and shall permit manual operation in case of coil failure.

C. Coil Assembly: UL listed, replaceable with molded electromagnetic coil, moisture and fungus proof, with surge protector and color coded lead wires, integral junction box with pilot light.

D. Electrical Characteristics: 10 to 15 watts, voltage compatible with control system, single phase, 60 Hz.

2.13 FILTER-DRIERS

A. Replaceable Cartridge Angle Type:
1. Manufacturers:
   a. Sporlan, Model CW Catch-All.
   b. Emerson Climate Technologies.
2. Shell: ARI 710, UL listed, steel with epoxy paint finish, copper sweat fittings, removable cap with zinc-plated fasteners, for maximum working pressure of 500 psig (3450 kPa), size as recommended by manufacturer.
3. Suction Filter Cartridge: Pleated media with integral end rings, stainless steel support, ARI 730 rating for capacity of the equipment served.
4. Filter/Dryer Cartridge: Pleated media with solid core molecular sieve with activated alumina, ARI 730 rating for capacity of the equipment served.
5. Wax Removal Cartridge: Molded bonded core of activated charcoal with integral gaskets, with filter surface area, desiccant volume and ARI 710 moisture rating as recommended by the manufacturer based on line size and refrigeration system horsepower (kW).

B. Permanent Straight Through Type:
1. Manufacturers:
   a. Sporlan, Model CW Catch-All.
   b. Emerson Climate Technologies.
2. ARI 710, UL listed, steel shell with copper plated steel sweat or flare fittings, molded molecular sieve/activated alumina desiccant filter core, for maximum working pressure of 500 psig (3450 kPa).
3. Rating: ARI 730 flow capacity of the equipment served.
2.14 STRAINERS

A. Straight Line or Angle Line Type:
   1. Manufacturers:
      b. Sporlan.
      c. Superior.
   2. Brass or steel shell, steel cap and flange, and replaceable cartridge, with screen of stainless steel wire or monel reinforced with brass; for maximum working pressure of 430 psig (2960 kPa).

B. Straight Line, Non-Cleanable Type:
   1. Manufacturers:
      b. Mueller.
   2. Steel shell, copper plated fittings, stainless steel wire screen, for maximum working pressure of 430 psig (2960 kPa).

C. Screens: 80 mesh (0.007 in. (0.18 mm) square openings) in most uses, 60 mesh (0.010 in. (0.25 mm) square openings) in line sizes above 1-1/8 inch (29 mm), and 40 mesh (0.015 in. (0.38 mm) square openings) for use in suction lines.

PART 3 - EXECUTION

3.1 PREPARATION
   A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
   B. Remove scale and dirt on inside and outside before assembly.
   C. Prepare piping connections to equipment with flanges or unions.

3.2 INSTALLATION
   A. Install refrigeration specialties in accordance with manufacturer's instructions.
   B. Route piping in orderly manner, parallel or perpendicular to building structure, and maintain gradient.
   C. Install annealed piping free of kinks, and with bends only as necessary.
   D. Install piping to conserve building space and not interfere with use of space.
   E. Group piping whenever practical at common elevations and locations. Slope piping one percent in direction of oil return.
   F. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
G. Arrange piping to return oil to compressor. Provide traps and loops in piping, and provide double risers as required.

H. Pipe Sleeves and Escutcheons:
   1. See Division 23 Section “Sleeves and Escutcheons for HVAC Piping.”
   2. Provide sleeves, sized to fit outside the pipe insulation with at least 1/4-inch clearance, at penetrations of building assemblies. Interrupt insulation where required by fire ratings.
   3. Extend floor sleeves to 2 in. (50 mm) above finished floor and seal watertight.
   4. For below-grade penetrations and where indicated, provide watertight link-type pipe seals.
   5. Secure sleeves in place, and caulk, grout or firestop into the building assembly.
   6. Provide split chrome or painted escutcheons where exposed to occupancy.

I. Provide clearance for installation of insulation and access to valves and fittings.

J. Provide access to concealed valves and fittings. Coordinate size and location of access doors with Division 08 Section “Access Doors and Frames.”

K. Flood piping system with nitrogen when brazing.

L. Where pipe support members are welded to structural building frame, brush clean, and apply one coat of zinc rich primer to welding.

M. Prepare unfinished pipe, fittings, supports, and accessories ready for finish painting. Refer to Division 09 Section “Painting.”

N. Insulate piping and equipment; refer to Division 23 Sections “HVAC Piping Insulation” and “HVAC Equipment Insulation.”

O. Follow ASHRAE 15 procedures for charging and purging of systems and for disposal of refrigerant.

P. Provide liquid line replaceable cartridge (unless sealed type is indicated) filter-driers, with isolation valves and valved bypass. On low temperature systems, or after a hermetic motor burnout, provide wax removal cores. Provide upstream and downstream pressure-testing access valves.

Q. Provide suction line replaceable cartridge filters, with isolation valves and valved bypass. Provide upstream and downstream pressure testing access valves. On low temperature systems, or after a hermetic motor burnout, provide temporary wax removal cores. After cleanup of the system, replace cores with filter elements for lower pressure drop.

R. Locate expansion valve sensing bulb immediately downstream of evaporator on suction line.

S. Provide external equalizer piping on expansion valves with refrigerant distributor connected to evaporator.

T. Fully charge completed system with refrigerant after testing.

U. Provide electrical connection to solenoid valves. Refer to Division 26.
3.3 FIELD QUALITY CONTROL

A. Field inspection and testing will be performed under provisions of Division 01 Section “Quality Requirements.”

B. Test refrigeration system in accordance with ASME B31.5.

C. Pressure test system with dry nitrogen to 200 psig (1470 kPa). Perform final tests at 27 inches (92 kPa) vacuum and 200 psig (1470 kPa) using electronic leak detector. Test to no leakage.

D. Evacuate the system as required by Codes and by equipment manufacturer, including a vacuum test at 0.02 inches of mercury (500 microns). The system shall be valved off and tested for 2 hours with a pressure rise of no more than 0.002 inches of mercury (50 microns).

3.4 SYSTEM STARTUP

A. Lubricate motors and other moving parts as necessary before operating them.

B. Charge the system with liquid refrigerant into the low pressure side of the system, where the liquid will evaporate. Expel air from the system. Operate the compressor, condenser, water cooling pumps and evaporator fans during charging. Monitor compressor discharge pressure. Monitor oil levels for a period of 24 hours.

C. Coordinate control setpoints and wiring prior to startup.

D. Change suction filter elements if the pressure drop exceeds 1 Psi after the initial 24 hours of operation. Change suction wax removal cores to filter elements after system cleanup.

E. Adjust expansion valve superheat using a thermistor or thermocouple temperature sensor at the bulb location and a pressure gauge at the external equalizer line (or the compressor). Adjust under full system load, and again when the system stabilizes.

F. Check the system again after 7 full days of operation.

G. Periodically clean strainers until no more accumulation occurs.

END OF SECTION 232300
SECTION 232500 – HVAC WATER TREATMENT

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Cleaning of piping systems.

B. Chemical feeder equipment.

C. Chemical treatment.

1.2 PRODUCTS FURNISHED BUT NOT INSTALLED UNDER THIS SECTION

A. Division 23 Section “Hydronic Piping”: Placement of by-pass (pot) feeder.

1.3 PRODUCTS INSTALLED BUT NOT FURNISHED UNDER THIS SECTION

A. Division 01 Section “Summary”: Owner-furnished treatment equipment and chemicals.

1.4 RELATED SECTIONS

A. Division 23 Section “Instrumentation and Control For Mechanical Systems.”

B. Division 26 Section “Electrical”: Electrical characteristics and wiring connections.

1.5 REFERENCES

A. NFPA 70 - National Electrical Code.

1.6 SUBMITTALS

A. Submit under provisions of Division 01 Section “Submittal Procedures.”

B. Product Data: Provide chemical treatment materials, chemicals, and equipment including electrical characteristics and connection requirements.

C. Manufacturer’s Field Reports: Indicate start-up of treatment systems when completed and operating properly. Indicate analysis of system water after cleaning and after treatment.

D. Submit certificate of compliance from authority having jurisdiction indicating approval of chemicals and their proposed disposal.

1.7 OPERATION AND MAINTENANCE DATA

A. Submit under provisions of Division 01 Section “Operation and Maintenance Data.”

B. Operation and Maintenance Data: Include data on procedures and treatment programs. Include step by step instructions on test procedures including target concentrations.
1.8 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the products specified in this Section with minimum 3 years’ experience. Company shall have local representatives with water analysis laboratories and full time service personnel.

B. Installer: Company specializing in performing the work of this Section with minimum 3 years’ experience and approved by manufacturer.

1.9 REGULATORY REQUIREMENTS

A. Conform to applicable code for addition of non-potable chemicals to building mechanical systems, and for discharge to public sewage systems.

B. Products Requiring Electrical Connection: Listed and classified by UL as suitable for the purpose specified and indicated.

1.10 MAINTENANCE MATERIALS

A. Provide maintenance materials under provisions of Division 01 Section “Product Requirements.”

B. Provide sufficient chemicals for treatment and testing during warranty period.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Chemical Treatment Systems Products, and Services:

B. Chemical Treatment Products:
   1. Nu-Calgon.
   2. Culligan.
   4. Wesco Chemicals, Inc.

2.2 MATERIALS

A. System Cleaner:
   1. Liquid alkaline compound with emulsifying agents and detergents to remove grease and petroleum products.
   2. Biocide; chlorine release agents such as sodium hypochlorite or calcium hypochlorite, or microbiocides such as quarternary ammonia compounds, tributyl tin oxide, methylene bis (thiocyanate), or isothiazolones.

B. Closed System Treatment (Water):
   1. Sequestering agent to reduce deposits and adjust pH; polyphosphate.
2. Corrosion inhibitors; liquid boron-nitrite, sodium nitrite and borax, sodium tolyltriazole, low molecular weight polymers, phosphonates, sodium molybdate, or sulphites.
3. Conductivity enhancers; phosphates or phosphonates.

2.3 BY-PASS (POT) FEEDER

A. Manufacturers:
1. Neptune Chemical Pump Co.: Model DBF-5HP.
2. General Treatment Products, Inc.: Model DB5-QC-AR.
5. No substitutions.

B. 5.0 gal (18.9 L), with quick opening cap (coarse threaded or Victaulic grooved coupling type), domed (convex) top and bottom, for working pressure of 200 psig (1370 kPa) at 200°F (93°C), fittings as required for piping configuration indicated on the Drawings, minimum of 3/4-in. FPT inlet, outlet, and bottom drain.

C. Provide fitting for air vent ball valve, either on the feeder or on piping, to allow release of pressure before opening the cap.

D. Plug any unused openings.

E. Open fill funnel is not desired. If a fill funnel is provided, provide a lockable ball valve, and padlock with 3 keys, to prevent tampering. If more than one lock is provided, they shall be keyed alike. Furnish keys to the Owner.

F. Install above the floor with legs or pedestal. For feeders which don’t have integral legs or pedestal, provide additional support or concrete housekeeping pad.

PART 3 - EXECUTION

3.1 PREPARATION

A. Systems shall be operational, filled, started, and vented prior to cleaning. Use water meter to record capacity in each system.

B. Place terminal control valves in open position during cleaning.

C. Verify that electric power is available and of the correct characteristics.

3.2 CLEANING SEQUENCE

A. Concentration:
1. As recommended by manufacturer.
2. One pound per 100 gallons (1 kg per 1000 L) of water contained in the system.
3. One pound per 100 gallons (1 kg per 1000 L) of water for hot systems and one pound per 50 gallons (1 kg per 500 L) of water for cold systems.
4. Fill steam boilers only with cleaner and water.
B. Hot Water Heating Systems:
1. Apply heat while circulating, slowly raising temperature to 160°F (71°C) and maintain for 12 hours minimum.
2. Remove heat and circulate to 100°F (37.8°C) or less; drain systems as quickly as possible and refill with clean water.
3. Circulate for 6 hours at design temperatures, then drain.
4. Refill with clean water and repeat until system cleaner is removed.

C. Use neutralizer agents on recommendation of system cleaner supplier and approval of Architect/Engineer.

D. Flush open systems and glycol filled closed systems with clean water for 1 hour minimum. Drain completely and refill.

E. Remove, clean, and replace strainer screens.

F. Inspect, remove sludge, and flush low points with clean water after cleaning process is completed. Include disassembly of components as required.

3.3 INSTALLATION

A. Install in accordance with manufacturer's instructions.

3.4 CLOSED SYSTEM TREATMENT

A. Provide one bypass feeder on each system. Install isolating and drain valves and necessary piping. Install around balancing valve downstream of circulating pumps unless indicated otherwise.

B. Introduce closed system treatment through bypass feeder when required or indicated by test.

END OF SECTION 232500
SECTION 233013 – HVAC AIR DUCT CLEANING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Air duct cleaning to include site preparation, source removal of dirt and debris, chemical surface treatment, duct openings, sealing and repair of duct insulation.

B. At the time of Substantial Completion, the entire air distribution system shall be turned over to the Owner clear of construction dust and debris. If the interior surfaces of any ducted air moving equipment or the interior surfaces of any [new or modified] portion of the ductwork distribution system are found, as determined by the Architect, to contain significant construction dust and debris, the entire ductwork distribution system shall be cleaned in accordance with this Specification Section. If proper precautions are taken to prevent construction dust and debris from entering the ductwork during construction, and if the Architect finds the ductwork to be free from such dust and debris, air duct cleaning shall not be required.

C. If new or modified ductwork is found to require cleaning as specified in this Section, any existing ductwork downstream of this ductwork shall be inspected. If, in the opinion of the Architect, the existing ductwork has been significantly dirtied by the construction work, the downstream ductwork shall be cleaned as specified in this Section.

1.2 QUALITY ASSURANCE

A. The publications listed below form a part of this specification to the extent referenced.

B. The publications are referred to in the text by the basic designation only.


D. SMACNA Standards, HVAC Duct Construction Standards - Metal and Flexible (HVACDCS).

1.3 AIR DUCT CLEANING CONTRACTOR

A. Obtain the services of a qualified HVAC system cleaning Subcontractor to perform the air system cleaning as specified herein. Prior to commencing work under this section of the specifications, the testing organization shall have been approved by the Engineer. The criteria for determining qualifications shall be recent experience with similar projects done in accordance with National Air Duct Cleaners Association (NADCA) Standard 1992-01.

1.4 SUBMITTALS

A. Submit experience list of similar projects.

B. Submit cleaning methodologies and material safety data sheets (MSDS) for chemicals to be used.
PART 2 - PRODUCTS

2.1 APPROVED DUCT CLEANING AGENCIES

A. Mechanical Services, Inc., Portland, ME - Tel # 800-675-0229

B. Air Duct Klean, a division of Kitchen Klean, Inc., Epsom, NH - Tel # 800-736-4484

C. Cochrane Ventilation, Inc., Wilmington, MA - Tel # 800-974-9055

D. Haley’s Metal Shop, Inc., Biddeford, ME - Tel # 207-284-8571

E. Portland Diversified Services, Westbrook, ME - Tel # 800-639-3901

F. Steamatic, Portland, ME - Tel # 207-657-3088

2.2 PROCEDURES FOR AIR DUCT CLEANING

A. Perform work in accordance with NADCA Standard 1992-01.

B. Supply materials for cleaning, repairing and inspection work including HEPA filtered collection systems, rotary brushes, air lances, mechanical agitators, fiber optic borescopes, vacuums, or other equipment and materials necessary to perform work specified. Furnish materials and equipment that are of a reputable manufacturer. Submit Material Safety Data Sheets for chemicals utilized in this project prior to product usage.

C. Access points shall be constructed of metal or plastic. Points shall be installed in a hole that is a minimum of 1 inch in diameter. Access points shall be reusable by maintenance staff. If external insulation is removed during the installation process, repair the open edges with a similar color repair tape (as best as possible).

D. Access doors shall consist of 3 layers of precision stamped 0.030-inch (23 gauge) (0.78 mm) electro-galvanized zinc-plated steel. The inside door shall consist of 2 layers of metal which are spot-welded together at the rim, encapsulating high density fiberglass insulation - UL classified FHC 25/50. The inside surface shall be smooth to reduce friction. The gasket which seals the door from the inside to the duct shall consist of a closed cell neoprene gasket which is UL 94HF 1 listed with a service temperature of (ASTM D-746) 70° to 220°F (21° to 104°C). The gasket shall be permanently bonded to the inside of the door to eliminate leakage. Conical springs shall be installed over the bolts, between the inner and outer door, to facilitate opening. Access shall be accomplished by use of high impact polypropylene molded knobs that have threaded brass inserts to eliminate thread stripping. Knobs shall be easy to turn by hand without wrenches. Door shall be tested to 20 in.WG (4.9 kPa) with no leakage noted. The installed access door shall be a permanent reusable access system that can be utilized for further inspections and/or repair.

E. Clean outdoor air plenums thoroughly. Vacuum or scrape inlet louvers, bird screens, dampers, turning vanes, moisture deflectors and other irregular surfaces, if necessary.

F. Vacuum the interior surfaces of the mixing chamber, removing gross debris. Sanitize the plenum, drains, and dampers with an EPA registered sanitizing agent.
G. Remove filters from the rack and prepare the area for cleaning. If filters are to be reused, clean and store in a dry area. Scrape debris from the filter rack area. Vacuum clean and/or pressure wash the filter rack system (ensure proper drainage is available before cleaning). Sanitize the filter rack system.

H. Remove standing water from the condensate pans or base of the plenum. Clear the drains associated with each pan, ensuring proper operation before cleaning. If fins are bent prior to cleaning, straighten fins utilizing a coil combing system after the cleaning process. High-pressure-water clean the coil section. First apply a biodegradable cleaning solution to penetrate into the coil section (follow manufacturer’s guidelines). Repeat process on the other side of the coil section. Rinse each side. Continue process until clear water can penetrate coil section on entire coil face. After cleaning, sanitize coil section with an approved biocide-utilizing atomizing system. Report existing damage to the coil section or improper drainage in writing to the Architect.

I. Vacuum clean the fan housing and motors to remove debris. Hand scrape fan impellers and remove loose debris from the internal surfaces of the fan housing. Take precautions not to damage the impellers, alter blade shape or weight, or affect impeller balance.

J. Vacuum the internal surfaces of the plenums associated with the air handler. Remove gross debris and other debris or excess equipment that may be present. In severe cases, the internal plenum surface may be high-pressure-water cleaned to remove grease, dirt, and debris. After interior surfaces and equipment are cleaned, sanitize the unit with an approved sanitizer utilizing an atomizing system.

PART 3 - EXECUTION

3.1 DUCTWORK CLEANING PROCESS

A. Equipment used shall be portable and sized to enter these areas. Coordinate electrical requirements through the Owner’s electrical or maintenance department, as appropriate. Modifications to accommodate electrical requirements will be at the Contractor’s expense.

B. Address each main duct section by first securing debris collection equipment to diffuser branch ducts or to an isolated section of main trunk ductwork.

C. Collectors shall be fan powered, high velocity dust and particle collection systems which will be utilized in areas where debris is being removed from the system. Equip collection systems with HEPA filtration (99.97% collection efficiency for 0.3 micron size). The collection systems shall be self-contained, with appropriate components to adequately prevent dirt and debris loosened from upstream duct mains and branches during cleaning operations from entering the diffuser plenums by capturing this debris within the collection device. The components of the collector that connect the base collection unit to the duct or diffuser plenum shall be air-tight and reusable from area to area.

D. Agitate the loose debris on the interior surfaces to introduce the debris into the air flow produced and controlled by the collection systems. Collection systems shall be able to produce a minimum of 0.42 in.WG (104 Pa) in the targeted section of duct to be cleaned. Debris shall travel through the ductwork to the point of collection.
E. Ductwork shall be cleaned by inserting air powered brush systems, air powered extended whip sections, electric rotary brush systems, skipper balls, or air sweeps through the installed access. Utilize equipment that will best contact surfaces of the duct regardless of shape or size.

F. Where duct is large enough and able to support the weight of a worker, hand tools and vacuums may be used. Install collection equipment in the section of duct to be cleaned by hand as a precautionary measure to catch any residual debris.

G. Whenever the grilles, registers, or diffusers are removable, they shall be removed, washed, rinsed, dried, and then replaced. If for any reason they are not removable, they shall be vacuumed in place. Contractor is not responsible for existing improperly installed grilles, registers, and diffusers; for example, grilles, registers, or diffusers screwed directly into porous ceiling tiles. Whenever possible, reinstall grilles, registers, and diffusers that were originally improperly installed to the best of the Contractor’s ability in a timely manner. Report inability to reinstall grilles, registers, and diffusers in a proper manner in writing to the Architect.

