PROJECT MANUAL

DIVISIONS 01 THRU 28

UNLV MSL BUILDING
INTERIOR RENOVATION

100% CONSTRUCTION DOCUMENTS
OCTOBER 30, 2017

Simpson Coulter | STUDIO
PLANNING • ARCHITECTURE • INTERIOR DESIGN
Mechanical & Plumbing Engineer
Sigma Mechanical Engineering, Inc.
Bijan Salimi, P.E., CEM

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SECTION 01 11 00
SUMMARY OF WORK

PART 1   GENERAL

1.01   SECTION INCLUDES

A. Work by the Owner.
B. Owner furnished Products.
C. Contractor use of site.
D. Owner occupancy.

1.02   WORK BY OWNER

A. Any items noted NIC (Not in Contract) will be supplied and installed by Owner following Substantial Completion of the Work.
B. Any items noted OFCI (Owner Furnished Contractor Installed) will be supplied by the Owner and installed by the Contractor.

1.03   OWNER FURNISHED PRODUCTS

A. Owner's Responsibilities:
   1. Arrange for and deliver Owner reviewed Shop Drawings, Product Data, and Samples, to Contractor.
   2. Arrange and pay for Product delivery to site.
   3. On delivery, inspect Products jointly with Contractor.
   4. Submit claims for transportation damage and replace damaged, defective, or deficient items.
   5. Arrange for manufacturers' warranties, inspections and service.

B. Contractor's Responsibilities:
   1. Review Owner reviewed Shop Drawings, Product Data, and Samples.
   2. Receive and unload Products at site; inspect for completeness or damage, jointly with Owner.
   3. Handle, store, install and finish Products.
   4. Repair or replace items damaged after receipt.

1.04   CONTRACTOR USE OF SITE

A. The Contractor shall have full use of the areas indicated on the Drawings as being within the contract limit line, except for the following:
   1. Work along corridor connection between the EPA occupied portion of the building and the existing restrooms. This area will be of the contractor full use only during the construction phase dedicated for this corridor.
   2. Work on the existing Restrooms. This area will be of the contractor full use only during the construction phase dedicated for these spaces.
   3. Work in front of existing entry doors of the building currently providing direct access to the EPA portion of the building. These areas of work will need to be coordinated in detail with the Owner and EPA. This area will be of the contractor full use only during the construction phase dedicated for this work.

B. Haulage Routes and Staging Areas: Limited to those approved by Owner.
C. Construction Operations: Limited to areas noted on Drawings, unless revised by written agreement with Owner.

D. All areas adjacent to the contract limit line will be occupied by normal pedestrian and vehicular traffic.

1.05 OWNER OCCUPANCY

A. Cooperate with Owner to facilitate Owner's inspections and any Owner installation.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION
SECTION 01 29 13
REQUESTS FOR INTERPRETATION

PART 1  GENERAL

1.01  SECTION INCLUDES

A. Administrative and procedural requirements for handling and processing Requests for Interpretation (RFI).

B. RFI Form: Submit to Architect for approval prior of using it for request of interpretation submittals.

C. Direct questions during bidding phase as indicated in bidding and/or Contract Documents.

1.02  DEFINITIONS

A. RFI: Formal process used during construction phase to facilitate communication between Contractor and Architect or Owner’s Representative with regard to requests for additional information and clarification of intent of Contract Documents (Drawings and Specifications).

1.03  PROCEDURE

A. When conditions require clarification of Contract Documents, comply with the following:
   1. Subcontractors, manufacturers, and suppliers shall submit request for additional information and clarification to Contractor.
   2. Contractor shall contact Architect with requests for interpretation or additional information using the attached form. Architect will not accept requests for interpretation or information submitted directly from subcontractors, manufacturers, or suppliers.
   3. Architect will provide response to Contractor.
   4. Generate RFI by one source per project and number accordingly. Independent numbering system will be used before awarding and after awarding the project.
   5. Submit one request for information or clarification per form. Indicate specification section, inclusive of pertinent paragraph and/or sub-sections and/or associated construction document drawings sheet inclusive of pertinent drawing reference number.

B. Architect will review RFI from Contractor with reasonable promptness and Contractor will be notified in writing of decisions made within ten (10) calendar days. Contractor will state response date for any priority RFIs.

C. Architect’s written response to RFI shall not be considered as a Pricing Order or Pricing Directive, nor does it authorize changes in Contract Sum or Contract Schedule.

D. Contractor shall maintain a log of RFIs sent to, and responses from, Architect. This log shall be presented during each meeting with the Owner and/or Architect.