H. Perform sanitizing of the air distribution system as required using an air sprayer or fogging device to cover the interior surfaces of the ductwork. Make certain that surfaces are kept wet for at least 10 minutes. Sanitizing fluid shall be registered with the Environmental Protection Agency. Sanitizing shall be accomplished through installed access doors and access points.

I. Perform duct cleaning and sanitizing only at a time when the targeted air distribution systems can be shut down and the facility cleared of occupants. Schedule the duct cleaning for an appropriate time. Note: Occupants does not include maintenance or supervisory personnel who take proper precautions.

J. Replace, at no additional cost to the Owner, any ceiling tiles or gridwork that is/are damaged during the ductwork cleaning process.

K. De-activate and re-activate duct smoke detectors during the duct cleaning process. Coordinate with and receive approval from the local Fire Department and/or local Code Enforcement Officials prior to the de-activation and re-activation of smoke detectors.

3.2 PROJECT ASSESSMENT

A. Provide inspection access to the Architect any time during or immediately after the cleaning of the air delivery system or systems. Inspection shall be visual in nature by means of installed access doors and points with the benefit of a fiber optic borescope where necessary. Meet the guidelines set down in the NADCA Standard 1992-01 for Mechanical Cleaning of Non-Porous Air Conveyance System components.

B. Perform the NADCA vacuum test and submit report for approval.

C. Show exact locations of access doors installed as part of the cleaning process on the Record Drawings.

END OF SECTION 233013
SECTION 233113 – METAL DUCTS

PART 1 - GENERAL

1.1 SECTION INCLUDES
A. Metal Ductwork.
B. Nonmetal Ductwork.
C. Casing and Plenums.
D. Sealing of Existing Ductwork.

1.2 RELATED SECTIONS
A. Division 01 Section “Testing, Adjusting and Balancing for HVAC.”
B. Division 09 Section “Painting”: Weld priming, weather resistant, paint or coating.
C. Division 23 Section “Hangers and Supports for HVAC Piping and Equipment”: Sleeves.
D. Division 23 Section “Duct Insulation”: External insulation and duct liner.
E. Division 23 Section “HVAC Air Duct Cleaning.”
F. Division 23 Section “Air Duct Accessories”
G. Division 23 Section “Air Outlets and Inlets.”

1.3 REFERENCES
A. ASTM A 36 - Structural Steel.
B. ASTM A 90 - Standard Test Method for Weight of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings.
D. ASTM A 480 - General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip.
E. ASTM A 568 - Steel, Sheet, Carbon, Structural, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled.
F. ASTM A 653 - Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
G. ASTM A 1008 - Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable.
H. ASTM A 1011 - Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength.

I. ASTM B 209 - Aluminum and Aluminum-Alloy Sheet and Plate.

J. AWS D9.1 - Welding of Sheet Metal.


L. NFPA 90B - Installation of Warm Air Heating and Air Conditioning Systems.

M. SMACNA - HVAC Duct Construction Standards - Metal and Flexible (SMACNA HVACDCS).

N. UL 181 - Factory-Made Air Ducts and Connectors.

1.4 PERFORMANCE REQUIREMENTS

A. No variation of duct configuration or sizes is permitted except by written permission from the Architect. Size proposed substitutions of round ducts in place of rectangular ducts in accordance with ASHRAE table of equivalent rectangular and round ducts.

B. Field-verify concealed duct routing. Duct sizes and arrangement of concealed ducts on the Drawings are approximate. This Subcontractor is responsible for providing ductwork to meet the intent and performance of the ducts indicated on the Drawings.

1.5 SUBMITTALS

A. Submit under provisions of Division 01 Section “Submittal Procedures.”

B. Shop Drawings: Indicate duct fittings, particulars such as gauges, sizes, welds, and configuration. Submit prior to start of work.

C. Product Data: Provide data for duct materials, duct liner and duct connectors.

D. Samples:
   1. Submit as indicated on the Drawings, and as specified herein.
   2. Submit sample shop-fabricated mitered (vaned) and radiused elbows.
   3. Submit mock-up installation of a vertical or horizontal fire damper.

1.6 PROJECT RECORD DOCUMENTS

A. Submit under provisions of Division 01 Section “Closeout Procedures.”

B. Record actual locations of ducts and duct fittings. Record changes in fitting location and type. Indicate additional fittings used.

1.7 QUALITY ASSURANCE

A. Perform Work in accordance with SMACNA HVACDCS.
1.8 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the Products specified in this Section with minimum 3 years’ experience.

B. Installer: Company specializing in performing the work of this Section with minimum 3 years’ experience.

1.9 REGULATORY REQUIREMENTS

A. Construct ductwork to NFPA 90A and NFPA 90B standards.

1.10 ENVIRONMENTAL REQUIREMENTS

A. Do not install duct sealants when temperatures are less than those recommended by sealant manufacturers.

B. Maintain temperatures during and after installation of duct sealants.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Flexible Ducts:
   1. Flexible Technologies Group - Thermaflex product line.
   3. No substitutions.

B. Plastic Drawbands:
   1. Panduit.
   2. Thomas and Betts.
   3. Tyton.

C. Tape for Flexible Ducts:
   1. Ideal Tape Co., division of American Biltrite Inc.
   2. 3M Company.
   3. Nashua Tape Products, division of Berry Plastics Corp.
   4. Venture Tape Corporation.
   5. No substitutions.

D. Manufactured Ductwork - Round and Flat Oval:
   2. Aero Heating & Ventilating, Inc.; Portland, ME.
   3. Air Purchases, Inc.; Manchester, NH – spiral duct lengths.
   4. Atlantic Air Products LLC; Bow, NH.
   5. Central City Sheet Metal; Brewer, Caribou, and Gorham, ME.
   6. Hahnel Brothers; Bangor and Lewiston, ME.
   7. Hranec Corporation; Uniontown, PA.
   8. Lindab, Inc. – duct fittings only.
9. Macy Industries, Inc.; Hookset, NH.
10. Monroe Metal Mfg. Inc.; Monroe, NC.
11. Northeastern Sheet Metal Inc.; Goffstown, NH.
14. Sheet Metal Connectors Inc.; Minneapolis, MN.
15. Spiral Manufacturing Co. Inc.; Minneapolis, MN.
16. Total Air Supply; Nashua, NH – spiral duct lengths.
17. No substitutions.

E. Manufactured Ductwork - Transverse Duct Connection System:
1. Ductmate.
2. HFC Enterprises; Baldwin Park, CA – Dura Flange product line, for round and flat oval ducts only.

F. Sealants:
1. Hardcast, a division of Carlisle Corporation.
2. 3M Company.
3. Ductmate.
4. Foster.
5. McGill AirSeal LLC, a subsidiary of United McGill Corporation.
7. Polymer Adhesive Sealant Systems.

2.2 MATERIALS

A. Galvanized Steel Ducts:
1. Steel sheet metal components of galvanized ductwork in this Specification Section shall be galvanized steel sheet, lock-forming quality, having G60 or heavier zinc coating (G90 minimum for outdoor or moist applications) conforming to ASTM A653 rating system and tested in accordance with ASTM A90.
2. Provide paint-grip exterior surfaces for exposed ducts, where available.
3. Sheet metal gauge shall be not less than 26 gauge (0.56 mm).


2.3 FLEXIBLE DUCTS

A. Insulated Flexible Ducts:
1. Semi-Rigid Flexible Aluminum Ductwork:
   b. Triple lock mechanical joint aluminum flex duct, constructed entirely without the use of adhesive.
   c. Fiberglass insulation and fire-retardant polyethylene vapor retarder film.
   d. Pressure Rating: Positive pressure 12 in. WG (2988 Pa) for all sizes. Negative pressure 12 in. WG (2988 Pa) for sizes thru 16 in. (406 mm) diameter, 8 in. WG (1993 Pa) for sizes 18 and 20 in. (457 and 508 mm) diameter.
   e. Maximum Velocity: 5500 fpm (27.9 m/sec).
   f. Inside bend radius: Minimum one diameter.
g. Temperature Range: -40°F to 250°F (-40°C to 121°C).
h. UL 181, Class 0 air duct.
i. Meets NFPA 90A and 90B standards.

2. Fabric-Core Flexible Ductwork:
   a. Thermaflex Model M-KC.
   b. Greenguard certified.
   c. UL 181, Class 1, heavy fiberglass cloth fabric supported by helically wound spring steel wire; fiberglass insulation; reinforced metalized vapor barrier film.
   d. Pressure Rating: 10 inches WG (2.5 kPa) positive and 2.0 inches (500 Pa) negative.
   e. Maximum Velocity: 6000 fpm (30.4 m/sec).
   f. Temperature Range: -20°F to 250°F (-28°C to 121°C).

B. Non-Insulated Flexible Ducts:
   1. Semi-Rigid Flexible Aluminum Ductwork:
      a. Flexmaster Triple-Lock Buck Duct - Bare.
      b. Triple lock mechanical joint aluminum flex duct, constructed entirely without the use of adhesive.
      c. Pressure Rating: 12 inches WG (2988 Pa) positive for all sizes, 12 inches WG (2988 Pa) negative for sizes thru 16" diameter (406 mm), 8 inches WG (1992 pa) negative for sizes 18" (457 mm) and 20" (508 mm).
      d. Maximum Velocity: 5500 fpm (27.9 m/sec).
      e. Inside bend radius: Minimum one diameter.
      f. Temperature Range: -40°F to 250°F (-40°C to 121°C).
      g. UL 181, Class 0 air duct.
      h. Meets NFPA 90A and 90B standards.

C. Return and Exhaust: Use either semi-rigid flexible aluminum type (insulated or bare), or fabric-core type (insulated). Non-insulated fabric-core type does not have adequate negative pressure rating.

2.4 ACCESSORIES

A. Drawbands for Flexible Ducts:
   1. Stainless Steel: 1/2-inch (13 mm) wide with screw-driven worm gear.
   2. Plastic: Panduit PLT5H or PLT8H; Thomas and Betts Dukt-Rap, VAL-26-50, or VAL-275X-25; or Tyton T150L or LX. Install with manufacturer’s lever-action tightening tool.

B. Tape for Flexible Ducts: Ideal-Seal 587A/B, UL 181B-FX listed, aluminum foil with pressure-sensitive acrylic adhesive, -20°F to 250°F (-28°C to 121°C) temperature range, 25.0 lb/in. width (109.4 N/25.4 mm width) tensile strength.

C. Fasteners: Rivets, bolts, or sheet metal screws.

D. Sealants: See Duct Sealant portion of this Specification.

E. Hanger Rod: ASTM A36; galvanized steel; threaded both ends, threaded one end, or continuously threaded.
F. Wire Rope Hanging System for Concealed Ductwork: At the Contractor’s option, Ductmate Industries’ Clutcher hanger system may be used with Ductmate wire rope (no substitutions). System use and installation shall conform with manufacturer’s requirements. System shall not be painted or otherwise coated. System shall not be used in corrosive environments.

2.5 DUCTWORK FABRICATION

A. Fabricate and support in accordance with SMACNA HVACDCS, as specified or as indicated on the Drawings. Provide duct material, gauges, reinforcing, and sealing for operating pressures indicated.

B. SMACNA Duct Construction Manuals:
   1. The SMACNA recommendations shall be considered as mandatory requirements.
   2. Substitute the word "shall" for the word "should" in these manuals.
   3. Where the Contract Specifications differ from SMACNA recommendations, the more stringent requirements (as determined by the Architect) shall take precedence.
   4. Details on the Contract Drawings take precedence over SMACNA standards.

C. Sheet metal shall be galvanized steel as specified in Part 2 paragraph “Materials” in this Section, unless otherwise indicated or specified.

D. Construct Tees, bends, and elbows with radius of not less than 1-1/2 times width of duct on centerline.
   1. Where space is too restricted for full-radius elbows, provide mitered (square-throat) elbows with single wall 16-gauge turning vanes. Do not use air-foil turning vanes.
   2. Mitered elbows in round or flat-oval ductwork shall be factory-manufactured.
   3. Radiused elbows with throat radius 1/2 times width of duct (centerline radius 1 width of duct) may be used instead of mitered elbows, but only where space is too restricted for full radius.
   4. Fittings not conforming to these requirements will be ordered removed and replaced with proper fittings.

E. Increase duct sizes gradually, not exceeding 15 degrees divergence or convergence (per side) wherever possible; maximum 30 degrees divergence (per side) upstream of equipment and 45 degrees convergence (per side) downstream.

F. Fabricate continuously welded round and oval duct fittings two gauges heavier than duct gauges indicated in SMACNA Standard. Joints shall be minimum 4 inch (100 mm) cemented slip joint, brazed or electric welded. Prime coat welded joints.

G. Provide standard 45 degree lateral wye takeoffs unless otherwise indicated where 90 degree conical tee connections may be used.

H. Longitudinal locks or seams known as “button-punch-snap-lock” and other “snap-lock” types will not be permitted in rectangular duct. Snap-lock longitudinal seams may be used on round ducts up to 8 inches diameter, with screws provided to secure the seams at 24 inches on center maximum spacing.

I. Exposed Ducts: Select and handle materials with care for a neat appearance. Joint connections on round and flat oval ducts shall be sleeve or flanged type; drawbands are not acceptable.
2.6 MANUFACTURED DUCTWORK AND FITTINGS

A. Manufactured ductwork and fittings listed below are acceptable alternatives to standard ductwork systems. For exposed round and flat oval ductwork, factory-manufactured ductwork and fittings are required.

B. Manufacture in accordance with SMACNA HVACDCS, and as specified or as indicated on the drawings. Provide duct material, gauges, reinforcing, and sealing for operating pressures indicated.

C. Exposed Round and Flat Oval Ductwork: Shall be manufactured ductwork by one of the listed manufacturers.
   1. Spiral Ductwork Acceptable Products:
      a. McGill Airflow: Standard Uni-Seal product line (smooth surface between spiral lockseams) or Uni-Rib product line (one standing seam reinforcement between each pair of spiral lockseams).
      b. Monroe Metal Inc.: Standard spiral product line (smooth surface between spiral lockseams). V-Rib product line is not allowed.
      c. Other Manufacturers: Standard spiral product line (smooth surface between spiral lockseams).
      d. Ductwork and fittings shall be products of a single manufacturer.

D. Exposed Ducts:
   1. Select and handle materials with care for a neat appearance.
   2. Joint connections on round and flat oval ducts shall be sleeve or flanged type; drawbands are not acceptable. Joint connections on flat oval ducts 42 inches and wider shall be flanged type to ensure tight fit and good appearance.
   3. Provide exterior reinforcing only where required, with prior approval from the Architect.
   4. External reinforcement of flat-oval ducts shall be full-perimeter angle rings. Straight angles along flat sides only are not allowed.

E. Galvanized and stainless steel sheet metal used in fabrication shall be not less than 26 gauge thickness. Aluminum shall be not less than 0.025 inch nominal thickness. Duct gauges indicated on the Drawings take precedence. This requirement supersedes SMACNA requirements.

F. Round and Flat Oval Duct and Fittings:
   1. Shall be suitable for at least 4 in. WG positive pressure and 2 in. WG negative pressure in accordance with SMACNA HVACDCS standards. This is a minimum; provide higher ratings where required.
   2. Fittings shall be fabricated of sheet metal at least one gauge heavier than straight duct of the same size.
   3. Fittings shall be factory-sealed so that no field sealing of joints between gores or segments is required. Acceptable methods of construction are fully welded, spot-welded with inner sealant, or standing-seam crimped joints.

G. Radiused Elbows in Round and Flat Oval:
   1. In exposed ductwork shall be non-adjustable type, factory-sealed.
   2. In concealed ductwork may be adjustable type, with full long radius as detailed on the Drawings. Short-radius elbows are not allowed.
3. Shall be constructed of the following minimum number of segments or gores: 90-degree: 4 gores; 60-degree: 3 gores; 45-degree: 3 gores; 30-degree: 2 gores; 22-1/2-degree: 2 gores.
4. 1-piece stamped elbows are acceptable up to 12 inches diameter. Pleated elbows are acceptable up to 10 inches diameter.

H. Mitered Elbows in Round and Flat Oval:
1. Available in both 90-degree and 45-degree elbows.
2. Shall have minimum number of welded single-wall vanes as follows (size is duct width in plane of bend):
   a. 3 to 9 inch: 2.
   b. 10 to 14 inch: 3.
   c. 15 to 19 inch: 4.
   d. 20 to 60 inch: 5.
   e. Larger Sizes: 12-inch maximum spacing.

I. Inner tie-rod reinforcement is not allowed. Increase duct sheet metal gauge or external reinforcement as required.

J. Flat Oval Ducts: Machine made from round spiral lockseam duct.

K. Transverse Duct Connection System: SMACNA "F" rated or SMACNA "J" rated rigidity class connection, interlocking angle and duct edge connection system with sealant, gasket, cleats, and corner clips. Product shall be Ductmate factory-manufactured connectors, or field-formed flanges using a specialized machine.

2.7 PRESSURE CLASSIFICATION

A. Ratings as indicated on the Drawings or as specified. See Ductwork Pressure Class Schedule in Part 3 of this Section.

B. If no ratings are indicated, ductwork shall be rated for the external static pressure of the system plus twenty-five percent.
   1. If 4 dampers (of any type) or fewer can isolate a duct system, that portion of the system shall be rated for the shut-off pressure of the system fans.

2.8 DUCT SEALING

A. Seal ductwork as outlined in the SMACNA HVACDCS. Seal ductwork to a minimum of class A (transverse joints, longitudinal seams, and duct wall penetrations), regardless of pressure class.

B. Seal ductwork systems as required to ensure that maximum duct leakage does not exceed that allowed by the latest edition of the SMACNA HVAC Air Duct Leakage Test Manual. Allow sealant to dry in accordance with manufacturer’s requirements of time and environmental conditions before ductwork systems are pressurized.

C. Existing Ductwork: Seal existing ductwork served by, and/or connected to, the equipment furnished under Division 23, and ductwork as indicated on the Drawings. Contractor shall be responsible to field-verify quantities and sizes. Provide access to existing ductwork as required for complete sealing; sealing ducts enclosed in gypsum-board or masonry shafts and chases is not...
required. Remove existing finishes and loose existing sealants as required for proper adhesion of sealant. For ductwork which has existing insulation or is to be insulated, seal bare portions of the ductwork prior to patching or applying insulation; it is not required to remove intact insulation to gain access for sealing.

D. Duct sealing materials used shall be non-flammable and non-combustible in both liquid and solid states.

E. Seal exposed ducts by applying mastic-type or gasket-type sealer just before the joint or seam is made; remove excess sealant for a neat appearance.

F. Fill (with matching duct material such as sheet metal) any gaps in duct which exceed the recommendations of the sealant manufacturer, and in no case shall liquid or mastic sealant be used to fill gaps or openings which exceed 1/8 inch (3.2 mm) in any direction. Verify that system air pressure acting on a wide gap will not exert enough force to damage or loosen the sealant.

G. Materials for Sealing:
2. Hardcast: gypsum-based tape and mastic, waterproof type when used on moist-air exhaust or in humid or outdoor locations.
3. Ductmate: Flanged lateral joints with gaskets.
4. Ductmate: PROseal.
5. Foster: Duct-Fas or Safetee mastic sealant. Duct-Fas is UV resistant and recommended for applications exposed to sunlight.
6. Mon-Eco: Eco-Duct Seal 4450 (red color) or 4452 (grey color). Use grey color where ducts will be unpainted and exposed to public view.

2.9 UNIFORMITY OF MATERIALS

A. Ductwork accessories, including but not limited to volume dampers, smoke dampers, fire dampers, combination fire/smoke dampers, backdraft dampers and motorized dampers, shall be fabricated of materials that are similar to the ductwork in which they are installed.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install ducts in accordance with SMACNA HVACDCS.

C. Duct Sizes are inside clear dimensions. For lined ducts, maintain sizes inside lining.

D. “Fishmouth” duct connections are not allowed.

E. Inner tie-rod reinforcement is not allowed. Increase duct sheet metal gauge or external reinforcement as required.
F. Exposed Ducts:
1. Handle with care for a neat appearance. Repair or replace dented or damaged ductwork as required by the Architect. Select hangers for appearance, and to prevent sagging or distortion of duct.
2. Remove labels attached to ducts before receiving paint.

G. Provide openings in ductwork where required to accommodate thermometers and controllers. Provide pitot tube openings where required for testing of systems, complete with metal can with spring device or screw to ensure against air leakage. Where openings are provided in insulated ductwork, install insulation material inside a metal ring.

H. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.

I. Use crimp joints with or without bead for joining round duct sizes 8 inch (200 mm) and smaller with crimp in direction of air flow.

J. Use double nuts and lock washers on threaded rod supports. Strap hangers shall be minimum 16-gauge (1.50 mm) x 1-inch (25 mm) galvanized straps. Hanger and support components including but not limited to “unistrut” shall be galvanized steel except that where other duct materials are used, the hanger materials shall be compatible and non-corrosive to the duct. Wire hangers are not acceptable.

K. Flexible Ducts:
1. Connect diffusers or light troffer boots to low pressure supply ducts directly or with 5 feet (1.5 m) maximum length of flexible duct held in place with strap or clamp.
2. Minimum bend radius shall be 1-1/2 times the duct diameter. Support the bend to maintain this radius.
3. Bends shall not exceed 45 degrees.
4. Connect flexible ducts to metal ducts with 2 turns of duct tape and metal draw bands. Plastic drawbands may be used if they are installed using the band manufacturer’s lever-action tightening tool. On insulated flexible ducts, provide an additional seal of tape and drawband on the insulation’s vapor barrier.

L. Set plenum doors 6 to 12 inches (150 to 300 mm) above floor. Arrange door swings so that fan static pressure holds door in closed position.

M. During construction, provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering ductwork system. Do not start ducted air moving equipment until construction is completed to a stage where airborne construction dust is no longer present. At the time of substantial completion, the entire air distribution system shall be turned over to the Owner clear of construction dust and debris. If the interior surfaces of any ducted air moving equipment or the interior surfaces of any portion of the ductwork distribution system are found, as determined by the Architect, to contain significant construction dust and debris, the entire air distribution system shall be cleaned in accordance with Division 23. If proper precautions are taken to prevent construction dust and debris from entering the ductwork during construction and if the Architect finds all ductwork to be free from such dust and debris, air duct cleaning shall not be required.
N. For fresh air intake and exhaust plenums connected to louvers or brick or block vents, pitch bottom of plenums down to bottom of louver at minimum 1/4 inch per foot (2 percent). Seal connections and joints on bottom of plenums watertight with mastic. Connect bottom of plenum to top-inside edge of bottom louver blade or waterstop as detailed on the Drawings, to ensure positive drainage.

O. Install duct-mounted components furnished under other Sections of this Specification, such as smoke dampers, control dampers, control sensors, and smoke detectors. Install with straight lengths of duct as required for proper operation. Provide access at such components as required. Install in accessible locations for maintenance; notify the Architect if a location indicated or selected requires addition of access by other trades.

3.2 SCHEDULES

A. Ductwork Material Schedule

<table>
<thead>
<tr>
<th>AIR SYSTEM</th>
<th>MATERIAL</th>
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</thead>
<tbody>
<tr>
<td>Low Pressure Supply (Heating Systems)</td>
<td>Galvanized Steel, Aluminum</td>
</tr>
<tr>
<td>Low Pressure Supply (System with Cooling Coils)</td>
<td>Galvanized Steel, Aluminum</td>
</tr>
<tr>
<td>Return and Relief</td>
<td>Galvanized Steel, Aluminum</td>
</tr>
<tr>
<td>General Exhaust</td>
<td>Galvanized Steel, Aluminum</td>
</tr>
<tr>
<td>Outside Air Intake</td>
<td>Galvanized Steel, Aluminum</td>
</tr>
<tr>
<td>Combustion Air</td>
<td>Galvanized Steel, Aluminum</td>
</tr>
</tbody>
</table>

B. Ductwork Pressure Class Schedule

<table>
<thead>
<tr>
<th>AIR SYSTEM</th>
<th>SMACNA PRESSURE CLASS</th>
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</thead>
<tbody>
<tr>
<td>Supply (Rooftop Air Conditioner Upstream of Room Reheat Coils)</td>
<td>4 inch (1000 Pa)</td>
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<tr>
<td>Supply (Rooftop Air Conditioner Downstream of Room Reheat Coils)</td>
<td>2 inch (500 Pa)</td>
</tr>
<tr>
<td>Supply (Other Air Handling Systems)</td>
<td>1 inch (250 Pa)</td>
</tr>
<tr>
<td>Return and Relief</td>
<td>2 inch (500 Pa)</td>
</tr>
<tr>
<td>General Exhaust</td>
<td>1 inch (250 Pa)</td>
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<td>Description</td>
<td>Size</td>
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<tr>
<td>----------------------</td>
<td>-------------</td>
</tr>
<tr>
<td>Outside Air Intake</td>
<td>2 inch</td>
</tr>
<tr>
<td>Combustion Air</td>
<td>1 inch</td>
</tr>
<tr>
<td>Other Ductwork</td>
<td>2 inch</td>
</tr>
</tbody>
</table>

END OF SECTION 233113
SECTION 233300 – AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Dampers:
   1. Counterbalanced Dampers.
   2. Fire Dampers.
   3. Volume Control Dampers.

B. Duct Access Doors.

C. Duct Sleeves, Prepared Openings and Closure Collars.

D. Duct Test Holes.

E. Eliminators.

F. Flexible Duct Connections.

G. Roof Curbs.

H. Round Duct Branch Taps.

I. Turning Vanes.

J. Wire Mesh for Screens.

1.2 RELATED SECTIONS

A. Division 01 Section “Operation and Maintenance Data.”

B. Division 07 Section “Through-Penetration Firestop Systems.”

C. Division 23 Section “Identification for HVAC Piping and Equipment.”

D. Division 23 Section “Vibration and Seismic Controls for HVAC Piping and Equipment.”

E. Division 23 Section “Metal Ducts.”

F. Division 23 Section “Sound Attenuators.”

G. Division 26 Section “Electrical”: Electrical characteristics and wiring connections.

1.3 REFERENCES


C. NFPA 90A - Installation of Air Conditioning and Ventilating Systems.

D. NFPA 70 - National Electrical Code.


G. UL 33 - Heat Responsive Links for Fire-Protection Service.

H. UL 94 - Safety of Flammability of Plastic Materials for Parts in Devices and Appliances Testing.

I. UL 555 - Fire Dampers and Ceiling Dampers.


1.4 SUBMITTALS

A. Submit under provisions of Division 01 Section “Submittal Procedures.”

B. Shop Drawings: Indicate for shop fabricated assemblies including volume control dampers, duct access doors and duct test holes.

C. Product Data: Provide for shop fabricated assemblies including volume control dampers, duct access doors, duct test holes and hardware used. Include electrical characteristics and connection requirements.

D. Manufacturer's Installation Instructions: Indicate for fire dampers and combination fire and smoke dampers.

1.5 PROJECT RECORD DOCUMENTS

A. Submit under provisions of Division 01 Section “Closeout Procedures.”

B. Record actual locations of access doors and test holes.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the products specified in this Section with minimum 3 years’ experience.
1.7 REGULATORY REQUIREMENTS

A. Products Requiring Electrical Connection: Listed and classified by Underwriters' Laboratories Inc., as suitable for the purpose specified and indicated.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect and handle products to site under provisions of Division 01 Section “Product Requirements.”

B. Protect dampers from damage to operating linkages and blades.

PART 2 - PRODUCTS

2.1 GALVANIZED STEEL

A. Steel sheet metal components of accessories in this Specification Section shall be galvanized steel sheet, lock-forming quality, having G60 or heavier zinc coating conforming to ASTM A653 rating system and tested in accordance with ASTM A90. Provide paint-grip exterior surfaces for exposed ducts, where available.

2.2 DAMPERS

A. MANUFACTURERS
   1. Ruskin.
   2. Air Balance, Inc.
   3. Arrow.
   5. NCA.
   6. Tamco.
   7. Ventex.
   8. Vent Products, Inc.
   9. No substitutions.

B. Counterbalanced Dampers:
   1. Multi-Blade, Parallel Action Gravity Balanced Counterbalanced Dampers: Frames of 16 gage (1.5 mm) thick galvanized steel, or extruded aluminum, with blades of maximum 6 inch (150 mm) width, with felt or flexible vinyl sealed edges, linked together in rattle-free manner with 90 degree stop, steel ball or sintered bronze bearings, and plated steel pivot pin; adjustment device to permit setting for varying differential static pressure. Pressure and velocity ratings shall be suitable for the application.

C. Fire Dampers:
   1. Fabricate in accordance with NFPA 90A and UL 555, and as specified or as indicated on the Drawings.
   2. Fire Dampers Other Than Ceiling Dampers:
      a) Fire dampers shall be of the dynamic closure type, shall have been successfully tested to UL Standard 555 - 6th Edition as to their ability to close under dynamic airflow conditions and shall bear the UL label stating that they are suitable for that
application. Static fire dampers designed to operate with no airflow in the ductwork shall not be acceptable. Dynamic closure fire dampers shall have been successfully tested in both horizontal and vertical mounting positions to close against a velocity of 2,400 fpm (12.2 m/s) and a static pressures of 4.5 in. w.g. (1.12 kPa).

b) Multiple Blade Dampers: Galvanized steel frame and blades, oil-impregnated bronze or stainless steel sleeve bearings and plated steel axles, plated steel concealed linkage, stainless steel closure spring, and blade stops. Dampers shall be dual-directional airflow rated for ease of installation.
   1) Dampers shall be equal to Ruskin DFD60, airfoil-shaped blades, rated for 4,000 fpm (20.3 m/s) and 6 in. w.g. (1.5 kPa) maximum, 1-1/2-hour or 3-hour rated as required. Pressure drop at 1,000 fpm (5.08 m/s) in a 24 in. x 24 in. (600 x 600 mm) damper shall not exceed 0.03 in. w.g. (7.5 Pa).
   2) Damper linkage shall be capable of being held open with a pair of hand pliers while the fusible link is replaced during testing.

c) Curtain-Type Dampers: For use in easy-access locations directly behind grilles and registers or open-ended ducts ONLY. Type B with blades out of the air stream. Provide thinline type where required. Galvanized steel with interlocking blades. Stainless steel closure springs.

d) Submittals shall include a schedule of damper locations indicating size, design airflow, design airflow face velocity, system external static pressure, and fire rating of the building assembly, with selected damper model, accompanied by damper and accessory data sheets and manufacturer’s installation instructions. If only one model of damper is required, submittals may be simplified accordingly.

e) Dampers may be furnished with factory sleeves (verify length and gage), retaining angles, and breakaway connections at the Contractor’s option.

f) Dampers for Out-of-Wall or Out-of-Floor Installation: Provide factory assembly including damper, sleeve, and factory-installed fire-retardant insulation.

3. Ceiling Dampers:
   a) To provide fire and heat protection where HVAC components penetrate the ceiling membrane of fire-rated floor/ceiling or roof/ceiling assemblies, standard 1-1/2 and 3 hour primary fire dampers DO NOT provide the necessary protection. Ceiling dampers are required.
   b) Description: UL Classified radiation dampers, galvanized steel, with butterfly-type blades, UL-classified blade insulation as required.
   c) Provide external thermal insulating blankets as required by damper manufacturer. Provide retainer wire as required.
   d) Associated components (air devices, ductwork, supports) shall be steel. For installation with non-ferrous air devices, provide steel extensions and/or steel angles to the ceiling surface as required by damper manufacturer.

4. Fusible Links: UL 33, separate at 165°F (100°C) with adjustable link straps for combination fire/balancing dampers. Provide links melting at 212°F (100°C) within 50 feet (15.2 m) downstream of heating coils.
   a) Mounting shall either be the flat-strap type requiring no tools to bend the straps for removing the link, or shall use standard threaded hex-nut fastening. Fastening with heavy-gauge wire hooks or other methods requiring difficult bending are not allowed.

5. Testing and Access: See Part 3 of this Section for requirements for field testing of each damper, and associated access doors. Provide replacement fusible links as required. During testing, furnish means for holding dampers open while fusible link is reset.
D. Volume Control Dampers:

1. Factory-fabricate in accordance with SMACNA HVACDCS, and as specified or as indicated on the Drawings.

2. Shop fabrication is permitted for single blade dampers only.

3. Height is the dimension perpendicular to the blade rod or shaft. Width is the dimension parallel to the blade rod.

4. Single Blade Dampers: For duct sizes (height x width) up to 7 x 30 inch (175 x 760 mm). When height or width exceeds its respective maximum, provide multi-blade damper.

5. Multi-Blade Damper: Opposed blade pattern with maximum blade sizes (height x width) 8 x 72 inch (200 x 1825 mm). Assemble center and edge crimped blades in prime coated or galvanized channel frame with suitable hardware.

6. End Bearings: Except in round ductwork 6 inches (150 mm) and smaller, provide end bearings. On multiple blade dampers, provide oil-impregnated nylon or sintered bronze bearings. Provide retainer clips or other devices to prevent bearings from pulling out. For single-blade dampers, plastic bearings are allowed.

   a) Manufacturers:
      1) Duro Dyne.
      2) Elgen Manufacturing.
      3) Rossi.
      4) Ventfabrics.

   b) Snap-in Plastic Bearings for Single-Blade Dampers: Designed to push into hole in sheet metal, with retaining tabs. Flame Retardant, Glass Reinforced, “Zytel” polymer by Du Pont, conforming to UL 1995 and UL 94 with the required flammability rating of 5VA or lower. Acceptable materials include Polyamide 66 (PA66) (glass-reinforced Du Pont Zytel), nylon and acetyl. Submit manufacturer’s verification of the suitability of these bearings for the application, including operating pressures and temperatures.

7. Quadrants:

   a) Manufacturers:
      1) Duro-Dyne.
      2) Elgen Manufacturing.
      3) Ventfabrics.

   b) Duro-Dyne Specline SR and SRH series; Quadline series; or Stampline dial regulators and wedge-loc regulators. Or equal by Elgen or Ventfabrics. Factory-manufactured dampers shall have damper manufacturer’s choice of quadrant equal to the Duro-Dyne products specified.

   c) Provide locking, indicating quadrant regulators on single and multi-blade dampers. Regulators shall include lever handle, locking wing nut and graduated indicator dial. Provide shaft seals, bushings, or gaskets for duct penetrations. Quadrants without these features are not allowed.

   d) On insulated ducts mount quadrant regulators on stand-off mounting brackets, bases, or adapters, with open space to run insulation through.

   e) Where rod lengths exceed 30 inches (750 mm) provide regulator at both ends, with a single rod so that either regulator will control the entire damper.

8. Remote Manual Operators:

   a) Manufacturers:
      1) Young Regulator Company.

   b) Cable Type with Rack and Pinion: Bowden remote cable assembly, including rack and pinion controllers at damper and ceiling, galvanized angle bracket for duct
mounting, stainless pull wire with galvanized steel flexible outer casing, and
2-5/8-in. (66 mm) diameter zinc cup with 3-in. (76 mm) diameter cover plate.
c) Cable Type with Worm Gear Actuator: Model 1200-FS with worm gear operator
for duct mounting, flexible shaft, and concealed ceiling cup and cover.
d) Rigid Shaft Type with Worm Gear Actuator: 927 or 1200 series worm gear
assembly, 301 or 315 series concealed ceiling regulator with cup and cap, and
square connecting rod.
e) Cover Plate Finish: Selected by Architect, from manufacturer’s standard offerings
including zinc plated, chrome plated, stainless steel, and primer painted.
9. Provide required operating wrenches for balancing, and furnish to the Owner at project
completion.

2.3 DUCT ACCESS DOORS

A. Manufacturers:
1. Standard Doors:
   a) Ruskin.
   b) Air Balance, Inc.
   c) Arrow.
   d) Buckley Associates.
   e) Cesco.
   f) DuctMate.
   g) Greenheck.
   h) Nailor.
   i) Vent Products, Inc.
   j) Shop fabricated.
2. Medium and High-Pressure Doors:
   a) Ruskin.
   b) DuctMate.
   c) Greenheck.
   d) Nailor.
   e) No substitutions.
3. Grease Duct Doors:
   a) Ductmate.
   b) Shop fabricated.

B. Fabricated in accordance with SMACNA HVACDCS, and as specified or as indicated on the
Drawings. Standard access doors and access doors for grease ducts may be shop-fabricated.
Pressure rating shall be equal to the rating of the associated ductwork; see Part 3 Division 23
Section “Metal Ducts” for schedule of pressure classes.

C. Standard Doors: Removable, with retainer chain. Rigid and close-fitting with sealing gaskets
and quick fastening locking devices. For insulated ductwork, install minimum 1 inch (25 mm)
thick insulation with galvanized steel sheet metal airstream-side cover.
1. 16 inches (406 mm) Square and Smaller: Secure with two sash locks.
2. Over 16 inches (406 mm), up to 24 inches (610 mm) Square: Provide four sash locks.
3. Larger Sizes: Hinges and two compression latches with outside and inside handles.
4. Clamping-type doors with knob handles, as manufactured by Ductmate, may be
   substituted for standard sizes.

6. Provide in negative-pressure systems, and in positive-pressure systems with specified pressure class at or below 2 in. WG (498 Pa).

D. Medium- and High-Pressure Positive-Pressure Ducts:
1. Ruskin ADHP-3 high pressure access door rated up to 12 in. WG (2985 Pa), with spring latches to allow the door to open temporarily to relieve negative pressures.
2. Provide in positive-pressure systems with specified pressure class above 2 in. WG (498 Pa).

E. Access doors with sheet metal screw fasteners are not acceptable.

F. Sizing: Select sizes to allow testing, service, and maintenance within the ductwork. Such access may require the insertion of one or both hands, arms, and shoulders as appropriate. Doors sized for viewing-only are not acceptable. Doors found to be of inadequate size shall be replaced with proper size.

2.4 DUCT SILENCERS

A. See Division 23 Section “Sound Attenuators.”

2.5 DUCT SLEEVES, PREPARED OPENINGS AND CLOSURE COLLARS

A. Duct Sleeves and Closure Collars: Fabricate from minimum 20-gage (1.0 mm) galvanized steel or equivalent thickness of aluminum, select material to match duct material. Where sleeves are installed in bearing walls, provide structural steel sleeves.

B. Prepared Openings: Provide 1-inch (25.4 mm) clearance between the duct and the sleeve.

2.6 DUCT TEST HOLES

A. Manufacturers:
   1. Ductmate.
   2. Carlyle Corporation.
   3. Duro-Dyne.
   4. Ventfabrics.

B. Temporary Test Holes: Cut or drill in ducts as required. Cap with neat patches, neoprene plugs, threaded plugs, or threaded or twist-on metal caps.

C. Permanent Test Holes: Factory fabricated, air tight flanged fittings with screw cap. Provide extended neck fittings to clear insulation.

2.7 FLEXIBLE DUCT CONNECTIONS

A. Manufacturers:
   1. Ductmate.
   2. Ventfabrics.
   3. Duro-Dyne.
4. No substitutions.

B. Fabricate in accordance with SMACNA HVACDCS, and as specified or as indicated on the Drawings.

C. Connector: Fabric crimped into metal edging strip.
   1. Connectors shall be Ductmate PROFLEX Commercial series.
   2. Fabric: UL listed coated woven glass fiber fabric meeting the requirements of NFPA 90A and NFPA 701. Resistant to weather and most chemicals, fat, grease, and oil. Neoprene coated, minimum density 30 oz per sq yd (1.0 kg/sq m). Fire-retardant coating. Black color. Temperature range -40 to 200°F (-40 to 93°C).
   3. Net Fabric Width: Approximately 3 inches (75 mm) wide.
   4. Metal: 3 inch (75 mm) wide, 24 gage (0.6 mm thick). G-60 galvanized steel.
   5. Connectors shall have double fold seams. Single fold seams (metal folded once only) shall not be accepted.

2.8 ROOF CURBS

A. Manufacturers:
   1. Greenheck.
   2. Acme Engineering and Manufacturing Corp.
   3. Loren Cook.
   4. Thybar Corporation.

B. For miscellaneous duct applications requiring roof curbs which are not specified with equipment in other Sections, provide curbs as specified in this Section. If roof curbs are indicated and detailed on Architectural Drawings, furnish them under Architectural divisions of the Specifications.