E. Contractor shall make every reasonable effort to answer questions pertaining to Construction Documents before submitting an RFI.

1.04  RFI FORM

A. Submit RFIs on approved form. Architect will not respond unless the approved form is used.

B. If submittal form or format does not provide space needed for complete information, additional sheets may be attached.
<table>
<thead>
<tr>
<th>PART 2</th>
<th>PRODUCTS</th>
<th>Not Used</th>
</tr>
</thead>
<tbody>
<tr>
<td>PART 3</td>
<td>EXECUTION</td>
<td>Not Used</td>
</tr>
</tbody>
</table>

END OF SECTION
PART 1 GENERAL

1.01 SECTION INCLUDES

A. Format.
B. Detail.
C. Updating.
D. Submittals.

1.02 RELATED SECTIONS

A. Section 01 11 00 - Summary of Work.
B. Section 01 26 00 - Contract Modification.
C. Section 01 29 00 - Payment Procedures.
D. Section 01 32 16 - Construction Progress Schedule.
E. Section 01 33 00 - Submittal Procedures.

1.03 FORMAT - SCHEDULE OF VALUES

A. Submit on an original AIA Form G703 (Continuation Sheet).
B. Separate values of the work by phases and/or areas of the Project.
C. Include the following project identification:
   1. Project number, Project name/location.
   2. Phase name and location as appropriate.
   3. Contractor’s name and address.
   4. Date of submittal.

1.04 DETAIL - SCHEDULE OF VALUES

A. Submit a detailed Schedule of Values to satisfy the Owner’s requirements.
B. Prepare in detailed form and supported by such data to substantiate accuracy.
C. Each item in the Schedule of Values shall be complete to include its cost and its proper share of overhead and profit and shall aggregate the total Contract Sum.
D. Each item in the Schedule of Values shall be provided for materials which could be billed as materials stored on site and subsequent installation costs for materials.
E. Include separate line items for the completed CPM baseline project schedule, and closeout requirements.
F. Include line items for completion of the following items:
   1. Baseline Schedule.
   2. Storm Water Pollution Permit full value.
   3. Landscape Maintenance full value.
5. Operation and Maintenance Data (Manuals).
6. As-Builts and Project Record Documents.
7. Systems Demonstration Mechanical.

G. Include separate line items for principal subcontract amounts.

H. Include separate line items for the cost of the materials, and for subsequent installation costs for the materials when Application of Payment includes materials or equipment purchased or fabricated and stored, but not yet installed.

I. Include separate line items for temporary facilities and other major cost items that are not direct cost of actual work-in-place.

J. Include separate items for each activity indicated by specifications sections from Divisions 2 through 32.

1.05 UPDATING - SCHEDULE OF VALUES

A. Update and resubmit the Schedule of Values when Change Orders result in a change in the Contract Sum.

1.06 SUBMITTALS

A. Submit the proposed Schedule of Values prior to the Pre-Construction Conference. Provide a copy to both the Owner and Architect for review.

B. Participate in the review of proposed Schedule of Values jointly with the Owner and Architect as requested.

C. Revise to incorporate all comments from the review.

D. Resubmit, as required, within five (5) days after the review notice.

E. The Owner and Architect must accept the Schedule of Values before the Contractor may submit the first Application for Payment.

F. The accepted Schedule of Values shall be used as a basis for reviewing monthly Applications for Payment.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

A. Contractor shall not submit a front-loaded Schedule of Values.

B. Prepare the Schedule of Values in coordination with Contractor’s Construction Schedule.

END OF SECTION
SECTION 01 31 13
PROJECT COORDINATION

PART 1 GENERAL

1.01 SECTION INCLUDES
A. Coordination of Work.

1.02 RELATED SECTIONS
A. Section 01 25 13 - Product Substitution Procedures.
B. Section 01 31 19 - Project Meetings.
C. Section 01 32 16 - Construction Progress Schedule.
D. Section 01 33 00 - Submittal Procedures.
E. Section 01 33 23 - Shop Drawings, Product Data, and Samples.
F. Section 01 40 00 - Quality Control.
G. Section 01 66 00 - Product Storage and Handling Requirements.
H. Section 01 77 00 - Closeout Procedures.

1.03 DESCRIPTION
A. Coordinate scheduling, submittals, and Work of the various sections of specifications to assure efficient and orderly sequence of installation of construction elements, with provisions for accommodating items to be installed later.