C. Construction: Galvanized steel or aluminum, with continuously welded seams, 1-1/2 in. (38 mm) thick rigid fiberglass insulation with 3.0 lb/cu ft (48 kg/m3) density and coated for airstream exposure, base flashing flange at least 1-1/8 in. (38 mm) wide, and factory installed wood nailer strip installed with notched and lapped joints for strength. For curbs where duct is not continuous thru the curb (such as curbs with sound baffles), provide metal liner to keep the wood nailer out of the airstream. For curbs with hot ducts where clearance to combustibles is a concern, wood nailer may be omitted.

D. Height: For installations where base of curb is under the roof insulation, curb shall be 16 inch (400 mm) high (unless otherwise indicated or specified) with built-in cant strips. For installations where base of curb is not under any roof insulation (but may be under thin roof finish material such as membrane, shingles, or metal roofing), curb shall be at least 12 inch (300 mm) high (unless otherwise indicated) with no cant strips.

E. Pitched Roof Curbs: Curbs for pitched and double-pitched roofs shall have base with built-in slopes to match roof pitches. Height of these curbs shall be at least the height specified above, measured at the highest point on the sloped base.

F. Curb Seal: Provide rubber curb seal for installation between curb and equipment.
2.9 ROUND DUCT BRANCH TAPS AND SPIN-IN FITTINGS

A. Saddle Taps: For round ducts branching off main ducts at 90 degrees, provide factory fabricated, saddle-tap fittings with conical or bellmouth taps, or 45-degree rectangular-to-round branch fittings. For round ducts branching off at 45 degrees, fittings do not require conical or bellmouth expansion. Fittings shall be furnished with flange for fastening and sealing designed to overlap onto adjacent duct, and shall be shaped to fit tight to the exterior of the duct, flat for rectangular duct, curved for round duct.

B. Spin-in fittings, factory-fabricated with conical or bellmouth taps are an acceptable substitute for saddle taps.

C. Factory-fabricated taps and spin-ins may be furnished with integral volume dampers and quadrants as specified in paragraph “Manual Dampers” in this Section.

2.10 TURNING VANES

A. Manufacturers for Turning Vanes and Vane Rails:
1. Ductmate Industries - PROrail 2-inch Turning Vane Rail.
2. Duro Dyne - Junior Vane Rail.
3. Hardcast, a division of Carlisle Corporation - Dyn-O-Rail Jr.

B. Factory-fabricated and factory-or-field-assembled units consisting of curved turning vanes for uniform air distribution and change of direction with minimum turbulence and pressure loss. Provide curved single thickness vanes for mitered elbows with change in direction of 45 degrees or greater, conforming to SMACNA HVACDCS single vane schedule for small vanes. Each vane shall form a 90-degree arc. Fill the entire duct cross-section with vanes. Orient leading edge of vanes parallel to the side of the duct (directed straight into the entering airstream). Turning vanes shall be minimum 16 gauge (1.61 mm), regardless of gauges that are recommended by SMACNA. Double thickness turning vanes are not allowed.

C. Turning vanes in rectangular ductwork and shop-fabricated round ductwork shall conform with details on the Drawings. If not detailed, the SMACNA detail for small-radius small-spacing single-thickness vanes shall be used.

D. Turning vanes in manufactured round and flat oval duct elbows shall be the duct manufacturer’s standard size, spacing, and gauge, but must be single-wall and not less than 16 gauge (1.61 mm).

E. Factory-fabricated turning vane rails shall be a minimum of 24 gauge (0.7 mm) galvanized steel.

F. Material for vanes and rails shall be the same as the duct sheet metal.

2.11 WIRE MESH FOR SCREENS

A. Manufacturers:
1. McNichols Co.
2. Banker Wire and Iron Works, Inc.
3. Belleville Wire Cloth Co.
4. Edward J. Darby & Son, Inc.
5. No substitutions.
B. Galvanized Welded Wire Mesh: Hardware and industrial class welded wire square mesh, hot dipped galvanized, welded trimmed construction, 2 mesh (2 openings per inch, wires 1/2” on center), 0.0630 inch wire nominal diameter parallel to width and length, 0.437 inch openings, 76 percent open area, 0.51 lb/sq. ft weight. Specification is the minimum acceptable for strength and weight of materials.

C. Material to Match Ductwork: Where screens are installed in ductwork or louvers of other materials such as stainless steel or aluminum, provide screens of material to match the ductwork or louver, with strength equal to the requirements specified for galvanized mesh. Aluminum screens may be fabricated of expanded metal instead of welded wire.

D. Provide mesh installed in a removable frame to support the mesh completely flat and rigid, with fasteners in an accessible location.

2.12 UNIFORMITY OF MATERIALS

A. Ductwork accessories, including but not limited to volume dampers, smoke dampers, fire dampers, combination fire/smoke dampers, backdraft dampers and motorized dampers, shall be fabricated of materials that are similar to the ductwork in which they are installed.

PART 3 - EXECUTION

3.1 PREPARATION

A. Verify that electric power is available and of the correct characteristics.

3.2 INSTALLATION

A. Install accessories in accordance with manufacturer's instructions, NFPA 90A, and follow SMACNA HVACDCS. Refer to Division 23 Section “Metal Ducts” for duct construction and pressure class.

B. Provide duct access doors in horizontal return air, exhaust air and fresh air intake ductwork to facilitate the removal of accumulations of dust and combustible materials in accordance with NFPA 90A. Install access doors at maximum 20 foot (6 m) intervals and at the base of each vertical riser.

C. Provide duct access doors for inspection, servicing, and cleaning before filters, before and after coils, before and after fans, before automatic dampers, at fire dampers, at smoke detector sampling tubes (upstream of the sampling tube), at multiple blade volume dampers, at backdraft and counterbalanced dampers, and elsewhere as specified or as indicated on the Drawings. Provide minimum 8 x 8 inch (200 x 200 mm) size for hand access, 18 x 18 inch (450 x 450 mm) size for shoulder access, and as specified or as indicated on the Drawings. Review locations prior to fabrication.

D. Access doors installed for access to fire dampers shall be provided with identification with letters of minimum 1/2 inch (13 mm) height to indicate the presence of fire protection devices within. Conform with NFPA 90A and applicable Codes. Refer to Division 23 Section “Identification for HVAC Piping and Equipment” for labeling materials specifications.
E. Provide fire dampers at locations indicated, where ducts and outlets pass through fire rated components. Install with required perimeter mounting angles, sleeves, breakaway duct connections, corrosion resistant springs, bearings, bushings and hinges.

F. Fire Damper Testing: Demonstrate operation and re-setting of each fire damper and fire/smoke damper to Owner's representative after installation and prior to building occupancy. Remove or melt the fusible link and allow the damper to close, then reopen the damper and replace the link. Repair or replace any damper which doesn’t close and open properly. Coordinate with access door installation to ensure that access doors are of adequate size and location to allow required reach with 2 hands to hold the damper open while replacing the link.

G. Provide balancing dampers at points on supply, return, and exhaust systems where branches are taken from larger ducts as required for air balancing. Install minimum 2 duct widths from duct take-off.

H. Provide balancing dampers on high velocity systems where indicated. Refer to Division 23.

I. Provide balancing dampers on duct take-offs to diffusers, grilles, and registers, regardless of whether dampers are specified as part of the diffuser, grille, or register assembly. Where branch duct is completely above non-accessible wallboard ceiling and the Architect has not approved the use of access doors, provide remote cable damper operators.

J. For volume dampers located above suspended ceilings and in areas that are not visible to building occupants (e.g. mechanical rooms), provide fluorescent orange colored surveyor’s tape. Permanently attach tape to damper handles and run tape down to 10 in. (254 mm) above ceiling or 12 in. (304 mm) below damper handle where ceilings do not exist (e.g. mechanical rooms).

K. Provide flexible connections immediately adjacent to equipment in ducts associated with fans and motorized equipment, and support by vibration isolators. Staple and seal connections airtight.

L. Duct Sleeves and Prepared Openings: Install for ducts passing through roofs, ceilings, walls and floors. Field determine the proper size and location of sleeves and prepared openings.
   1. Duct Sleeves: Allow 1-inch (25 mm) clearance between duct and sleeve or 1-inch (25 mm) clearance between insulation and sleeve for insulated ducts, except at grilles, registers, and diffusers.
   2. Prepared Openings: Allow 1-inch (25 mm) clearance between duct and opening or 1-inch (25 mm) clearance between insulation and opening for insulated ducts, except at grilles, registers, and diffusers.

M. Closure Collars:
   1. Provide not less than 4 inches (100 mm) wide on each side of walls or floors where sleeves or prepared openings are installed. Fit collars snugly around ducts. Grind smooth edges of collar to prevent tearing or puncturing insulation covering or vapor barrier.
   2. Where insulated ducts penetrate non-fire-rated walls, insulation shall be continuous through the closure collars and the closure collars shall be installed tight to the insulation.
   3. Where insulated ducts penetrate fire rated walls, insulate ducts on both sides of closure collars and seal points of contact between closure collar and insulation with vapor proof adhesive.
4. Where ducts penetrate fire rated walls, provide fire proof sealant at closure collar. Refer to Division 07 Section “Through-Penetration Firestop Systems,” for fire proof sealant requirements.

5. Secure closure collars to ducts with sheet metal screws at maximum 6-inch (152 mm) centers and secure closure collars to walls or floors with sheetrock screws, nails or other appropriate fastener at maximum 6-inch (152 mm) centers.

6. Packing: Pack with non-combustible glass fiber insulation in spaces between sleeve/opening and duct/duct insulation. Cover or seal edges of packing to contain loose fibers.

N. Duct Hangers and Supports: SMACNA HVACDCS, Section 4. Hang ducts up to and including 36 inches (914 mm) in width by a minimum of 1 in x 16 gage (25 mm x 1.61 mm) flat straps on each side of the duct on 4 ft (1.22 m) centers, bent under bottom of duct a minimum of 2 inches (50 mm) and securely fastened to duct. Hang ducts larger than 36 inches (914 mm) in width by 3/8 inch (9.5 mm) steel rods and 2 x 2 x 1/4-inch (50x50x6.3 mm) steel angle trapeze hangers, spaced 4 ft (1.22 mm) on center. Anchor risers in the center of the vertical run to allow ends of riser free vertical movements. Attach supports only to structural framing members and concrete slabs. Do not anchor supports to metal decking unless a means is provided and approved for preventing the anchors from puncturing the metal decking. Where supports are required between structural framing member, provide suitable intermediate metal framing. Where C clamps are used, use retainer clips.

1. Flexible Ducts: Support ducts by hangers every 3 feet (0.9 m), unless supported by ceiling construction. Stretch flexible air ducts to smooth out corrugations, and long radius elbows, where possible, using a minimum length to make connections.

2. Flexible Connectors: Provide flexible connectors between fans and ducts or casings and where ducts are of dissimilar metals. For round ducts, securely fasten flexible connectors by zinc-coated steel clinch-type draw-bands. For rectangular ducts, lock flexible connectors to metal collars.

3. Ducts with Extra Weight Such As Lead Lining or Lagging: Include the extra weight in determination of suitable hangers and supports.

O. Drain (Drip) Pans, Drain Connections, and Drain Lines: Provide coils with drain and drain connections. Where coils are sectionalized, with one section above the other, provide intermediate drain pans. There shall be no entrainment of water in air stream. Drain condensate from drain pans to the nearest floor drains disposal points as specified or as indicated on the Drawings. Equip drain lines with U-traps and a seal height 1-inch (25 mm) (unless otherwise detailed or required by the unit manufacturer) greater than the maximum static pressure rating of the fan system. Insure pans drain completely under operating conditions. Provide unions at drain pan connections. For outdoor drain lines, provide a vent, and arrange the trap to allow rotation and draining for winter operation.

P. Provide duct test holes where indicated and required for testing and balancing purposes.

Q. Duct Silencers:
1. Install with straight runs of ductwork upstream and downstream as recommended by the manufacturer and as indicated on the Drawings, to minimize noise and pressure drop. If there is conflict between manufacturer’s recommendations and the Drawings, notify the Architect in writing prior to installing silencers.

2. Provide access doors upstream and downstream sized to allow cleaning.
3. Provide flanged connections to allow removal of silencers. Provide removable sections in the external insulation at flanges.

R. Counterbalanced Dampers: Adjust weights as directed by the Testing and Balancing Agent.

S. Provide interconnecting power and control wiring as required, in accordance with Division 26.

END OF SECTION 233300
SECTION 233321 – SOUND ATTENUATORS

PART 1 - GENERAL

1.1 SECTION INCLUDES
   A. Duct Silencers.

1.2 RELATED SECTIONS
   A. Division 07 Section “Joint Sealants.”
   B. Division 23 Section “Duct Insulation”: Sound lagging insulation.
   C. Division 23 Section “Metal Ducts”: Connections to silencers.
   D. Division 23 Section “Air Duct Accessories”: Flexible duct connections.

1.3 REFERENCES
   A. ANSI S1.1 - Acoustical Terminology.
   D. SMACNA - HVAC Duct Construction Standards - Metal and Flexible.

1.4 DEFINITIONS
   A. Submittals and Report: Conform to ANSI S1.1.

1.5 SUBMITTALS
   A. Submit under provisions of Division 01 Section “Submittal Procedures.”
   B. Product Data: Provide catalog information indicating, materials, dimensional data, pressure losses, and acoustical performance.
   C. Test Reports: Indicate dynamic insertion loss and noise generation values of silencers.

1.6 PROJECT RECORD DOCUMENTS
   A. Submit under provisions of Division 01 Section “Closeout Procedures.”

1.7 QUALIFICATIONS
   A. Manufacturer: Company specializing in manufacturing the Products specified in this Section with minimum 3 years’ experience.
PART 2 - PRODUCTS

2.1 DUCT SILENCERS

A. Approved Manufacturers:
   1. Price Industries.
   2. Commercial Acoustics, a division of Metal Form Manufacturing Co. Inc.
   3. Industrial Acoustics Company (IAC).
   5. Vibro Acoustics.
   6. No substitutions.

B. Description: Duct section with sheet metal outer casing, sound absorbing fill material, and inner casing of perforated sheet metal; incorporating interior baffles of similar construction. Fabricate in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible.

C. Configuration: Rectangular with lined splitters with radiused nose and contoured tails, modular.

D. Materials:
   1. Outer Casing: Minimum 18 gage thick galvanized steel stiffened as required, with welded seams, 2 inch (50 mm) long, 11 gage (2.9 mm) slip joints on both ends.
   2. Inner Casing and Splitters: Minimum 26 gage thick perforated galvanized steel.
   3. Fill: Glass fiber or mineral wool of long resilient fibers packed with at least 10% compression.
   4. Materials shall comply with 25/50 flame/smoke ratings as required by NFPA 90A.

E. Ratings: As scheduled on the Drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Support duct silencers independent of ductwork.

3.2 MANUFACTURER'S FIELD SERVICES

A. Prepare and start systems under provisions of Division 01 Section “Quality Requirements.”

B. Inspect installation periodically under provisions of Division 01 Section “Quality Requirements.”

END OF SECTION 233321
SECTION 233700 - AIR OUTLETS AND INLETS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Diffusers.
B. Registers/Grilles.
C. Louvers.

1.2 RELATED SECTIONS

A. Division 09 Section “Painting”: Painting of ductwork visible behind outlets and inlets.
B. Division 23 Section “Particulate Air Filtration”.

1.3 REFERENCES

A. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum.
C. AMCA 500 - Test Method for Louvers, Dampers and Shutters.
D. AMCA 511 - Certified Ratings Program for Air Control Devices
E. ARI 650 - Air Outlets and Inlets.
H. ASTM E413 - Classification for Rating Sound Insulation.
I. SMACNA - HVAC Duct Construction Standard - Metal and Flexible.
J. NFPA 70 - National Electrical Code.

1.4 SUBMITTALS

A. Submit under provisions of Division 01 Section “Submittal Procedures.”
B. Product Data: Provide data for equipment required for this project. Review outlets and inlets as to size, finish, and type of mounting prior to submission. Submit schedule of outlets and inlets indicating type, size, application, rated airflow, noise level, pressure drop, and throw distance as applicable. Submit both manufacturer’s standard performance tables and graphs, AND tabulated
selection data specific to this project. NOTE: Submittals without complete and sufficient information, to verify the performance specified and scheduled on the Drawings, shall be rejected.

1.5 PROJECT RECORD DOCUMENTS

A. Submit under provisions of Division 01 Section “Closeout Procedures.”
B. Record actual locations of air outlets and inlets.

1.6 QUALITY ASSURANCE

A. Test and rate air outlet and inlet performance in accordance with ADC Equipment Test Code 1062 and ASHRAE 70.
B. Test and rate louver performance in accordance with AMCA 500.

1.7 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the Products specified in this Section with minimum 3 years’ experience.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Diffusers, Registers, and Grilles:
   1. Anemostat.
   2. Krueger.
   3. Metalaire.
   5. Titus.

B. Louvers:
   1. Greenheck.
   2. Airolite.
   3. American Warming and Ventilating.
   4. Arrow.
   5. Ruskin.

C. No substitutions.

2.2 RECTANGULAR CEILING DIFFUSERS

A. Type: Square and rectangular, multi-louvered directional diffuser to discharge air in pattern as indicated. Removable and interchangeable core for cleaning and changing patterns without tools.

B. Frame: Surface mount, inverted T-bar, snap-in, or spline type, as indicated and as required to be compatible with ceiling. In plaster ceilings, provide plaster frame and ceiling frame.
C. Fabrication: Steel or aluminum with baked enamel off-white finish.

D. Accessories: Opposed blade damper and multi-louvered equalizing grid, with damper adjustable from diffuser face.

2.3 CEILING EXHAUST AND RETURN REGISTERS/GRILLES

A. Type: Streamlined blades, 3/4 inch (19 mm) minimum depth, 3/4 inch (19 mm) maximum spacing, with blades set at 45 degrees, vertical or horizontal face as indicated.

B. Frame: 1-1/4 inch (32 mm) margin with countersunk screw or concealed mounting. Where grille type scheduled is designed to completely fill a lay-in ceiling panel, the frame width shall be as required.

C. Fabrication: Steel with 20 gauge (0.90 mm) minimum frames and 22 gauge (0.80 mm) minimum blades, steel and aluminum with 20 gauge (0.90 mm) minimum frame, or aluminum extrusions, as indicated, with factory off-white enamel finish.

D. Damper: Integral, gang-operated, opposed blade type with removable key operator, operable from face where not individually connected to exhaust fans.

2.4 CEILING SLOT DIFFUSERS

A. Type: Continuous slot of width indicated, with adjustable vanes for left, right, or vertical discharge.

B. Fabrication: Aluminum extrusions with factory enamel finish, off-white on exposed face, black on interior and pattern vanes.

C. Frame: 1-1/8 or 7/8 inch (28 or 22 mm) (field-verify compatibility with ceiling grids) margin with concealed support clips for suspension system or support clips for T bar mounting and gasket, end cap.

D. Plenum: Integral, galvanized steel, insulated.

E. Alignment Strips: Provide where 2 or more sections are installed in a continuous line.

2.5 WALL SUPPLY REGISTERS/GRILLES

A. Type: Streamlined and individually adjustable blades, 3/4 inch (19 mm) minimum depth, 3/4 inch (19 mm) maximum spacing with spring or other device to set blades, vertical or horizontal face as indicated, double deflection.

B. Frame: 1-1/4 inch (32 mm) margin with countersunk screw mounting and gasket.

C. Fabrication: Steel with 20 gauge (0.90 mm) minimum frames and 22 gauge (0.80 mm) minimum blades, steel and aluminum with 20 gauge (0.90 mm) minimum frame, or aluminum extrusions, as indicated, with factory off-white enamel finish.

D. Damper: Integral, gang-operated opposed blade type with removable key operator, operable from face.
2.6 WALL EXHAUST AND RETURN REGISTERS/GRILLES

A. Type: Streamlined blades, 3/4 inch (19 mm) minimum depth, 3/4 inch (19 mm) maximum spacing, with blades set at 45 degrees, vertical or horizontal face as indicated.

B. Frame: 1-1/4 inch (32 mm) margin with countersunk screw mounting.

C. Fabrication: Steel with 20 gauge (0.90 mm) minimum frames and 22 gauge (0.80 mm) minimum blades, steel and aluminum with 20 gauge (0.90 mm) minimum frame, or aluminum extrusions, as indicated, with factory off-white enamel finish.

D. Damper: Integral, gang-operated, opposed blade type with removable key operator, operable from face where not individually connected to exhaust fans.

2.7 LOUVERS (4-INCH)

A. Louvers shall be equal to, and shall have free areas no less than, Greenheck Model ESD-435.

B. For reference, free area of a model ESD-435 in 48"x48" (1.2 m x 1.2 m) size is 8.98 sq. ft (0.83 m2).

C. Free area velocity at beginning of water penetration shall be at least 1000 fpm (5.0 m/sec). Beginning of water penetration is defined by AMCA as 0.01 oz. per sq. ft (3 g/m2).

D. Air pressure drop for intake air at an air velocity of 1000 fpm (5.0 m/sec) in intake mode shall not exceed 0.20 in. wg (49.8 Pa).

E. Testing for water penetration and air performance shall be in accordance with AMCA Standard 511, using a 48"x48" (1.2 m x 1.2 m) louver.

F. Type: 4 inch (100 mm) deep with drainable blades on approximately 37 to 45 degree slope, heavy channel frame, removable expanded aluminum bird screen with 1/2 inch (13 mm) mesh mounted on interior face.

G. Fabrication: 0.081-inch (2.05 mm) thick 6063-T5 extruded aluminum alloy, welded assembly.

H. Mounting: Furnish with standard box frame and angles for installation in masonry walls. For other locations, provide frame type and accessories as required.

I. Finish: Factory 2-coat, 1.2-mil (0.03 mm) thickness 70% Kynar 500/Hylar 5000 fluoropolymer finish, with 10-year warranty. For louvers set into or surrounded by window frames, provide custom color as directed by the Architect. For louvers surrounded by masonry or wall panels, submit manufacturer’s standard color chart with at least 24 colors. The Architect will select color for each louver individually, with up to 3 different colors for the project. Accessories visible from outdoors or exposed to the airstream, such as interior and exterior screens, shall have finish identical to the louver.

J. Louvers shall bear the AMCA rating seal for water penetration and air performance.
PART 3 - EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Check location of outlets and inlets and make necessary adjustments in position to conform to architectural features, symmetry, and lighting arrangement.

C. Install outlets and inlets to ductwork with air tight connection.

D. Slope ducts or plenums at louvers to drain outward, and seal bottoms watertight.

E. Provide balancing dampers on duct take-off to diffusers, and grilles and registers, despite whether dampers are specified as part of the diffuser, or grille and register assembly.

F. Paint ductwork visible behind air outlets and inlets matte black. Refer to Division 09 Section “Painting.”

G. Surfaces exposed to view shall be clean, and free of stains, smudges, and scratches.

END OF SECTION 233700
SECTION 234100 – PARTICULATE AIR FILTRATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Disposable, Pleated-Media Extended Area Panel Filters.
B. Extended Surface High Efficiency Mini-Pleated V-Bank Media Filters.
C. Filter Gauges.

1.2 RELATED SECTIONS

A. Division 01 Section “Temporary Facilities and Controls” - Filters for temporary heating and ventilating.

1.3 REFERENCES

A. ARI 850 - Commercial and Industrial Air Filter Equipment.
C. IEST - Recommended Practice IEST-RP-CC001.
E. NFPA 70 - National Electrical Code.
F. UL 900 - Test Performance of Air Filter Units.

1.4 DEFINITIONS

A. MERV: Minimum Efficiency Reporting Value, in accordance with ASHRAE Standard 52.2.
B. MERV-A: Minimum Efficiency Reporting Value, in accordance with ASHRAE Standard 52.2 Appendix J, using an aerosol to neutralize electrostatic charge.

1.5 PERFORMANCE TOLERANCES

A. Conform to ARI 850 Section 7.4.
B. Particle Size Efficiency: Plus or minus 5 percent, relative to the ASHRAE 52.2-2007 rating standards.

1.6 SUBMITTALS

A. Submit under provisions of Division 01 Section “Submittal Procedures.”
B. Shop Drawings: Indicate filter assembly and filter frames, dimensions, motor locations, and electrical characteristics and connection requirements.

C. Product Data: Provide data on filter media, filter performance data, filter assembly and filter frames, dimensions, motor locations and electrical characteristics and connection requirements.

1.7 OPERATION AND MAINTENANCE DATA
A. Submit under provisions of Division 01 Section “Operation and Maintenance Data.”
B. Operation and Maintenance Data: Include instructions for operation, changing, and periodic cleaning.

1.8 QUALIFICATIONS
A. Manufacturer: Company specializing in manufacturing the products specified in this Section with minimum 3 years’ experience.

1.9 REGULATORY REQUIREMENTS
A. Products Requiring Electrical Connection: Listed and classified by Underwriters' Laboratories Inc., as suitable for the purpose specified and indicated.

1.10 EXTRA MATERIALS
A. Furnish under provisions of Division 01 Section “Closeout Procedures.”
B. Provide one set of filters.

PART 2 - PRODUCTS

2.1 GENERAL
A. Filter efficiency (MERV) ratings shall be in accordance with ASHRAE Standard 52.2-2007. Filter ratings shall incorporate particle size vs. efficiency.

B. Particulate Filters
1. Ratings shall be MERV-A in accordance with the Standard’s Appendix J (part of Addendum B, approved in 2008), which requires a conditioning step using a KCl aerosol to neutralize electrostatic charge.
2. If the manufacturer has not completed MERV-A testing, submittals shall include a statement that the filtration and MERV rating are entirely mechanical and does not rely on an electrostatic charge.
3. Fine fiber media, which maintain their efficiency over time, are required, as opposed to coarse-fiber media which rely on electrostatic charge and lose efficiency over time as the charge dissipates.
2.2 MANUFACTURERS

A. Filters, Frames, and Housings:
2. AAF International (American Air Filter and AAF brands).
3. Airguard - a Clarcor company.
4. Eco-Air - division of Flanders Corporation.
5. Fiberbond Corporation.
6. Flanders Corporation.
8. Purolator - a Clarcor company.
9. No substitutions.

B. Gauges:
1. Dwyer.

2.3 DISPOSABLE, PLEATED-MEDIA EXTENDED AREA PANEL FILTERS

B. Media: UL 900 Class 2, pleated, lofted, non-woven, reinforced cotton and synthetic fabric; supported and bonded to wire grid.
1. Frame: High-wet-strength beverage board.
2. Pleats: Rounded radial type for full usage of media area.
3. Nominal thickness: 2 inches (50 mm), unless otherwise indicated.

C. Performance Ratings:
1. MERV (ASHRAE 52.2): 8 (except as indicated).
2. MERV-A (ASHRAE 52.2, Appendix J): 8 (except as indicated).
3. Maximum Initial Resistance:
   a. At 350 Fpm (1.78 m/sec) Face Velocity:
      1) 1-inch-thick (25 mm) Filter: 0.23 inch WG (77 Pa).
   b. At 500 Fpm (2.54 m/sec) Face Velocity:
      1) 2-inch-thick (25 mm) Filter: 0.31 inch WG (77 Pa).
      2) 4-inch-thick (50 mm) Filter: 0.27 inch WG (77 Pa).
4. Recommended Final Resistance: 1.0 inch WG (249 Pa).
5. Guaranteed Pressure Drop Without Failure: 2.0 inch WG (498 Pa).
6. Maximum Operating Temperature: 180°F (82°C) continuous, 200°F (93°C) intermittent.
7. Total Media Area, 24”x24” (610 mm x 610 mm) Nominal Size:
   a. 1-inch (12.5 mm) Thick: 9.8 sq. ft (0.9 m²).
   b. 2-inch (25 mm) Thick: 17.3 sq. ft (1.6 m²).
   c. 4-inch (25 mm) Thick: 27.7 sq. ft (2.5 m²).

2.4 EXTENDED SURFACE HIGH EFFICIENCY MINI-PLEATED V-BANK AIR FILTERS

A. Product: Camfil Farr Durafil ES.
B. Air filters shall be V-bank mini-pleated fiberglass disposable type with pleat separators, polyurethane pack-to-frame sealant, and polystyrene enclosing frame.
C. Construction:
1. Filter media shall be of wet-laid microfine glass fibers formed into uniform pleats with a spacing of 10 pleats per inch and a uniform pleat height of 24 mm. Pleats shall be separated at 25 mm intervals to ensure uniform pleat distribution and even airflow through the filter pack.
2. Pleats media packs shall be assembled into a V-bank configuration with sufficient total media area to meet airflow requirements. The filter outlet shall be radial in shape with a maximum of 60% open area to maintain low-pressure drop and uniform airflow (20 x 20 inch (508 x 508 mm) shall be straight V style design).
3. The media packs shall be bonded to the inside periphery of a polystyrene enclosing frame with a polyurethane sealant. The enclosing frame shall include top and bottom molded tracks as an integral part of the frame to ensure a proper seal.
4. Media packs shall be recessed at least 1 inch (25 mm) from the headered side of the enclosing frame to allow uniform airflow when a prefilter is mounted directly to the enclosing frame. The header shall include a gasket on the vertical side to create a filter-to-filter seal in side-access housing applications.
5. Rigid plastic end caps shall be mechanically fastened to the top and bottom of the media pack enclosing structure to ensure a rigid and durable filter.
6. Carrying handles shall be an integral part of the filter frame and shall bridge from media pack to media pack providing additional filter support and filter rigidity. Handles shall include fastener connection locations for the application of spring mounting fasteners when the filter is applied in reverse flow applications.

D. Performance Ratings:
1. MERV (ASHRAE 52.2): 11 or 13.
3. Maximum Initial Resistance at 500 Fpm (2.54 m/sec) Face Velocity, 24”x24” (610 mm x 610 mm) Nominal Size:
   a. MERV-11 Filter: 0.22 inch WG (55 Pa).
   b. MERV-13 Filter: 0.28 inch WG (70 Pa).
4. Recommended Final Resistance: 1.5 inch WG (373 Pa).
5. Guaranteed Pressure Drop Without Failure: 2.0 inch WG (498 Pa).
6. Guaranteed Filter Integrity: 10.0 inch WG (2.49 kPa).
7. Maximum Operating Temperature: 175°F (79°C), 99% relative humidity.
8. Total Media Area, 24”x24” (610 mm x 610 mm) Nominal Size: 200 sq. ft (18.5 m²).

2.5 FILTER GAUGES
A. Product: Dwyer Magnehelic.
B. Direct Reading Dial: 3-1/2 inch (90 mm) diameter diaphragm actuated dial in metal case, vent valves, black figures on white background, front recalibration adjustment, range 0-1.0 inch WG (0-250 Pa), 2 percent of full scale accuracy.
C. Accessories: Static pressure tips with integral compression fittings, 1/4 inch (6 mm) aluminum tubing, 2-way or 3-way vent valves.
PART 3 - EXECUTION

3.1 INSTALLATION

A. Install air cleaning devices in accordance with manufacturer's instructions.

B. Prevent passage of unfiltered air around filters with felt, rubber, or neoprene gaskets.

C. Install filter gauge static pressure tips upstream and downstream of filters. Mount filter gauges on outside of filter housing or filter plenum, in accessible position. Adjust and level.

D. Provide new filters in air handling systems immediately before the systems are balanced by the approved balancing contractor. Air handling systems shall be balanced with clean filters.

E. Do not operate fan system until filters (temporary or permanent) are in place. Once air handling systems are in operation and before substantial completion, provide filter replacement as required. Filters shall be replaced when their pressure drop (as measured by the approved balancing contractor) reaches the manufacturer’s recommended changeout pressure drop. At the time of substantial completion, provide air handling systems with a new set of filters. After substantial completion, provide any air handling systems that are subjected to significant dust and debris as a result of continued construction with filter changeouts as specified above, and provide new filters when construction is completed.

F. Provide filter gauges on filter banks and in rooftop air conditioning units, installed with separate static pressure tips upstream and downstream of filters.

END OF SECTION 234100
SECTION 235700 – HEAT EXCHANGERS FOR HVAC

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Heat exchangers for hydronic systems. See other Sections for refrigerant systems and air systems.
B. Plate type heat exchangers.
C. Accessories and trim.

1.2 RELATED SECTIONS

A. Division 23 Section “Hydronic Piping.”
B. Division 23 Section “Hydronic Specialties.”
C. Division 23 Section “Instrumentation and Control for Mechanical Systems.”

1.3 REFERENCES


1.4 REGULATORY REQUIREMENTS

A. Conform to Section 8D of the ANSI/ASME Boilers and Pressure Vessels Code for manufacture of tubular heat exchangers and heat exchanger shells.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this Section with minimum 3 years’ experience.

1.6 SUBMITTALS

A. Submit Shop Drawings and product data under provisions of Division 01 Section “Submittal Procedures.”
B. Indicate dimensions, locations, and size of tappings and performance data.
C. Submit manufacturer's installation instructions.
D. Submit design data in sufficient detail to verify that heat exchangers meet or exceed specified requirements.
1.7 OPERATION AND MAINTENANCE DATA
   A. Submit operation and maintenance data under provisions of Division 01 Section “Operation and Maintenance Data.”
   B. Include start up and shut down instructions, assembly drawings, and spare parts lists.

1.8 DELIVERY, STORAGE, AND HANDLING
   A. Deliver products to site under provisions of Division 01 Section “Product Requirements.”
   B. Store and protect products under provisions of Division 01 Section “Product Requirements.”
   C. Protect internals from entry of foreign material by temporary caps on flanged openings.

PART 2 - PRODUCTS

2.1 PLATE TYPE HEAT EXCHANGERS – DISASSEMBLEABLE TYPE
   A. Manufacturers:
      1. Taco.
      2. Armstrong.
      3. Bell & Gossett.
      4. Flo Fab.
      5. GEA
   B. Design: The plate suspension method incorporated in the frame shall provide plate alignment and guidance. Plate gaskets shall be only for sealing, not for alignment. Frame shall provide ample space for full removal and cleaning of the plates without disassembling the frame or piping. Frame shall provide space for at least 20 percent more plates than are required to meet the scheduled heat transfer capacity, to allow the addition of future plates.
   C. Frames: Components include but are not limited to fixed front frame plate, movable rear pressure plate with roller bearing, upper carry bar, lower guide bar, tightening bolts, and support column. Carrying and guide bar surfaces in contact with the plate pack shall be Type 304 stainless steel. Other components shall be carbon steel with epoxy enamel paint finish.
   D. Plates: Stainless steel Type 304.
   E. Gaskets: Nitrile rubber or Ethylene propylene diene monomer (EPDM).
   F. Nozzles: 150 psig (7.18 kPa) rated, NPT threaded for sizes 2 inches (50 mm) and smaller, flange type for larger sizes. Rubber or metal liners as required for the intended service, to prevent fluid contact with the front plate material.
   G. Finish: Exposed surfaces of steel components epoxy enamel paint coated.
H. Maximum Working Pressures and Temperatures: As scheduled on the Drawings. If not scheduled on the Drawings, the following shall apply.
   1. Pressure: 150 psig (1030 kPa).
   2. Temperature: 230°F (110°C).

I. Constructed in accordance with ASME Section VIII.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install to permit removal of plates with minimum disturbance to installed equipment and piping.

C. Support heat exchangers on welded steel pipe and angle floor stand.

D. Pitch shell to completely drain condensate.

E. Pipe relief valves to nearest floor drain.

F. Pipe drain valves to nearest floor drain.

3.2 WATER TO WATER HEAT EXCHANGER TRIM

A. Water Inlets and Outlets: Thermometer wells, pressure gauge tappings.

B. Heated Water Outlet: Thermometer well for temperature regulator sensor, ASME rated pressure relief valve, valved drain.

END OF SECTION 235700
SECTION 236200 - PACKAGED COMPRESSOR AND CONDENSER UNITS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Condensing unit package.
B. Charge of refrigerant and oil.
C. Controls and control connections.
D. Refrigerant piping connections.
E. Motor starters.
F. Electrical power connections.

1.2 RELATED SECTIONS

A. Division 23 Section “Motors, Drives, and Accessories.”
B. Division 23 Section “Vibration and Seismic Controls for HVAC Piping and Equipment.”: Placement of vibration isolators.
C. Division 23 Section “Refrigerant Piping.”
D. Division 23 Section “Air Coils.”
E. Division 23 Section “Convection Heating and Cooling Units.”: Blower-coil units.
F. Division 23 Section “Instrumentation and Control for Mechanical Systems” - Sequence of Operation.
G. Division 26 Section “Electrical.”

1.3 REFERENCES

B. ARI 270 - Sound Rating of Outdoor Unitary Equipment.
C. ARI 365 - Commercial and Industrial Unitary Air-Conditioning Condensing Units.
D. ASHRAE 14 - Methods of Testing for Rating Positive Displacement Condensing Units.
G. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

H. NEMA MG 1 - Motors and Generators.

I. UL 207 - Refrigerant-Containing Components and Accessories, Non-Electrical.


1.4 SUBMITTALS

A. Division 01 Section “Submittal Procedures”: Procedures for submittals.

B. Shop Drawings: Indicate components, assembly, dimensions, weights and loadings, required clearances, and location and size of field connections.

C. Product Data: Provide rated capacities, weights specialties and accessories, electrical nameplate data, and wiring diagrams.

1.5 SUBMITTALS AT PROJECT CLOSEOUT

A. Submit under provisions of Division 01 Section “Closeout Procedures”: Procedures for submittals.

B. Operation and Maintenance Data: Include start-up instructions, maintenance instructions, parts lists, controls, and accessories. Submit under provisions of Division 01 Section “Operation and Maintenance Data.”

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this Section with minimum 3 years’ experience.

1.7 REGULATORY REQUIREMENTS

A. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.

1.8 DELIVERY, STORAGE, AND PROTECTION

A. Division 01 Section “Product Requirements”: Transport, handle, store, and protect products.

B. Comply with manufacturer's installation instructions for rigging, unloading, and transporting units.

C. Protect units on site from physical damage. Protect coils.

1.9 WARRANTY

A. Provide a 5 year warranty to include coverage for refrigerant compressors.
PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Lennox.
B. Carrier.
C. Johnson Controls.
D. McQuay.
E. Trane.

2.2 MANUFACTURED UNITS

A. Units: Self-contained, packaged, factory assembled and pre-wired units suitable for outdoor use consisting of cabinet, compressors, condensing coil and fans, integral sub-cooling coil, controls, liquid receiver, and screens.
B. Construction and Ratings: In accordance with ARI 210/240, ARI 365 and UL 207 and UL 303. Testing shall be in accordance with ASHRAE 14.
C. Performance Ratings: Energy Efficiency Rating (EER) and Coefficient of Performance (COP) not less than prescribed by ASHRAE 90A.

2.3 CASING

A. House components in welded steel frame with galvanized steel panels with weather resistant, baked enamel finish.
B. Mount starters and controls in weatherproof panel provided with full opening access doors. Provide mechanical interlock to disconnect power when door is opened.
C. Provide removable access doors or panels with quick fasteners and piano hinges.

2.4 CONDENSER COILS

A. Coils: Aluminum fins mechanically bonded to seamless copper tubing. Provide sub-cooling circuits. Air test under water to 425 psig (2900 kPa), and dehydrate.
B. Coil Guard: Hail-guard type of closely-spaced stamped sheet metal louvers or heavy-duty PVC-coated wires. Spacing shall block finger access.

2.5 FANS AND MOTORS
A. Vertical discharge direct driven propeller type condenser fans with fan guard on discharge.

B. Weatherproof motors suitable for outdoor use, single phase permanent split capacitor or 3 phase, with permanent lubricated ball bearings and built in current and thermal overload protection.

C. Motors as indicated, in compliance with Division 23 Section “Motors, Drives, and Accessories.”

2.6 COMPRESSORS

A. Compressor: Hermetic scroll type.

B. Mounting: Statically and dynamically balance rotating parts and mount on rubber-in-shear vibration isolators. Internally isolate hermetic units on springs.

C. Lubrication System: Reversible, positive displacement or centrifugal oil pump with oil charging valve, oil level sight glass, and magnetic plug or strainer.

D. Motor: Constant speed suction gas cooled with electronic sensor and winding over temperature protection, designed for across-the-line starting. Furnish with starter.

E. Crankcase Heater: Evaporates refrigerant returning to sump during shut down. Energize heater thermostatically.

2.7 REFRIGERANT CIRCUIT

A. Provide each unit with refrigerant circuit quantity as scheduled on the Drawings, factory supplied and piped. Refer to Division 23 Section “Refrigerant Piping.”

B. For Each Refrigerant Circuit, Provide:
   1. Filter dryer.
   2. Liquid line sight glass and moisture indicator.
   3. Thermal expansion valve for maximum operating pressure.
   4. Insulated suction line.
   5. Suction and liquid line service valves and gage ports.
   6. Liquid line solenoid valve.
   7. Charging valve.
   8. Discharge line check valve.
   9. Compressor discharge service valve.
   10. Condenser pressure relief valve.