1.04 MEETINGS
A. Hold coordination meetings with personnel and subcontractors to assure coordination of Work.

1.05 COORDINATION OF SUBMITTALS
A. Schedule and coordinate submittals specified in Section 01 33 00.
B. Coordinate Work of various sections having interdependent responsibilities for installing, connecting to, and placing in service, such equipment.

1.06 COORDINATION OF SPACE
A. Coordinate use of project space and sequence of installation of mechanical and electrical Work which is indicated diagrammatically on drawings. Follow routings shown for pipes, ducts, and conduits as closely as practicable, with due allowance for available physical space; make runs parallel with lines of building. Utilize space efficiently to maximize accessibility for other installations, for maintenance, and for repairs.
B. In finished areas except as otherwise shown, conceal pipes, ducts, and wiring in the construction. Coordinate locations of fixtures and outlets with finish elements.
C. Coordinate Construction Phasing as required to maintain in operation the use of the existing restroom facilities by other portions of the building not part of this renovation. Supply
provisional restroom facilities for the exclusive use of the building users from the portion of the building not being part of this renovation work, while the renovation work takes place at the restrooms, in the proximity of them or at the corridors providing access to the restrooms. The construction phasing plans need to be approved by AHJ, owner and architect prior to commence any of the renovation work.

1.07 COORDINATION OF CONTRACT CLOSEOUT

A. Coordinate completion and cleanup of Work of separate sections in preparation for Substantial Completion.

B. After Owner occupancy of premises, coordinate access to site by various sections for correction of defective Work and Work not in accordance with Contract Documents, to minimize disruption of Owner's activities.

C. Assemble and coordinate closeout submittals specified in Section 01 77 00.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used
PART 1 GENERAL

1.01 SECTION INCLUDES

A. Quality Assurance.
B. Schedule Review Conference.
C. Pre-Construction Conference.
D. Project Meetings.
E. Pre-Closeout Conference.
F. Coordination Meetings.

1.02 RELATED SECTIONS

A. Section 01 32 16 - Construction Progress Schedule.

1.03 QUALITY ASSURANCE

A. Persons designated by the Contractor to attend and participate in conferences and/or project meetings shall have the authority to commit the Contractor to solutions agreed upon in the conference and/or project meetings.

B. The following list is not inclusive of the Contractor’s requirement to attend other conferences and/or meetings as specified elsewhere in this project manual or conference and/or meetings as requested by the Owner and/or Architect.

1.04 SCHEDULE REVIEW CONFERENCE

A. The Contractor shall participate in a Schedule Review Conference with the Owner and Architect. Time, agenda and subsequent requirements resulting from this conference shall be as provided in the Conditions of the Contract and Owner-Construction Manager as Constructor Agreement.

1.05 PRE-CONSTRUCTION CONFERENCE

A. Within seven days from the Notice of to Proceed, the Contractor, including the Project superintendent and major subcontractors, shall attend a Pre-Construction Conference with the Owner and Architect. Location of this conference to be as agreed upon by Owner, Architect and Contractor.

B. Discuss items of significance that could affect progress, including the following:
   1. Tentative construction schedule
   2. Critical work sequencing
   3. Designation of responsible personnel
   4. Procedures for processing field decisions and Change Orders
   5. Procedures for processing Applications for Payment
   6. Distribution of Contract Documents
   7. Submittal of Shop Drawings, Product Data, and Samples
   8. Preparation of record documents
   9. Use of the premises
   10. Parking availability
11. Office, work, and storage areas  
12. Equipment deliveries and priorities  
13. Safety procedures  
14. First aid  
15. Security  
16. Housekeeping  
17. Working hours  

C. The Contractor shall prepare minutes from the conference and make distribution to all attendees.

1.06 PROJECT MEETINGS  

A. The Contractor shall attend regularly scheduled project meetings with the Owner and Architect. Such meetings shall be held once each week unless determined otherwise by the Owner and Architect. Project meetings shall be held at the project site or at location determined by the Owner. The date of the first project meeting shall be established at the Pre-Construction conference jointly by the Owner, Architect and Contractor.

B. In addition to representatives of the Owner, General Contractor and the Architect, each subcontractor, supplier or other entity concerned with current progress or involved in planning, coordination, or performance of future activities may be represented at these meetings.

C. The Contractor shall prepare minutes from each project meeting and make distribution to all attendees.

1.07 PRE-CLOSEOUT CONFERENCE  

A. The Contractor and his major subcontractors shall attend a pre-closeout conference with the Owner and Architect to review and schedule the contractual obligations such as the substantial completion inspection, punch list, temporary certificate of occupancy, certificate of occupancy, final cleaning, project record documents, operations and maintenance data, spare parts, closeout certificates and warranty period.