2.8 CONTROLS

A. On unit, mount weatherproof steel control panel, NEMA 250, containing power and control wiring, factory wired with single point power connection.

B. For each compressor, provide across-the-line starter, non-recycling compressor overload, starter relay, and control power transformer or terminal for controls power. Provide manual reset
current overload protection. For each condenser fan, provide across-the-line starter with starter relay.

C. Provide Safety Controls Arranged So Any One Will Shut down Machine:
   1. High discharge pressure switch (manual reset)
   2. Low suction pressure switch (automatic reset).
   3. Oil Pressure switch (manual reset).

D. Provide the Following Operating Controls:
   1. Off timer prevents compressor from short cycling.
   2. Low ambient thermostat to lock out compressor at low ambient temperatures.
   3. Controls to permit operation down to the low ambient temperature scheduled on the Drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's installation instructions.

B. Complete structural, mechanical, and electrical connections in accordance with manufacturer's installation instructions.

C. Provide for connection to electrical service. Refer to Division 26.

D. Install units on raised welded steel frames with minimum 2-coat epoxy paint finish, color selected by the Architect.

E. Install units on concrete base as indicated. Refer to Division 01 Section “Submittal Procedures.”

F. Provide connection to refrigeration piping system and evaporators. Refer to Division 23 Section “Refrigerant Piping.” Comply with ASHRAE 15.

G. Furnish charge of refrigerant and oil.

3.2 DEMONSTRATION AND INSTRUCTIONS

A. Division 01 Section “Closeout Procedures”: Demonstrating installed work.

B. Supply initial charge of refrigerant and oil for each refrigeration system. Replace losses of oil or refrigerant prior to end of correction period.

C. Charge system with refrigerant and test entire system for leaks after completion of installation. Repair leaks, put system into operation, and test equipment performance.

D. Shut-down system if initial start-up and testing takes place in winter and machines are to remain inoperative. Repeat start-up and testing operation at beginning of first cooling season.

E. Provide cooling season start-up, and winter season shut-down for first year of operation.
F. Inspect and test for refrigerant leaks every 3 months during first year of operation.

END OF SECTION 236200
SECTION 237413 – ROOFTOP AIR CONDITIONING UNITS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Packaged rooftop air conditioning units.
B. Maintenance service.

1.2 RELATED SECTIONS

A. Division 23 Section “Common Motor Requirements for HVAC Equipment.”
B. Division 23 Section “Vibration and Seismic Controls for HVAC Piping and Equipment.”
C. Division 23 Section “Particulate Air Filtration.”

1.3 REFERENCES

A. ARI 210 - Unitary Air-Conditioning Equipment.
B. ARI 240 - Air Source Unitary Heat Pump Equipment.
C. ARI 270 - Sound Rating of Outdoor Unitary Equipment.
D. ARI 360 - Unitary Air-Conditioning Equipment.
E. ARI 370 - Sound Rating of Large Outdoor Refrigerating and Air Conditioning Equipment.
F. ANSI/ASHRAE 90A - Energy Conservation in New Building Design
G. NFPA 70 - National Electrical Code.

1.4 SUBMITTALS

A. Division 01 Section “Submittal Procedures.”
B. Shop Drawings: Indicate capacity and dimensions of manufactured products and assemblies required for this project. Indicate electrical service with electrical characteristics and connection requirements, and duct connections.
C. Product Data: Provide capacity and dimensions of manufactured products and assemblies required for this project. Indicate electrical service with electrical characteristics and connection requirements, and duct connections.
D. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, installation instructions, maintenance and repair data, and parts listing. Submit in
accordance with Division 01 Section “Operation and Maintenance Data.”

1.5 QUALITY ASSURANCE

A. Manufacturer: Company specializing in manufacturing the Products specified in this Section with minimum 3 years’ experience.

1.6 REGULATORY REQUIREMENTS

A. Products Requiring Electrical Connection: Listed and classified by Underwriters’ Laboratories, Inc., as suitable for the purpose specified and indicated.

B. Unit shall conform to UL 1995/CSA 22.2 #236 for construction of packaged air conditioner and shall have UL/CSA label affixed to rooftop package.

1. In the event the unit is not UL/CSA approved, the manufacturer shall, at his expense, provide for a field inspection by a UL/CSA representative to verify conformance to UL/CSA standards. If necessary, contractor shall perform required modifications to the unit to comply with UL/CSA, as directed by the UL/CSA representative, at no additional expense to the Owner.

C. Gas-fired heating rooftop units shall conform to ANSI Z21.47/Canadian Standards Association (CAN/CSA -2.3) for construction of packaged air conditioner.

1. In the event the unit is not CSA approved, the manufacturer must, at his expense, provide for a field inspection by a CSA representative to verify conformance to CSA standards. If necessary, contractor shall perform modifications to the unit to comply with CSA, as directed by the CSA representative, at no additional expense to the Owner.

1.7 DELIVERY, STORAGE, AND PROTECTION

A. Division 01 Section “Product Requirements”: Transport, handle, store, and protect products.

B. Protect units from physical damage by storing off site until roof mounting curbs are in place, ready for immediate installation of units.

1.8 WARRANTY

A. Provide a full parts warranty for 1 year from substantial completion.

B. Provide 5 year extended warranty for compressors including materials only.

1.9 MAINTENANCE SERVICE

A. Division 01 Section “Closeout Procedures.”

B. Furnish service and maintenance of packaged roof top units for 1 year from Date of Substantial Completion.

C. Provide maintenance service with a 2 month interval as maximum time period between calls. Provide 24-hour emergency service on breakdowns and malfunctions.
D. Include maintenance items as outlined in manufacturer's operating and maintenance data, including minimum of 6 filter replacements, minimum of 1 fan belt replacement, and controls check-out, adjustments, and recalibration.

E. Submit copy of service call work order or report, and include description of work performed.

1.10 ACOUSTICS

A. Manufacturer of packaged rooftop equipment shall provide indoor and outdoor sound power level data across major octave band center frequencies for cataloged operating range of unit at gross cooling capacity range. Data shall be obtained in conformance with ANSI S1.32-1980, American National Standard Methods for the Determination of Sound Power Levels of Discrete Frequency and Narrow Band Noise Sources in Reverberation Rooms and per AMCA Standard 300-85 test code "Sound Rating Air Moving Devices".

1.11 EXTRA MATERIALS

A. Division 01 Section “Closeout Procedures.”

B. Provide 1 set of filters.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. McQuay.

B. Carrier.

C. Trane.

D. York.

E. No substitutions.

2.2 PACKAGED ROOFTOP UNITS

A. General Unit Description:
   1. Units shall be packaged rooftop-type air handling units as indicated on the Drawings and within these Specifications. Cooling capacity ratings shall be based upon ARI Standard 360. Unit(s) shall consist of insulated weathertight casing with hinged access doors, compressors, air cooled condenser coil, condenser fans, evaporator coil, filters, heating section, supply and return fans with motors and drives, dampers, sound attenuator, and unit controls.
   2. Unit(s) up to 52 feet (15.8 m) long shall be single-piece construction as manufactured at the factory. Site assembled sub- assemblies will not be allowed. Packaged units shall be constructed for installation on a roof curb providing full perimeter support under air handler section and pedestal support under condenser section.
   3. Unit(s) shall be factory run tested to include the operation of fans, compressors, heat exchangers, and control sequences.
4. Unit(s) shall have labels, decals, and/or tags to aid in the service of the unit and indicate caution areas.

B. Unit Casing:
1. Cabinet: Galvanized steel, phosphatized, and finished with base primer and polyester resin topcoat in neutral beige or grey color, durable enough to withstand 750-hour salt spray test in accordance with standard ASTM B 117. Base frame shall be constructed of pre-painted galvanized steel, in heavy gauges designed to fully support the unit with only perimeter curb or grillage support. Structural members and exterior panels shall be designed to operate at internal static pressures up to 6.5 in. wg (1.61 kPa). Inner liners shall be 22 gauge minimum thickness. Roof panels shall be sloped to provide positive drainage of rain water / melting snow away from the cabinet.

2. Provide insulated solid bottom panel for mounting on raised grillage.

3. Access Doors: Fully gasketed hinged doors of double wall construction with quick-release lever or knob fasteners, safety catches, and door holders or and chained tie-backs to provide access to filters, evaporator coil, heating section, heating valves, fan sections, and control panels.

4. Control Panel: The unit control panel section shall be compartmented to separate high and low voltage components.

5. Insulation: Provide 2-inch (100 mm) thick 1-1/2 lb/cu.ft (24 kg/m3) density, R-6.5 h-ft2-°F/Btu (R=1.14 K-m2/W) airstream-coated fiberglass internal liner on exterior and floor panels in contact with the conditioned air stream.

C. Fans – Supply and Return:
1. Forward curved or airfoil fans as scheduled on the Drawings, with fixed-pitch sheave drive assemblies. Fans shall be Class II type (unless otherwise scheduled on the Drawings), fabricated from heavy-gauge aluminum.

2. Dynamically balance fans and the unit's running fan assembly (fan mounted on actual shaft, bearings and in scroll housing) to assure smooth operation of the fan and its associated assembly. Balancing of the fan only shall not be acceptable.

3. Mount fan motor(s) and fan on a common base assembly and isolated from unit with spring isolators with seismic restraints. Provide thrust restraint isolation on the fan housing/fan board to assure smooth fan startup transition and operation.

4. Fan shaft shall be mounted on grease lubricated ball bearings, sized to provide L-50 life of 200,000 hours.

5. Motor shall be open drip-proof. Motor shall have a standard T-frame and a minimum service factor of 1.15. Drive components shall be accessible without the use of scaffolds or ladders, to facilitate periodic maintenance checks and for operator safety.

6. Each fan drive shall have a minimum of 2 belts.

7. Isolation including springs and flexible duct connections shall comply with Division 23 Section “Vibration and Seismic Controls for HVAC Piping and Equipment.”

8. Fans shall be controlled by independent factory-furnished variable-frequency drives.

D. Refrigeration System:
1. Each unit shall have 2 independent refrigeration circuits. Each circuit shall include low pressure control, filter-drier, liquid moisture indicator / sight glass, solenoid, thermal expansion valve, liquid line shutoff valve with charging port, discharge line shutoff valve, manual reset high pressure safety switch, and high pressure relief device. The thermal expansion valves shall provide modulation from 100% to 25% of rated capacity. Sight glasses shall be accessible for viewing during unit operation.
2. Each circuit shall be dehydrated and leak tested.
3. Compressors: Multiple heavy-duty scroll type. Compressors shall have crankcase heaters, oil sight glass, anti-slug protection, current and motor temperature sensing, and motor overload protection. Provide time delays to prevent short cycling and prevent simultaneous starting after a power failure.
4. Capacity control shall be accomplished by staging of the unit’s multiple compressors. Staging shall be controlled by the factory-installed main unit control system.

E. Condenser Section:
1. Provide multi-row cast aluminum micro-channel coils, V-bank configuration, recessed so that cabinet panels provide hail protection. Factory leak-test coils with high-pressure air under water.
2. Provide vertical discharge, direct drive fans with steel blades, and 3-phase motors. Fans shall be statically and dynamically balanced. Motors shall be permanently lubricated, with built-in current and thermal overload protection and rain sheilds.
3. Each circuit shall have fan cycling control on at least 1 condenser fan, controlled to maintain positive head pressure. An ambient thermostat shall prevent the refrigeration system from operating below 45°F (7.2°C).

F. Evaporator Coil Section:
1. Coil with seamless copper tubing mechanically expanded into aluminum plate fins. Coil circuiting shall be interlaced to maintain full active coil face area at part load conditions. Coil shall be factory leak tested with high pressure air under water.
2. Provide pitched stainless steel drain pan to assure positive drainage of condensate from the unit casing. Units with stacked cooling coils shall have a secondary drain pan piped to the primary drain pan.

G. Hot Water Heating Section:
1. Coil with heavy-duty aluminum fins mechanically bonded to seamless copper tubes. Factory leak test coil with high-pressure air under water.
2. Coil vents and drains shall be factory-installed.
3. At Contractor’s option, a 3-way modulating control valve with electronic actuator shall be factory-installed, and controlled by the factory-installed main unit control system. The valve shall be piped with unions and offsets to enable coil removal. The valve bypass shall include a balancing valve to equalize the coil pressure drop for equal flow in bypass mode. Coordinate with other Sections of the Specifications.
4. The unit roof curb shall provide space for piping roof penetrations within the curb. If necessary, the unit shall be provided with an external insulated piping vestibule to match unit construction, and a roof curb extension under the vestibule.
5. The unit cabinet shall include hinged access doors providing access to the coil and valves for inspection and cleaning.

H. Outdoor Air Section:
1. Provide 0-100% outdoor air economizer with outdoor, return, and exhaust air dampers. Outdoor air shall enter from both sides through horizontal louvered intake panels with bird screens and rain lips, with floors sloped to drain outward. Exhaust/relief air shall leave the unit at a location designed to prevent re-entrainment of the exhaust into the intake. In addition to the motorized exhaust damper, a barometric exhaust damper with edge gasketing shall maintain unit relief pressure. Dampers shall be sized for 100% of the unit supply airflow, to allow 100% return, 100% outside air, and 100%
exhaust/relief.
2. Dampers shall be McQuay UltraSeal low-leak opposed-blade dampers with full blade
gasketing and end seals, for leakage of less than 0.2% at 1.5 in. wg () static pressure
differential, tested in accordance with AMCA Standard 500.
3. Damper actuators shall be modulating, spring-return type. Separate actuators shall be
provided for outside air and return air to allow independent control of each damper.

I. Air Filter Housing: Filters shall mount integral within unit casing and be accessible via hinged
access doors. Provide steel or aluminum filter tracks, metal holding frame for each filter, and
corrugated metal filter panels to prevent air bypassing filters. Filter access doors shall have
compressible gasketing or elastomeric foam insulation to seal tight against the ends of the filters.
1. Air Filters: Filters shall mount integral within unit casing and be accessible via hinged
access panels. Prefilters shall be 2 inch (50 mm) thick MERV 8 disposable pleated-media
extended-area panel filters in metal holding frames. Final filter shall be MERV 11 or 13
extended-surface high-efficiency mini-pleated V-bank media filters. Refer to Division 23
Section “Particulate Air Filtration.”
2. Accessories:
   a. Filter Gauges: Dwyer Magnahelic filter gauges to read pressure drop across filters.
      Gauges shall be factory-mounted in exterior unit panels.
   b. Filter Pressure Switch: Factory-mount differential pressure switches across filters
to provide digital signal to the building control system.

J. Sound Attenuator: Integral section downstream of the supply fan, with perforated double-wall
construction and hinged access door. Internal splitters and baffles shall be provided to meet
the sound and pressure drop requirements scheduled on the Drawings. The acoustic fill shall
conform to flame/smoke ratings as required by NFPA 90A, tested per UL 723. The attenuator
ratings shall be determined in accordance with ASTM E477. Submittals shall include
dynamic insertion loss, self-generated sound power, and aerodynamic performance for reverse
and forward flow test conditions.

K. Unit Performance Requirements: As scheduled on the Drawings.

L. Variable-Frequency Drives (VFDs):
1. Drive manufacturers shall be [manufacturer’s standard or] one of the manufacturers listed
   in Division 23 Section “Common Motor Requirements for HVAC Equipment.”
2. Drive construction and performance shall be as specified in Division 23 Section
   “Common Motor Requirements for HVAC Equipment.”
3. Drives shall include a manual bypass allowing the fan to operate at full speed during drive
   service, unless the equipment is 100 percent redundant.
4. Each fan or pump furnished with the air-handling unit shall have its own separate VFD,
   unless otherwise indicated.
5. Drives shall be mounted in a weather-protected enclosure, and ventilated and heated to
   provide the operating conditions required by the VFD manufacturer.
6. Separation of wiring shall be as required by the VFD manufacturer, and in accordance
   with Division 23 Section “Common Motor Requirements for HVAC Equipment.”

M. Miscellaneous Features:
1. Supply-air smoke detector, factory mounted, compatible with the building fire alarm
   system.
2. Unit mounted 115 volt convenience outlet.
3. Marine light fixtures in fan and access sections, wired to switch mounted on the unit exterior.
4. Single-point main power connection with disconnect switch. Separate connections may be required for convenience outlet and lights.

N. Building Management System:
1. Provide factory mounted DDC microprocessor controller with human interface, LCD display with 22 characters X 5 lines of alphanumeric English coded information, and password protection. Control memory shall be non-volatile type, which maintains setpoints during extended power shutdowns and during disruptions of network communications.
2. Controller shall have protection against transients or wrong voltages.
3. Provide with BacNet, LonWorks, or other open communications protocol as required by the building Automatic Temperature Controls (ATC) provider, see Division 23 Section “Instrumentation and Control for Mechanical Systems.” This communication shall allow the ATC system to completely access, adjust, and control read-only and read-and-write system variables, setpoints, inputs, outputs, and alarms.
4. Provide installation and startup support to the ATC provider as required.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Division 01 Section “Project Management and Coordination”: Verification of existing conditions prior to beginning work.

B. Verify that roof is ready to receive work, and opening dimensions are as indicated on Submittals.

C. Verify that proper power supply is available.

3.2 INSTALLATION

A. Install in accordance with manufacturer’s instructions.

B. Install in accordance with NFPA 90A.

C. Mount units on structural steel roof grillage, providing watertight curbs and flashing enclosures to protect ductwork and utility services. Install and shim unit level.

D. Bolt units in place with galvanized steel hex-head bolts and washers at each factory mounting hole, with fasteners’ diameter as large as the factory holes allow. Protect dissimilar metals from contact.

E. Electrical connections shall be flexible in accordance with Division 23 Section “Vibration and Seismic Controls for HVAC Piping and Equipment” and Division 26 – Electrical.

3.3 MANUFACTURER’S FIELD SERVICES

A. Prepare and start systems under provisions of Division 01 Section “Quality Requirements.”
B. Provide initial start-up and shut-down during first year of operation, including routine servicing and check-out.

C. Manufacturer shall furnish a factory trained service engineer without additional charge to start the unit(s) and to coordinate interface with building’s ATC system (coordinate with Division 23 Section “Instrumentation and Controls for Mechanical Systems”). Packaged rooftop unitary manufacturers shall maintain service capabilities no more than 100 miles (161 km) from the jobsite.

END OF SECTION 237413
SECTION 238126 – SPLIT-SYSTEM AIR CONDITIONERS

PART 1 - GENERAL

1.1 SECTION INCLUDES
   A. Air Conditioning Units.
   B. Heat Pump Units.
   C. Controls and Control Panels.

1.2 REFERENCES
   D. UL - Underwriters' Laboratories.

1.3 QUALITY ASSURANCE
   A. Manufacturer's Qualifications: Company specializing in manufacturing the Products specified in this Section with minimum 3 years’ experience.
   B. Installer Qualifications: Company specializing in performing the work of this Section with minimum 3 years’ experience.

1.4 REGULATORY REQUIREMENTS
   A. Conform to ANSI/NFPA 90A for the installation of Computer Room air conditioning units.

1.5 SUBMITTALS
   A. Submit Shop Drawings and product data under provisions of Division 01 Section “Submittal Procedures.”
   B. Submit product data for manufactured products and assemblies required for this project.
   C. Indicate water, drain, electrical and refrigeration rough-in connections on Shop Drawings or product data.
   D. Submit manufacturer's installation instructions under provisions of Division 01 Section “Submittal Procedures.”
1.6 OPERATION AND MAINTENANCE DATA

A. Submit operation and maintenance data under provisions of Division 01 Section “Operation and Maintenance Data.”

B. Include manufacturer's descriptive literature, operating instructions, installation instructions and maintenance and repair data.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Lennox.

B. Carrier.

C. Daikin.

D. Fujitsu.

E. LG.

F. Mitsubishi.

G. Panasonic (formerly known as Sanyo).

H. Samsung.

2.2 GENERAL

A. The system to consist of a compact wall-mounted packaged evaporator section and matching air-cooled outdoor unit.

B. The units shall be listed by Electrical Testing Laboratories (ETL) and bear the ETL label.

C. Wiring shall be in accordance with the National Electrical Code (N.E.C.).

D. The units shall be rated in accordance with ARI Standard 210 and bear the ARI label.

E. A full charge of R-410A for refrigerant tubing shall be provided in the condensing unit. Tubing length shall be provided as required (coordinate with Drawings). A holding charge shall be provided in the evaporator.