B. Notify the Owner and Architect fifteen (15) days prior to the anticipated courtesy inspection.

C. The Contractor shall prepare minutes from the conference and shall make distribution to all attendees.

1.08 OTHER CONFERENCES AND COORDINATION MEETINGS  

A. The Contractor shall attend other conferences and coordination meetings with the Owner and Architect as requested.

B. Project coordination meetings are in addition to specific conferences held for other purposes, such as regular project meetings and special pre-installation conferences.

PART 2 PRODUCTS  

Not Used

PART 3 EXECUTION  

Not Used

END OF SECTION
November 9, 2015

U.S. Environmental Protection Agency
Office of Research and Development (ORD)
National Exposure Research Laboratory (NERL)
109 T.W. Alexander Drive
Mail Code D305-01
Research Triangle Park, NC 277089

Attn: Ms. Beverly McKim, Task Order Project Officer

Subject: Final Reports, EPA Las Vegas Environmental Due Diligence Process (EDDP), Asbestos Consulting Services, Program Operations Support (POS) Building and Quality Assurance Laboratory (QAL) Building

Dear Ms. McKim:

Booz Allen Hamilton is pleased to submit the Final Reports for the EPA Las Vegas EDDP Asbestos Consulting Services for the POS and QAL Buildings. Booz Allen welcomes all questions and feedback on this material, and looks forward to continuing to support this project.

Sincerely,

Justin Nyland, PE, LEED AP
Program Manager

Cc: Steve Gardner, EPA Alternate Task Order Project Officer

Attachments: EPA Las Vegas EDDP, Asbestos Consulting Services, Final Reports for the POS and QAL Buildings (pdf)
November 2, 2015

Mr. Santiago Vila
Amec Foster Wheeler Environment & Infrastructure, Inc.
4021 Stirrup Creek Drive, Suite 100
Durham, NC  27703

Subject: **Asbestos Consulting Services**
EPA Harmon Avenue Complex
Program Operations Staff (POS) Building
Rooms 15 and 30
944 East Harmon Avenue
Las Vegas, Nevada

Dear Mr. Vila:

In accordance with your request and authorization of services under the *Short Form Laboratory Services Subcontract Agreement* dated September 8, 2015, Infinity Environmental Services, LLC (Infinity) of Las Vegas, Nevada, collected three bulk samples of suspect asbestos containing building materials from room 30 on October 19, 2015, and on October 21, 2015, collected three samples from room 15 of the subject building located in Las Vegas, Nevada. Mr. Steven Havens, the owner of Infinity and a Nevada licensed asbestos abatement consultant (building inspector), conducted the sampling survey. The suspect asbestos containing materials (ACMs) homogenous areas identified and sampled during the course of our investigation consisted of wall plaster and surfacing.

The samples were analyzed by Forensic Analytical Laboratories, Inc. (FALI) located in Las Vegas, Nevada. FALI is accredited under the National Voluntary Laboratory Accreditation Program (NVLAP) for asbestos analysis. The samples submitted for primary testing were analyzed by Polarized Light Microscopy (PLM). The analytical reports are enclosed.
The results of our survey and the laboratory analyses are summarized as follows:

<table>
<thead>
<tr>
<th>Sample ID</th>
<th>Sampling Locations and Materials Sampled</th>
<th>Laboratory Results</th>
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<td>Layer 1: Off-White Plaster</td>
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<td></td>
<td>Layer 3: Paint</td>
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</table>

ND = No Asbestos was Detected in the Sample and/or Layer Collected

Based on the laboratory results, the laboratory is reporting no asbestos detected in the samples collected.
This report is for the use of Amec Foster Wheeler Environment & Infrastructure, Inc., Booz Allen Hamilton, Inc., and the Environmental Protection Agency as it applies to the above mentioned building in Las Vegas, Nevada. Infinity is not responsible for any claims or damages associated with interpretation of available information. This assessment should not be regarded as a guarantee that no further asbestos, beyond that which was suspected to be present (and sampled) during our investigation, is present at the property. In addition, asbestos is usually not distributed uniformly throughout a material and Infinity cannot guarantee that the areas sampled are exactly as represented throughout the property.

We thank you for this opportunity to be of service. If you have any questions regarding the information provided in this report, please call the undersigned.

Sincerely,

Infinity Environmental Services, LLC

Steven Havens
Owner
Nevada Asbestos Abatement Consultant License No. IM-472

Encl: Infinity, Material Data Chain of Custody Forms, Asbestos Forensic Analytical, Laboratory Reports, Asbestos Abatement Consultant License
<table>
<thead>
<tr>
<th>Infinity Inspector</th>
<th>Project Name</th>
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<th>Instructions</th>
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<td>Steven Havens</td>
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<tr>
<td>Infinity Phone Number</td>
<td>Infinity Email</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(702) 449-1479</td>
<td><a href="mailto:Lvhavens@gmail.com">Lvhavens@gmail.com</a></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SAMPLE ID</th>
<th>MATERIAL DESCRIPTION</th>
<th>SAMPLE LOCATION</th>
<th>SAMPLE NOTES</th>
</tr>
</thead>
<tbody>
<tr>
<td>POS 30 - PW - 01</td>
<td>Wall Surfacing and Plaster</td>
<td>North Wall in Room 30</td>
<td></td>
</tr>
<tr>
<td>POS 30 - PW - 02</td>
<td>Wall Surfacing and Plaster</td>
<td>South Wall in Room 30</td>
<td></td>
</tr>
<tr>
<td>POS 30 - PW - 03</td>
<td>Wall Surfacing and Plaster</td>
<td>West Wall in Room 30</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>MATERIAL</th>
<th>CONDITION</th>
<th>UNITS</th>
<th>ASBESTOS</th>
</tr>
</thead>
<tbody>
<tr>
<td>PFI - Pipe Fitting Insulation</td>
<td>FT - Floor Tile</td>
<td>WT - Wall Texture</td>
<td>LF - Linear Ft</td>
</tr>
<tr>
<td>PPI - Pipe Part Insulation</td>
<td>FTM - Floor Tile Mastic</td>
<td>WP - Wall Plaster</td>
<td>SF - Square Ft</td>
</tr>
<tr>
<td>PEI - Pipe Elbow Insulation</td>
<td>SF - Sheet Flooring</td>
<td>DW - Drywall</td>
<td>CF - Cubic Ft</td>
</tr>
<tr>
<td>PI - Pipe Insulation</td>
<td>CB - Cove Base</td>
<td>JC - Joint Compound</td>
<td>A - Asbestos</td>
</tr>
<tr>
<td>TSI - Thermal System Insulation</td>
<td>CBM - Cove Base Adhesive</td>
<td>RM - Roofing Material</td>
<td>Ch - Chrysotile</td>
</tr>
<tr>
<td>FP - Fire Proofing</td>
<td>ACT - Acoustical Ceiling Tile</td>
<td>S - Stucco</td>
<td></td>
</tr>
<tr>
<td>BI - Boiler Insulation</td>
<td>ACS - Acoustical Ceiling Paint</td>
<td>X - Miscellaneous Debris</td>
<td></td>
</tr>
</tbody>
</table>

Reconciled By: Steven Havens

Date/Time: 10-20-15 8:30 AM

Reconciled By: William

Date/Time: 10-20-15 8:30 AM

Received By: William

Date/Time: 10-20-15 8:30 AM
# Bulk Asbestos Analysis

(EPA Method 600/R-93-116, Visual Area Estimation)

### Sample Details

- **Client ID:** L1234
- **Report Number:** B212087
- **Date Received:** 10/20/15
- **Date Analyzed:** 10/20/15
- **Date Printed:** 10/20/15
- **First Reported:** 10/20/15

- **Job ID/Site:** 15-0531-01, EPA-POS Building, UNLV
- **Total Samples Submitted:** 3
- **Total Samples Analyzed:** 3

- **Date(s) Collected:** 10/19/2015

<table>
<thead>
<tr>
<th>Sample ID</th>
<th>Lab Number</th>
<th>Asbestos Type</th>
<th>Percent in Layer</th>
<th>Asbestos Type</th>
<th>Percent in Layer</th>
<th>Asbestos Type</th>
<th>Percent in Layer</th>
</tr>
</thead>
<tbody>
<tr>
<td>POS 30-PW-01</td>
<td>01105520</td>
<td>ND</td>
<td></td>
<td>ND</td>
<td></td>
<td>ND</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Total Composite Values of Fibrous Components:</td>
<td>Asbestos (ND)</td>
<td>Cellulose (Trace)</td>
<td></td>
<td>Comment: North Wall in Room 30</td>
<td></td>
</tr>
<tr>
<td>POS 30-PW-02</td>
<td>01105521</td>
<td>ND</td>
<td></td>
<td>ND</td>
<td></td>
<td>ND</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Total Composite Values of Fibrous Components:</td>
<td>Asbestos (ND)</td>
<td>Cellulose (Trace)</td>
<td></td>
<td>Comment: South Wall in Room 30</td>
<td></td>
</tr>
<tr>
<td>POS 30-PW-03</td>
<td>01105522</td>
<td>ND</td>
<td></td>
<td>ND</td>
<td></td>
<td>ND</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Total Composite Values of Fibrous Components:</td>
<td>Asbestos (ND)</td>
<td>Cellulose (Trace)</td>
<td></td>
<td>Comment: West Wall in Room 30</td>
<td></td>
</tr>
</tbody>
</table>