F. Unit shall be U.L. approved and shall bear a U.L. label.

2.3 INDOOR UNIT

A. The indoor unit shall be completely factory assembled and wired.

B. The casing shall have a white or off-white finish.
C. The evaporator fan shall be a high performance, forward curve line flow fan direct driven by a single motor. The fan shall be statically and dynamically balanced and run on permanently lubricated bearings.

D. An adjustable change vane shall be provided with the ability to direct the air flow from horizontal to vertical. An adjustable guide vane shall be provided to manually change the air direction from left to right.

E. The evaporator coil shall be of nonferrous construction with smooth plate fins bonded to copper tubing. The tubing shall have inner grooves for high efficiency heat exchange. Tube joints shall be brazed with phosphor copper or silver alloy. The coils shall be pressure tested at the factory.

F. A condensate pan with drain shall be provided under the coil.

G. A condensate pump shall be provided if required. The condensate pump shall fit within the evaporator housing and shall be completely concealed. If the pump must be exposed, it shall be hard-piped, and a wall-mounting shelf shall be provided. The pump shall be supplied by the air conditioning unit manufacturer and shall be field installed in accordance with manufacturer’s recommendations.

H. The unit shall be powered from the outdoor unit. See “Outdoor Unit” in this Section for more information.

I. The unit shall include washable filters.

2.4 OUTDOOR UNIT

A. The outdoor unit shall be completely factory assembled, piped, wired, and shall carry a complete refrigerant charge.

B. The casing shall be fabricated of galvanized steel, bonderized and finished with baked enamel.

C. The unit shall be furnished with a direct drive, propeller type fan arranged for horizontal discharge.

D. The motor shall have inherent protection, be of the permanently lubricated type and resiliently mounted for quiet operation.

E. The fan shall be provided with a raised wire guard to prevent contact with moving parts.

F. The compressor shall be of the high-performance serviceable rotary type with crankcase heater, accumulator and internal thermal overloads. The compressor shall be internally isolated with rubber mounts so as to avoid the transmission of vibration.

G. The refrigeration system shall have the capability to operate with a maximum height difference of 23 feet and overall refrigerant tubing length of 65 feet between indoor and outdoor sections without the need for line size changes, traps, or additional oil. Refrigerant flow from the condenser shall be controlled by means of a capillary tube or expansion valve.
H. The condenser coil shall be of nonferrous construction with smooth plate fins bonded to copper tubing. The tubing shall have inner grooves for high efficiency heat exchange. The coil shall be protected with an integral metal guard.

I. The unit shall be controlled by the microprocessor located in the matching indoor unit. The outdoor unit shall have the ability to provide power for the matching indoor unit. The unit electrical power shall be as scheduled on the Drawings.

J. The unit shall be capable of low ambient operation, with outside air temperature as low as 0°F (-17°C).

K. Heat Pump Units: The unit shall include valves and controls for automatic changeover from cooling to heating mode.

2.5 SYSTEM CONTROL

A. The control system shall consist of 2 microprocessors interconnected by a multi-wire cable. One microprocessor shall be factory wired and located within the indoor unit. It shall have the capability of sensing room temperature and indoor coil temperature; receive and process commands from the wall-mounted remote controller; and control the outdoor unit. Provide hard-wired interconnection if available as an option. If the manufacturer does not offer a hard-wired remote controller, a wireless remote controller with bracket will be acceptable.

B. The microprocessor within the wall-mounted remote monitor and controller shall display setpoint and room temperature; provide two (2) manually selected modes of cooling, normal and economy operation at 2°F (1°C) above setpoint; provide continuous or automatic start/stop of system operation; night setback operation of 4°F (2°C) above setpoint; and manual or automatic fan speed control. Automatic fan speed control shall be based upon the temperature difference between setpoint and room temperature maintaining lowest speed possible.

C. When heating capability is specified, the wall-mounted controller shall provide manually selected modes of heating, and night setback operation of 4°F (2°C) below setpoint.

2.6 REFRIGERANT PIPING

A. Unit shall be provided with pre-charged and pre-insulated line sets as recommended by the manufacturer.

2.7 WARRANTY

A. The units shall have a manufacturer's warranty for a period of 1 year from date of Substantial Completion.

B. The compressor shall have a warranty of 5 years from date of Substantial Completion.

C. If any part fails to function properly during the warranty period due to defects in workmanship or material, it shall be replaced or repaired.
PART 3 - EXECUTION

3.1 EXAMINATION
   A. Verify that system is located per Drawings.
   B. Verify that proper power supply is available.

3.2 INSTALLATION
   A. Install units in accordance with manufacturer's instructions.
   B. Mount rooftop air-cooled condensing units at least 16 in. (0.41 m) above the roof.
   C. Mount ground-mounted air-cooled condensing units at least 24 in. (0.61 m) above grade.
   D. Bolt roof and ground-mounted units with galvanized hex-head lag bolts and washers at each factory mounting hole. Protect dissimilar metals from contact.
   E. Mount wall-mounted air-cooled condensing units using bracket furnished by the manufacturer, and provide supplemental supports as required.
   F. Install condensing units so the fan blows in the same direction as the prevailing winds, unless otherwise directed by the manufacturer.
   G. Provide recessed wall mounting box for mounting the wired indoor controller. Fasten the box to wall framing stud, masonry, or other suitable structural surface approved by the Architect; fastening to gypsum wallboard is not acceptable. Provide interconnecting low-voltage and line-voltage wiring and conduits, concealed unless otherwise indicated. Wall mounting box, wiring, and conduits shall be in accordance with the requirements of Division 26 – Electrical.

END OF SECTION 238126
SECTION 238200 – CONVECTION HEATING AND COOLING UNITS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Blower Coil Air Handlers.
B. Finned Tube Radiation.

1.2 RELATED SECTIONS

A. Division 23 Section “Motors, Drives, and Accessories.”
B. Division 23 Section “Vibration and Seismic Controls for HVAC Piping and Equipment.”
C. Division 23 Section “Hydronic Piping.”
D. Division 23 Section “Hydronic Specialties.”
E. Division 23 Section “Refrigerant Piping.”
F. Division 23 Section “Packaged Compressor and Condenser Units.”
G. Division 23 Section “Instrumentation and Control for Mechanical Systems.”
H. Division 26 Section “Electrical” - Equipment Wiring Systems: Electrical characteristics and wiring connections. Installation of room thermostats. Electrical supply to units.

1.3 REFERENCES

A. NFPA 70 - National Electrical Code.

1.4 SUBMITTALS FOR REVIEW

A. Division 01 Section “Submittal Procedures.”
B. Product Data: Provide typical catalog of information including arrangements.
C. Shop Drawings:
   1. Indicate cross sections of cabinets, grilles, bracing and reinforcing, and typical elevations.
   2. Submit schedules of equipment and enclosures typically indicating length and number of pieces of element and enclosure, corner pieces, end caps, cap strips, access doors, pilaster covers, and comparison of specified heat required to actual heat output provided.
   3. Indicate mechanical and electrical service locations and requirements.

1.5 SUBMITTALS AT PROJECT CLOSEOUT

A. Division 01 Section “Closeout Procedures”: Procedures for submittals.
B. Project Record Documents: Record actual locations of components and locations of access doors in radiation cabinets required for access or valving.

C. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner’s name and registered with manufacturer.

D. Operation and Maintenance Data: Include manufacturer’s descriptive literature, operating instructions, installation instructions, maintenance and repair data, and parts listings. Submit under provisions of Division 01 Section “Operation and Maintenance Data.”

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this Section with minimum 3 years experience.

1.7 REGULATORY REQUIREMENTS

A. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.

1.8 EXTRA MATERIALS

A. Division 01 Section “Closeout Procedures”: Maintenance Data.

B. Provide 2 sets of filters.

PART 2 - PRODUCTS

2.1 BLOWER COIL AIR HANDLING UNITS

A. Manufacturers:
   1. International Environmental Corp. (IAC).
   2. Enviro-Tec.
   3. Johnson Controls.
   4. Trane.

B. Casing: Heavy gauge galvanized steel with inlet and outlet duct collars, and provisions for threaded hanging rods. Casing shall be fully insulated with premium-IAQ fiberglass acoustic lining to prevent unit sweating and attenuate fan noise. Casing shall have access panels on both sides, but the unit shall be have the capability of being installed with service access space on only one sides.

C. Electrical Raceway: Unit shall have an electrical raceway providing a single location for field wiring connections. Factory mounted electrical components shall have wire leads terminating in the unit raceway. Controls shall include interlocking lockout-tagout through-door disconnect switch, motor contactor, thermal overloads, motor fusing, filter change indicator, control transformer, and terminal strip.

D. Hot Water Coils: Serpentine style with piping connections on the side of the unit casing for minimal headroom, seamless copper tubing, with evenly spaced aluminum fins mechanically bonded to tubing. Tested at 200 psig (1379 kPa).
E. Refrigerant Coils: Coils shall have aluminum fins with copper tubes mechanically expanded for a permanent bond. Coils shall be proof tested at 715 psig (4929 kPa) and leak tested at 650 psig (4481 kPa) air-under-water. Coils shall be dehydrated and sealed with a dry air charge. Maximum standard operating conditions are 650 psig at (4481 kPa) 127°F (53°C) with R-410A refrigerant. Coils shall be rated in accordance with ARI Standard 410.

F. Fan assembly: Fan shall be forward curved, centrifugal blower type equipped with heavy-duty adjustable speed V-belt drive. The fan shaft shall be supported by heavy-duty, permanently sealed ball bearings. The fan shall be dynamically balanced. The fan shall be installed allowing complete service access to the fans and motors.

G. Motors: Open drip-proof with permanently sealed ball bearings, internal current and thermal overload protection, a minimum 1.15 service factor, and resilient base. Motor shall be factory-installed and wired to the unit junction box.

H. Drain pan: The drain pan shall be noncorrosive and double-sloped to allow condensate drainage. The construction shall be polymer or stainless steel. Coils mount above the drain pan, not in the drain pan, allowing the drain pan to be fully inspected and cleaned. The main drain connection shall be at the lowest point of the drain pan. An auxiliary drain connection shall be provided on the same side as the main connection.

I. Filters: Filters shall be 2-inch (50 mm) MERV 11 pleated throwaway type with prefilter and shall be positioned to filter air before the coil(s). Refer to Division 23 – Particulate Air Filtration.

J. Accessories: Furnish piping accessories as indicated on the Drawings and as required, including but not limited to: Liquid-line solenoid valve, thermal expansion valve, moisture-indicating sight glasses, filters and driers, service shutoff valves, and Schraeder access ports for charging and testing.

2.2 FINNED TUBE RADIATION

A. Manufacturers:
1. Sterling Hydronics.
2. Rittling.
3. Slant-Fin.
4. Vulcan.

B. Heating Elements: Seamless copper tubing, mechanically expanded into evenly spaced aluminum fins and suitable for soldered fittings.

C. Element Hangers: Quiet operating, ball bearing cradle type providing unrestricted longitudinal movement, on enclosure brackets.

D. Enclosures: 0.0478 inch (1.2 mm) steel up to 18 inches (450 mm) in height, 0.0598 inch (1.5 mm) steel over 18 inches (450 mm) in height, with easily jointed components for wall to wall installation. Support rigidly, on wall or floor mounted brackets spaced 3 feet (1000 mm) on center maximum.

E. Finish: Factory applied baked enamel of color as selected by the Architect on visible surfaces of enclosure and backplate.
F. Damper: Where not thermostatically controlled, provide knob-operated internal damper at enclosure air outlet.

G. Access Doors: For otherwise inaccessible valves, provide factory-made permanently hinged access doors, 6 x 7 inch (150 x 175 mm) minimum size, integral with cabinet.

H. Capacity: As scheduled, based on 65°F (18°C) entering air temperature.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install equipment exposed to finished areas after walls and ceiling are finished and painted. Avoid damage.

C. Protection: Provide finished cabinet units with protective covers during balance of construction.

D. Finned Tube Radiation: Locate on outside walls and run cover wall-to-wall unless otherwise indicated. Where drawings show elements located under windows, install with elements centered under windows. Install wall angles where units butt against walls.

E. Blower Coil Air Handlers: Install with spring isolators at top of threaded rods, furnished under Division 23 Section “Vibration and Seismic Controls for HVAC Piping and Equipment.”

F. Hydronic Units: Provide with shut-off valve on supply and lockshield balancing valve on return piping. If not easily accessible, extend vent to exterior surface of cabinet for easy servicing. For cabinet unit heaters, fan coil units, and unit heaters, provide float operated automatic air vents with stop valve.

G. Units with Cooling Coils: Connect drain pan to condensate drain.

3.2 CLEANING

A. After construction is completed, including painting, clean exposed surfaces of units. Vacuum clean coils and inside of cabinets.

B. Touch-up marred or scratched surfaces of factory-finished cabinets, using finish materials furnished by manufacturer.

C. Install new filters.

END OF SECTION 238200
SECTION 238216 - AIR COILS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Water Coils.

1.2 REFERENCES

B. SMACNA - HVAC Duct Construction Standards, Metal and Flexible (HVACDCS).

1.3 SUBMITTALS

A. Submit under provisions of Division 01 Section “Submittals”. Indicate coil and frame configurations, dimensions, materials, rows, connections, and rough-in dimensions.
B. Submit manufacturer's installation instructions under provisions of Division 01 Section “Submittal Procedures”.
C. Submit manufacturer's certificate, under provisions of Division 01 Section “Quality Requirements”, that coils are tested and rated in accordance with ANSI/ARI 410.

1.4 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the products specified in this Section with minimum 3 years' experience.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site under provisions of Division 01.
B. Store and protect products under provisions of Division 01.
C. Protect coil fins from crushing and bending by leaving in shipping cases until installation, and by storing indoors.
D. Protect coils from entry of dirt and debris with pipe caps or plugs.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Hydronic Coils:
   1. McQuay.
   2. Aerofin Corporation.
3. Coil Company, LLC.
4. Enviro-Tec.
5. Heatcraft.
7. Trane.
8. USA Coil.

2.2 FABRICATION - HYDRONIC COILS

A. Fins: Aluminum continuous plate type with full fin collars or individual helical finned tube type wound under tension.

B. Casing: Die formed channel frame of 16 gage (1.8 mm) galvanized steel with 3/8 inch (9.5 mm) mounting holes on 6 inch (150 mm) centers. Provide tube supports for coils longer than 36 inches (0.9 m).

2.3 WATER HEATING COILS

A. Headers: Cast iron with tubes expanded into header, seamless copper tube with silver brazed joints, or prime coated steel pipe with brazed joints.

B. Tubes: 5/8 inch (16 mm) OD seamless copper arranged in parallel or staggered pattern, expanded into fins, brazed joints.

C. Testing: Air test under water to 300 psig (2070 kPa) for working pressure of 200 psig (1380 kPa) and 220°F (104°C).

D. Configuration: Drainable, with threaded plugs for drain and vent; serpentine type with return bends on smaller sizes and return headers on larger sizes.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install with air filters mounted upstream of coil and downstream of any entering airstream, so that no unfiltered air reaches the coil.

C. Install in ducts and casings in accordance with SMACNA HVACDCS.

D. Support coil sections independent of piping on steel channel or double angle frames and secure to casings. Provide frames for a maximum of 3 coil sections. Arrange supports to avoid piercing drain pans.

E. Provide airtight seal between coil and duct or casing.

F. Protect coils to prevent damage to fins and flanges. Comb out bent fins.

G. Install coils level. Install cleanable tube coils with 1:50 pitch.
H. Make connections to coils with unions and flanges.

I. Locate water supply at bottom of supply header and return water connection at top. Provide manual air vents at high points complete with stop valve. Ensure water coils are drainable and provide drain connection at low points.

J. On water heating coils, connect water supply to leaving air side of coil (counterflow arrangement).

K. Insulate headers located outside air flow as specified for piping.

END OF SECTION 238216
SECTION 261000 – ELECTRICAL

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Intent Is to Provide and Install Complete Electrical Systems, as Required to Accommodate the renovations to the existing Building

B. Upgraded electric panels as indicated.

C. Building lighting and power shall be wired for three phase, four wire, 120/208 volt, 60 cycle A.C. System shall be complete with breakers, panelboards, disconnect switches, power and lighting outlets, etc

D. Furnish, install and connect all panelboards, switches, power and lighting outlets as indicated or required.

E. Wire and connect plumbing and heating equipment furnished and installed under other Sections of these Specifications. Wiring and connections shall include power supply and service disconnect.

F. Furnish, install and connect all lighting fixtures and lamps as indicated on the Drawings and in the Fixture Schedule.

G. Furnish and install all required system and equipment grounds in accordance with the requirements of the National Electrical Code and additional grounding as indicated and specified.

H. Extend the existing fire alarm system.

I. Secure and pay for all permits and certificates as required by local, State and Federal laws.

J. All work shall be in accordance with the latest issue of the National Electrical Code, NFPA 70.

K. All fire alarm indicating and initiating appliances/devices shall be mounted in location required by code. System design and installation shall be in compliance with the most recent versions of the National Electrical Code, National Fire Protection Association, Life Safety Code #101, NFPA #72, American with Disabilities Act, and all local, state, and Federal codes.

L. Interior raceways and junction boxes for system indicated.

1.2 RELATED REQUIREMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section. Examine all contract documents for requirements affecting the work.

1.3 SHOP DRAWINGS
A. Submit Shop Drawings, Owner’s Manuals, and Operating Instructions in accordance with Division 01 Section - Submittal Procedures.

B. The Contractor shall, after award of Contract and before installation, submit Shop Drawings, Owner's Manuals and Operating Instructions for equipment to be furnished under this Contract. Shop Drawings shall be submitted for the following items (Shop Drawings are required prior to acceptance):
   1. Disconnect switches.
   2. Circuit Breaker.
   3. Devices.
   4. Fire alarm system components.
   5. Wiring materials and devices.

1.4 PROJECT CLOSE-OUT DOCUMENTATION

A. Provide Material Safety Data Sheets (MSDS).

B. Instruction manuals shall be provided for all proposed equipment, components, and accessories.

1.5 RECORD DRAWINGS

A. The Contractor shall keep a marked set of Drawings at the site as a record set indicating all revisions in the work as the work progresses. At the completion of the work, the Drawings shall be marked "AS-BUILT DRAWINGS" with the Contractor's name and date, and shall be delivered to the Architect.

PART 2 - PRODUCTS

2.1 CIRCUIT BREAKERS

A. Circuit breakers to be added to existing panelboards shall match the existing panelboard circuit breakers.

2.2 DISCONNECT SWITCHES

A. Fused and unfused disconnect switches shall be enclosed, heavy duty type, except as noted. Switches shall have visible blades and shall have NEMA-1 enclosure, 600-volt and 250-volt ratings as required by the particular circuit with fuses and ampere rating and number of poles as indicated on Drawings, or as required by the specific equipment. Where required for exterior use, switches shall be NEMA-3R rain tight.

B. Fuses for all fuse clips, plugs, etc., shall be provided and one (1) spare set delivered to Owner. A duplicate set of spare fuses shall be delivered to Owner and a receipt shall be delivered to the Architect with the request for final payment. Fuses shall be Bussman or Chase Shawmut.

C. Disconnect switches shall be as manufactured by ITE Siemens, Square-D, Cutler Hammer, or General Electric.
2.3 WIRING MATERIALS

A. In general, wherever existing building conditions allow, wiring shall be concealed above ceilings and within finished walls - securely supported in accordance with code requirements. Where there is no alteration work which would allow for concealed wiring, then wiring may be exposed in conduit or surface metal raceway (Wiremold). Wiring in areas with no finished ceilings (exposed construction) shall be exposed overhead such that all raceways are parallel or perpendicular to joists, columns or beams. Where possible conceal the wiring when dropping at walls.
   1. Obtain approval from the Owner before running exposed wiring.
   2. All exposed wiring shall be painted to match surface mounted to.
   3. Concealed Type MC cable will be allowed. Type MC cable shall not be run exposed.

B. Except as otherwise specifically noted, all wiring throughout the building, including raceways for each of the systems specified, shall be enclosed in intermediate steel or rigid galvanized steel or heavy wall aluminum conduit; or galvanized steel electrical metallic tubing; all sized in accordance with code requirements for the conductors indicated. Minimum size shall be 1/2" except as noted; conduits in poured concrete shall be 3/4" minimum size.
   1. All couplings and connectors for electrical metallic tubing shall be compression or set screw type.
   2. Termination for all conduit and tubing shall have insulated bushings or insulated throat connectors in accordance with code requirements.
   3. Connections to all motors where flexible permanent connection is required shall be provided with two feet (2') of flexible liquid-tight Type UA conduit, using approved liquid-tight fittings.
   4. All conduits shall be substantially supported with approved clips or hangers spaced not to exceed ten feet (10') on centers except 2" rigid conduit and 2" and 3/4" electrical metallic tubing shall have supports spaced not to exceed six feet (6'). Provide and install supporting racks of Power-Strut, or approved equal, for parallel runs of conduit.