---

Rachel Kolberg, Laboratory Analyst, Las Vegas Laboratory

Note: Limit of Quantification (LOQ) = 1%. 'Trace' denotes the presence of asbestos below the LOQ. 'ND' = 'None Detected'.

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**Infinity Environmental Services, LLC**  
9594 Newton Grove Court, Las Vegas, Nevada 89148

**MATERIAL DATA**  
**CHAIN OF CUSTODY FORM**

<table>
<thead>
<tr>
<th>infinity Inspector</th>
<th>Project Name</th>
<th>Project Number</th>
<th>Date Sampled</th>
<th>Instructions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Steven Havens</td>
<td>EPA - POS Building</td>
<td>15-0531-01</td>
<td>10-21-15</td>
<td></td>
</tr>
<tr>
<td>Infinity Contact</td>
<td>Project Location</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Steven Havens</td>
<td>UNLV</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Infinity Phone Number</td>
<td>Infinity Email</td>
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<td></td>
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</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SAMPLE ID</th>
<th>MATERIAL DESCRIPTION</th>
<th>SAMPLE LOCATION</th>
<th>SAMPLE NOTES</th>
</tr>
</thead>
<tbody>
<tr>
<td>POS - PW - 04</td>
<td>Wall Surfacing, Plaster</td>
<td>West Side of Room 15</td>
<td></td>
</tr>
<tr>
<td>POS - PW - 05</td>
<td>Wall Surfacing, Plaster</td>
<td>South Side of Room 15</td>
<td></td>
</tr>
<tr>
<td>POS - PW - 06</td>
<td>Wall Surfacing, Plaster</td>
<td>East Side of Room 15</td>
<td></td>
</tr>
</tbody>
</table>

**MATERIAL**

<table>
<thead>
<tr>
<th>MATERIAL</th>
<th>CONDITION</th>
<th>UNITS</th>
<th>ASBESTOS</th>
</tr>
</thead>
<tbody>
<tr>
<td>PFI - Pipe Fitting Insulation</td>
<td>FT - Floor Tile</td>
<td>WT - Wall Texture</td>
<td>G - Good (No maintenance is required currently) &lt;10%</td>
</tr>
<tr>
<td>PPI - Pipe Part Insulation</td>
<td>FTM - Floor Tile Mastic</td>
<td>WP - Wall Plaster</td>
<td>D - Damaged (Some repair needed)</td>
</tr>
<tr>
<td>PET - Pipe Elbow Insulation</td>
<td>SF - Sheet Flooring</td>
<td>DW - Drywall</td>
<td>SD - Significantly Damaged (Repair or replace ASAP)</td>
</tr>
<tr>
<td>PI - Pipe Insulation</td>
<td>CB - Cove Base</td>
<td>JC - Joint Compound</td>
<td></td>
</tr>
<tr>
<td>FSI - Thermal System Insulation</td>
<td>CEM - Cove Base Adhesive</td>
<td>RM - Roofing Material</td>
<td></td>
</tr>
<tr>
<td>FP - Fire Proofing</td>
<td>ACT - Acoustical Ceiling Tile</td>
<td>S - Stucco</td>
<td></td>
</tr>
<tr>
<td>BI - Boiler Insulation</td>
<td>ACS - Acoustical Ceiling Spray</td>
<td>X - Miscellaneous Debris</td>
<td></td>
</tr>
</tbody>
</table>

Reinlquished By: Steven Havens  
Date/Time: 10-25-15  
Date/Time: 10-25-15  
Received By: 10-22-15 9:55am
Bulk Asbestos Analysis  
(EPA Method 600/R-93-116, Visual Area Estimation)

Infinity Environmental Services  
Steve Havens  
9594 Newton Grove Court  
Las Vegas, NV 89148

Client ID: L1234  
Report Number: B212212  
Date Received: 10/22/15  
Date Analyzed: 10/22/15  
Date Printed: 10/30/15  
First Reported: 10/22/15

Job ID/Site: 15-0531-01, EPA-POS Building, UNLV  
FALI Job ID: L1234  
Total Samples Submitted: 3  
Total Samples Analyzed: 3

<table>
<thead>
<tr>
<th>Sample ID</th>
<th>Lab Number</th>
<th>Asbestos Type</th>
<th>Percent in Layer</th>
<th>Asbestos Type</th>
<th>Percent in Layer</th>
<th>Asbestos Type</th>
<th>Percent in Layer</th>
</tr>
</thead>
<tbody>
<tr>
<td>POS-PW-04</td>
<td>01105857</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Layer: Off-White Plaster</td>
<td>ND</td>
<td>Layer: White Non-Fibrous Material</td>
<td>ND</td>
<td>Layer: Paint</td>
<td>ND</td>
<td>Total Composite Values of Fibrous Components: Asbestos (ND)</td>
<td></td>
</tr>
<tr>
<td>Cellulose (5 %)</td>
<td>Comment: West Side of Room 15</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>POS-PW-05</td>
<td>01105858</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Layer: Off-White Plaster</td>
<td>ND</td>
<td>Layer: White Non-Fibrous Material</td>
<td>ND</td>
<td>Layer: Paint</td>
<td>ND</td>
<td>Total Composite Values of Fibrous Components: Asbestos (ND)</td>
<td></td>
</tr>
<tr>
<td>Cellulose (20 %)</td>
<td>Fibrous Glass (10 %)</td>
<td>Comment: South Side of Room 15. Identified as &quot;Wall Surfacing, Plaster&quot; on COC</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>POS-PW-06</td>
<td>01105859</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Layer: Off-White Plaster</td>
<td>ND</td>
<td>Layer: White Non-Fibrous Material</td>
<td>ND</td>
<td>Layer: Paint</td>
<td>ND</td>
<td>Total Composite Values of Fibrous Components: Asbestos (ND)</td>
<td></td>
</tr>
<tr>
<td>Cellulose (5 %)</td>
<td>Comment: East Side of Room 15</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Rachel Kolberg, Laboratory Analyst, Las Vegas Laboratory

Note: Limit of Quantification ('LOQ') = 1%. 'Trace' denotes the presence of asbestos below the LOQ. 'ND' = 'None Detected'.

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STATE OF NEVADA
DEPARTMENT OF BUSINESS AND INDUSTRY
DIVISION OF INDUSTRIAL RELATIONS
Occupational Safety and Health Administration
Asbestos Control Program

\[\checkmark\]

Certifies That Steven Havens
Infinity Environmental Services LLC
is Licensed As Asbestos Abatement Consultant

License No. IM-472 Expiration Date 06/23/2016
Signature Of Licensee

\[\text{Signature}\]
November 3, 2015

Mr. Santiago Vila
Amec Foster Wheeler Environment & Infrastructure, Inc.
4021 Stirrup Creek Drive, Suite 100
Durham, NC  27703

Subject: **Asbestos Consulting Services**
EPA Harmon Avenue Complex
Quality Assurance Laboratory (QAL) Building
Asbestos Samples Collected - Rooms 18, 21, and 4
Asbestos Inspections Without Sampling - Rooms 20, 22, and 25
944 East Harmon Avenue
Las Vegas, Nevada

Dear Mr. Vila:

In accordance with your request and authorization of services under the *Short Form Laboratory Services Subcontract Agreement* dated September 8, 2015, Infinity Environmental Services, LLC (Infinity) of Las Vegas, Nevada, collected twenty-one bulk samples of suspect asbestos containing building materials samples on October 19, 2015 from the above mentioned rooms of the subject building located in Las Vegas, Nevada. Mr. Steven Havens, the owner of Infinity and a Nevada licensed asbestos abatement consultant (building inspector), conducted the sampling survey. The suspect asbestos containing materials (ACMs) homogenous areas identified and sampled during the course of our investigation consisted of the following: 1" x 1" ceramic floor tiles with black mastic, ceramic floor tile grout, thin set concrete (located under the ceramic floor tiles), 12" x 12" floor tiles with yellow mastic, and 9" x 9" floor tiles with black mastic.