C. Wireways shall be furnished and installed complete as indicated on the Drawings for the number of circuits indicated.
   1. Wireways shall be Underwriters' approved, Code gauge, enameled steel of sizes as indicated, with couplings, fittings, offsets, supports, end caps, etc., complete. All wireways shall have screw type covers, with built-in protection of conductors from cover screws. Fittings shall have removable front covers for installation of wires. Wireway shall have knockouts top and bottom and cover on front.
   2. Provide supports as approved with supports located at every splice and fitting and at intervals not exceeding five feet (5').
   3. Wireways shall be as manufactured by ITE, Square D, or General Electric, or approved equal, for trim and neat installation.

D. Wiring within raceways shall be copper conductors with THHN/THWN or XHHW insulation rated for 600-volts, except as noted. Wiring #8 AWG and larger shall be stranded. All wiring shall be UL labeled and indicate manufacturer's name, type and size.
   1. Sizes shall be not less than indicated. Branch circuit conductors shall be not smaller than No. 12 AWG. Conductors for branch circuits of 120 volts more than 100 feet long from panel to load shall be No. 10 AWG.
   2. Non-load carrying control circuit wiring from motor control devices to motor control may be #14 AWG with control circuit fusing sized accordingly. Wire shall be insulated for
600 volts.
3. Feeder conductors from main service to panelboards, and where elsewhere specified, shall be Type XHHW insulated for 600 volts.
4. Wiring for recessed and surface incandescent fixtures shall be rated minimum 300 Degrees F in metallic conduit where required for Underwriters' approval. Wiring within fluorescent fixture housings and between fixtures and junction boxes above ceilings shall be Type THHN insulated conductors rated for use at temperatures not lower than 90 Degrees C.

E. Metal Clad Cable
1. Description: ANSI/NFPA 70 (N.E.C.), Type MC with separate insulated ground.
2. Conductor: Copper, maximum # 10 AWG.
4. Insulation Temperature Rating: 90ºC.
5. Armor Material: Galvanized Steel or Aluminum.
6. Armor Design: Interlocked Metal Armor or Corrugated tube
7. Jacket: None.

F. All exposed wiring shall have threaded cast "Condulet" type fittings. Fittings and boxes for exterior installation shall be weatherproofed.

G. Junction boxes shall be standard type galvanized steel minimum size four inch (4") octagon or four inch (4") square 2-1/8" minimum depth, except as noted. Provide four inch (4") and three inch (3") deep concrete boxes as required for ceiling outlets in concrete slabs. Provide plaster rings raised on boxes as required. Junction boxes shall be specially constructed of Code gauge galvanized sheet steel where required. Light outlet boxes are to be provided with drilled and tapped ears to receive fixture bars. Use 4-11/16" square boxes where required.
1. Outlet boxes, fittings, etc., for exterior use shall be cast type "Condulet" with gaskets for waterproofing.
2. Pull boxes shall be installed where indicated or required. Boxes shall be galvanized steel of adequate size for all conductors installed therein, and shall have either screw type or hinged flush covers as required.
3. All boxes shall be rigidly supported as approved.
4. Conduit Connections: When conduit is joined to a non-threaded or hubless NEMA 1 or NEMA 1A box or enclosure, it shall be joined by means of two locknuts and insulated or grounding bushing, as required. When conduit is joined to a non-threaded or hubless NEMA 12 or watertight box or enclosure, it shall be joined by means of Myers "Scru-Tite," or equal hubs.
5. Conduits and sleeves penetrating fire rated barriers shall be sealed and/or filled with approved material to maintain the fire rating.

2.4 SURFACE METAL RACEWAYS

A. Acceptable Manufacturers
1. Wiremold Series: 200, 500, 700
2. Or approved equal.
B. Description: U.L. approved assembly comprising a metal base and cover to form a raceway designed for surface mounting. Cover removable to allow installation of wires after the base channel is installed.
2.5 WIRING DEVICES

A. Wiring devices shall be as manufactured by Hubbell, except as otherwise specifically noted. Devices having equivalent details and matching interchangeable characteristics as manufactured by Pass & Seymour/Legrand, Cooper Wiring Devices or Leviton spec-grade may be used subject to submittal and approval of Shop Drawings. Color of devices shall be black with black nylon faceplates.

B. Convenience outlet receptacles shall be duplex grounding type, 20 ampere. All receptacles shall be installed with "U" ground at top.

C. Receptacles shall be No. CR5352 for 20 ampere.

D. Ground fault receptacles shall be Hubbell, Spec-Grade, or equal, Furnish with special plate, and install per manufacturer's instructions. Supply load type GFCI to serve other receptacles on same circuit.
   1. GFCI Duplex Receptacle, Rated 20 Amp, 120 volt:
      a. Hubbell, Model GF5362 Series.

E. Receptacles shall be ivory with matching nylon cover plates unless noted otherwise.

F. Plates for surface mounting in Utility areas shall be cadmium plated steel with rounded edges.

   1. 120 volt coil as required.
   2. Number of poles as indicated or required. Minimum number of poles: Four.
   3. Minimum continuous ampere rating: 5 amps.
   4. Enclosure: NEMA-1, except as noted.
   5. Electrically held, except as noted.
   6. 600 volt rated.

2.6 METALLIC BONDING SYSTEM

A. Provide and install 600 volt insulated bonding conductors throughout the distribution system with connection to bonding (or grounding) terminal on each panel and panelboard and with connections to other equipment where specifically indicated and noted.

B. Provide and install bonding conductor to each item of electrical equipment.

C. Bonding conductors shall be continuous where possible. Where splices are required, provide T & B, or approved equal, compression connectors of approved pattern. Insulate connectors to equivalent thickness of conductors.

2.7 WIRING FOR HEATING, VENTILATING, PLUMBING, AND EQUIPMENT FURNISHED UNDER OTHER SECTIONS OF THESE SPECIFICATIONS

A. Wire and connect supply and exhaust fans, air handling units, energy recovery units, circulators,
and pumps, as furnished under other Sections of these Specifications, as indicated on the Drawings and in the Specifications.

B. Wiring shall include final branch circuit connections to disconnects, motor controllers and motors.

C. Fused and non-fused disconnect switches shall be furnished and installed under Section 261000 for the above equipment, as required, except disconnect switches specifically provided with the equipment.

D. Except as specifically noted, motors, variable frequency drives, magnetic or manual starters and thermal overload protection will be furnished with the equipment for installation under Section 261000, except as follows:
   1. Single pole switches, switch and pilots, and light/fan switches shall be provided and installed under this section. Coordinate with equipment schedules on H&V Drawings.
   2. Temperature control wiring shall be provided and installed under Division 23 for instrumentation and controls for HVAC.

2.8 FIRE ALARM SYSTEM

A. System Description: Fire alarm components shall be as manufactured by Notifier. Provisions shall be made for new fire alarm components, devices and appliances to be integrated into the existing fire alarm system. The integrated system including equipment, components, and all accessories shall be UL listed for the purpose for which the devices are used.

B. Special programmable features: HVAC units: Interface shall be field programmable to allow activation on general alarm and/or on selective zoning of local detectors. Set initially to shut down on general alarm, plus send status signal to the Energy Management/Temperature Control system (ATC) provided under Division 23 for instrumentation and controls for HVAC. For all HVAC equipment that is required to be shut down upon a fire alarm condition, ensure that fire alarm shutdown of equipment is wired through input contacts within the starter enclosure. Upon receipt of a signal from the building's fire alarm system, power to the load side of the starter shall be turned off. Circuitry shall be provided to ensure that power is off whether the starter is in the "AUTO", "HAND" or "BYPASS" mode or "HAND", "OFF", "AUTO" mode. If this feature is not available from the starter manufacturer, Division 23 shall be responsible for providing a contactor on the line side of the starter to accomplish the same function. The contactor shall meet the requirements specified under this division.

C. The existing fire alarm control panel is a Notifier.

D. The intent is to provide new devices and appliances as indicated. Provide additional programming as required. Provide all interface modules to support the renovations.

E. All new devices shall be fully compatible with the existing system

F. Initiating Devices: Duct initiating devices shall be wired and programmed to shut down the associated HVAC unit/units and evacuate the appropriate building/buildings. Duct detectors shall be provided with remote test and indicating stations.

G. Wiring for alarm system within building shall be minimum size #16 AWG for initiating circuits and #14 AWG for alarm signal circuits, all copper, except as noted. Non power-limited wiring
and exposed wiring shall be in rigid conduit or electrical metallic tubing in accordance with Specifications for locations used. See Item "Wiring Materials". Concealed power limited wiring in dry locations above ceilings, in stud walls, except as noted, can be fire resistant teflon covered cables approved for use for fire alarm system in an air plenum. Cables shall be properly supported, labeled and tie wrapped. Complete installation shall meet requirements of NEC Article 760 "Fire Protective Signaling Systems” and NEC Article 725 Minimum size conductors for cables shall be #16 AWG.

H. All work shall be installed in accordance with National Electrical Code, National Fire Protection Association, Standards 72 and also all applicable Federal, State and local codes.

I. Provide nameplates identifying all equipment, junction boxes and controls.

J. Provide the services of a licensed authorized technical representative of Honeywell-Notifier to select proper matching components, to supervise the installation, plus adjusting, programming, and all testing of the system required to assure a complete and fully operative facility in accordance with the specifications, and to instruct designated personnel in the operation, adjustment, testing and maintenance of the system. Provide letter certifying results of test. Reprogram to annunciate zones as directed by the local authority having jurisdiction.

PART 3 - EXECUTION

3.1 WORKMANSHIP AND INSTALLATION

A. All work shall be in accordance with the National Electrical Code requirements as amended to date, with the local electric utility company's rules, the Fire Underwriters' requirements and all local, State and Federal laws and regulations. All equipment shall be Underwriters' listed.

B. Coordination: The drawings indicate the extent and the general location and arrangement of equipment, conduit and wiring. The Contractor shall become familiar with all details of the work and verify all dimensions in the field so that the outlets and equipment will be properly located and readily accessible. Lighting fixtures, outlets and other equipment and materials shall be located to avoid interference with mechanical or structural features; otherwise, lighting fixtures shall be symmetrically located according to the room arrangement when uniform illumination is required or asymmetrically located to suit conditions fixed by design and shown. Raceways, junction and outlet boxes, and lighting fixtures shall not be supported from sheet metal roof decks. If any conflicts occur necessitating departures from the drawings, details of and reasons for departures shall be submitted and approved prior to implementing any change.

C. In general, all wiring shall be concealed. Wiring to all wall outlets and devices shall be concealed within the walls. Wiring to ceiling outlets shall generally be concealed between the ceiling and the floor or roof above. Where construction requires exposed wiring, conduits or surface raceway shall be neatly arranged parallel and perpendicular to beams and joists with right angle turns consisting of bends, fittings, or outlet boxes where indicated. Drops to HVAC units and convenience outlets shall be concealed in the walls.

D. Conduits shall be of sizes required by the National Electrical Code increased as required to include bonding conductor as specified. No wire shall be installed until work which might cause damage to wires or conduits has been completed. Conduits shall be thoroughly cleaned of water or other foreign matter before wire is installed.
E. Conduits shall be fastened by suitable galvanized clips or approved hangers. Clips and boxes shall be fastened by wood screws on wooden surfaces, machine screws on metal, toggle bolts in masonry block, or by expansion shields in concrete. Parallel runs of conduit shall be neatly clustered with all bends and offsets of uniform pattern.

F. Separate circuits shall be run for lighting and receptacle outlets as indicated. Circuits shall be balanced and loads and capacities shall be in accordance with requirements of local electric light company and National Boards of Fire Underwriters.

G. Circuits for emergency lighting shall be run in separate conduits independent from other circuit wiring as required by Code.

H. The entire electrical system shall be permanently and effectively grounded in accordance with Code requirements.

I. Receptacle plates shall be installed vertically and plumb.

J. The location of conduits, outlets, equipment, etc., as shown shall be considered as approximate only. The Contractor shall study all Plans with relation to spaces surrounding each outlet, in order that his work may fit the work of others.

K. All splices shall be mechanically and electrically perfect, using approved solderless wire connectors. Splices shall be insulated equivalent to insulation on conductors.

L. All motors connected under this Section of the Specifications shall be connected for correct rotation.

M. All fixtures and equipment shall be in first-class condition at time of delivery of building to Owners with all scratches, mars, etc., refinished to factory standards.

N. All empty conduits shall have nylon pull rope or min. #10AWG wire installed and labeled.

O. Lighting Fixtures mounted within, on or from suspended ceilings shall be supported from structural framing above ceiling framing suspension system. Provide 10 gage safety hanger wire supports for all fixtures recessed in ceiling grids of suspended acoustical ceilings. Hangers shall be independent of ceiling framing suspension system and shall extend from fixture housing to structure above (top cord of bar joist for bar joist construction).
   1. Lighting fixtures weighing less than 56 pounds shall have minimum of two hangers, at diagonal corners of fixture (2 locations).
   2. Lighting fixtures weighing more than 56 pounds shall have four hangers, one at each corner of fixture (4 locations). Wires shall have no tension (slack) to prevent ceiling distortion. In addition, attach to ceiling framing "T"s as required by code.

P. Aim directional lampheads to maximize light in egress paths and as directed.

Q. D.C. Wiring: No.10 AWG. minimum, or as noted, in rigid conduit or electrical metallic tubing or MC cable.
   1. Except as noted, use home run from each device to associated battery unit.
   2. Devices may share same home run to battery unit provided that each home run meets the following criteria or wire sizes are increased to assure maximum of 2-1/2% voltage drop.

<table>
<thead>
<tr>
<th>Total Watts</th>
<th>Total Conductor Distance</th>
</tr>
</thead>
</table>

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R. AC Wiring to Exit and Emergency Lights: In separate conduit, or MC cable with ground.

S. Install products in accordance with manufacturer's instructions.

3.2 CONDUIT, WIRE, AND BOXES FOR FIRE ALARM WIRING.

A. Conductors for initiating, notification, and annunciation devices shall be sized and installed per manufacturer's recommendations. All fire alarm circuits shall be installed in a separate and independent conduit system from other electrical circuits. Initiating, notification, annunciation, and all other fire alarm system circuits shall be color coded cables and identified by number at termination and splice points. All associated electrical boxes and pull boxes shall be identified by having their covers painted red.

3.3 INSTALLATION OF POWER CONDUCTORS/CONDUITS NEAR TELECOMMUNICATIONS CONDUITS, PATHWAYS AND BOXES.

A. Pathways installed to carry telecommunications cables shall give consideration to noise sources such as power wiring, radio frequency (RF) sources, large motors, large generators, induction heaters, arc welders, transformers, fixture ballasts, etc.

1. Power conductors shall cross telecommunication pathways in a perpendicular orientation and at a minimum distance of 6 inches.
2. Telecommunication pathways shall run a minimum of 6" from lighting ballasts unless otherwise indicated.
3. Power conductors which run parallel to telecommunication pathways shall maintain the following minimum distance separation:

<table>
<thead>
<tr>
<th>CONDITION</th>
<th>MINIMUM REQUIRED SEPARATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>120 V, &lt; 20 A</td>
<td>120/208 V, &lt; 20 A</td>
</tr>
<tr>
<td>Power conductors in tray, telecom conductors in tray or air</td>
<td>12&quot;</td>
</tr>
<tr>
<td>Power conductors in tray, telecom conductors in metal conduit</td>
<td>9&quot;</td>
</tr>
<tr>
<td>Power conductors in metal conduit, telecom conductors in tray or air</td>
<td>9&quot;</td>
</tr>
<tr>
<td>Power conductors in metal conduit, telecom conductors in metal conduit or wireway</td>
<td>4&quot;</td>
</tr>
</tbody>
</table>
3.4 IDENTIFICATION

A. Furnish and install laminated phenolic nameplates engraved to the white core identifying all new panelboards plus circuits on all spaces of switchboards and distribution panels, also all safety switches, controls, relays, junction boxes, pull boxes, pilot lights, special switches and outlets, etc., as furnished under this Section. Nameplates shall identify function of device, space controlled, voltage conditions, fuse size, panel serving switch, etc., as indicated or required without abbreviations. Details shall be as approved.

B. Provide tags on each end of all pull wires, all intercommunication wires, etc., giving location of other end.

C. Branch circuit conductors, conductors throughout the building including feeder conductors, conductors in conduits and conductors in wireways and trenches shall have color to identify voltage and service supplied in accordance with the following:
   1. All metallic bonding conductors - Green.
   2. All neutral conductors (all systems) - White.
   3. Phase conductors of 120/208 volt system - black, red, blue.

D. All circuit conductors of the same color shall be connected to the same ungrounded feeder conductor throughout the installation. Conductors of different voltage systems shall not enter same raceway systems.

E. Where conductors are not available in the colors indicated, due to size or other reason, the Contractor shall install identifying adhesive bands 3/4” wide of colors indicated above around each conductor within six inches (6”) and twelve inches (12”) of each end and at a maximum of five foot (5’) intervals along wireways, at back of panelboards, etc., where conductors are accessible.

F. Fire Alarm Identification: Provide address and identification labeling installed on the bases of all addressable initiation and annunciation devices noting circuit and node identification.

3.5 TESTING AND ADJUSTING

A. The entire installation shall be free from short circuits and improper grounds. Tests shall be made in the presence of the Architects or their representatives. Each branch circuit shall be tested with switches closed, all fixtures in place and permanently connected, lamps removed or omitted from the sockets, and all wall switches closed.

B. Each system shall be completely tested and shall be adjusted for proper operation as required by the Architects.

C. Fire Alarm Certification and Testing: Tests shall be performed by the Contractor and the Manufacturers representative. The completed system shall be tested for proper operation, code compliance, and compliance to this standard. The Contractor and the Manufacturer's Representative shall sign a letter attesting to the completion of testing and its compliance to items outlined above. Testing shall be performed at a time convenient to the Owner.

3.6 CONTINUITY OF SERVICE AND SCHEDULE OF WORK

A. Construct Work in sequence under provisions of Division 01 Section “Summary”.
B. All work shall be scheduled and coordinated with the Div. 2, - Selective Structure Demolition and Alterations. Demolition and removal of electrical items are included as part of this Specification Section 261000, Electric. Patching of existing structure left by removals, specified under Section 024119.

C. Arrange to execute the work at such times and in such locations as may be required to provide uninterrupted services for the occupied sections of the building, or any of its sections
   1. Services Include but Not Limited to: Power, lighting, fire alarm, telephone, computer, and life safety systems as required to maintain occupancy.
   2. If necessary, install temporary work to provide for this condition. Authorization for interrupting services shall be obtained, in writing, from the Owner.

D. Costs for overtime work and temporary work shall be included in the bid.

3.7 ALTERATIONS AND DEMOLITION

A. Visit the site and become familiar with the existing conditions, and the requirements of the Plans and Specifications. No claim will be recognized for extra compensation due to failure of becoming familiar with the conditions and extent of the proposed work.

B. Execute all alterations, additions, removals, relocations, or new work, etc., as indicated or required to provide a complete installation in accordance with the intent of the Drawings and Specifications.

C. Repair or replace to the Owner’s satisfaction, all existing work disturbed or damaged by the alterations.

D. Except as follows, Retain ownership and remove from site all existing materials, equipment, fixtures, wiring and devices disconnected and not reused: Pay all charges for proper disposal of materials:
   1. Materials specifically indicated to be returned to Owner. Obtain receipt of delivery from Owner’s Representative.

E. Do not reuse existing wiring except as specifically indicated. Existing conduit raceways may be reused, provided that the existing wires are removed and new wires are installed.

F. Discontinued conductors shall be removed.

G. Provide finished blank plates on all existing ceiling and wall boxes which can not be removed.

H. Ensure all circuits in existing buildings are re-energized where existing panelboards are replaced, or existing wiring is rerouted, disconnected, or disturbed. Provide and install new wiring as required to meet this condition. Verify breaker/fuse sizes on existing circuits and do not load wiring to beyond 75% of their ampacities.

END OF SECTION 261000