The samples were analyzed by Forensic Analytical Laboratories, Inc. (FALI) located in Las Vegas, Nevada. FALI is accredited under the National Voluntary Laboratory Accreditation Program (NVLAP) for asbestos analysis. The samples submitted for primary testing were analyzed by Polarized Light Microscopy (PLM). The analytical report is enclosed.
The results of our survey and the laboratory analyses are summarized as follows:

<table>
<thead>
<tr>
<th>Sample ID</th>
<th>Sampling Locations and Materials Sampled</th>
<th>Laboratory Results</th>
</tr>
</thead>
</table>
| QAL 18 - CT - 01 | Room 18, Middle of the Floor:  
Layer 1: 1" x 1" Burgundy with White Spots Ceramic  
Layer 2: Black Mastic | Layer 1: ND      
Layer 2: ND |
| QAL 18 - CT - 02 | Room 18, Middle of the Floor:  
Layer 1: 1" x 1" Burgundy with White Spots Ceramic  
Layer 2: Black Mastic | Layer 1: ND      
Layer 2: ND |
| QAL 18 - CT - 03 | Room 18, Middle of the Floor:  
Layer 1: 1" x 1" Burgundy with White Spots Ceramic  
Layer 2: Black Mastic | Layer 1: ND      
Layer 2: ND |
| QAL 18 - CT - 04 | Room 18, Under the Cabinet:  
Layer 1: 1" x 1" Dark Brown with White Spots Ceramic  
Layer 2: Black Mastic  
Layer 3: Off-White Woven Material  
Layer 4: Red-Brown Grout | Layer 1: ND      
Layer 2: ND      
Layer 3: ND      
Layer 4: ND |
| QAL 18 - CT - 05 | Room 18, Under the Cabinet:  
Layer 1: 1" x 1" Dark Brown with White Spots Ceramic  
Layer 2: Black Mastic  
Layer 3: Off-White Woven Material  
Layer 4: Red-Brown Grout | Layer 1: ND      
Layer 2: ND      
Layer 3: ND      
Layer 4: ND |
| QAL 18 - CT - 06 | Room 18, Under the Cabinet:  
Layer 1: 1" x 1" Dark Brown with White Spots Ceramic  
Layer 2: Black Mastic  
Layer 3: Off-White Woven Material  
Layer 4: Red-Brown Grout | Layer 1: ND      
Layer 2: ND      
Layer 3: ND      
Layer 4: ND |
| QAL 18 - TG - 07 | Room 18, Middle of the Floor: Ceramic Floor Tile Grout  
Grey Grout | ND |
| QAL 18 - TG - 08 | Room 18, Middle of the Floor: Ceramic Floor Tile Grout  
Grey Grout | ND |
| QAL 18 - TG - 09 | Room 18 , Middle of the Floor: Ceramic Floor Tile Grout  
Grey Grout | ND |
<table>
<thead>
<tr>
<th>Sample ID</th>
<th>Sampling Locations and Materials Sampled</th>
<th>Laboratory Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>QAL 18 - TC - 10</td>
<td>Room 18, Middle of the Floor, Under the Ceramic Floor Tile: Thin Set Concrete Tan Cementitious Material</td>
<td>ND</td>
</tr>
<tr>
<td>QAL 18 - TC - 11</td>
<td>Room 18, Middle of the Floor, Under the Ceramic Floor Tile: Thin Set Concrete Tan Cementitious Material</td>
<td>ND</td>
</tr>
<tr>
<td>QAL 18 - TC - 12</td>
<td>Room 18, Middle of the Floor, Under the Ceramic Floor Tile: Thin Set Concrete Tan Cementitious Material</td>
<td>ND</td>
</tr>
<tr>
<td>QAL 21 - FT - 13</td>
<td>Room 21:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Layer 1: Grey/White Sheet Flooring</td>
<td>Layer 1: ND</td>
</tr>
<tr>
<td></td>
<td>Layer 2: Fibrous Backing Non-Fibrous</td>
<td>Layer 2: ND</td>
</tr>
<tr>
<td></td>
<td>Layer 3: Yellow Mastic</td>
<td>Layer 3: ND</td>
</tr>
<tr>
<td></td>
<td>Layer 4: 12&quot; x 12&quot; White Floor Tile</td>
<td>Layer 4: ND</td>
</tr>
<tr>
<td></td>
<td>Layer 5: Yellow Mastic</td>
<td>Layer 5: ND</td>
</tr>
<tr>
<td></td>
<td>Layer 6: Off-White Backing Non-Fibrous</td>
<td>Layer 6: ND</td>
</tr>
<tr>
<td>QAL 21 - FT - 14</td>
<td>Room 21:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Layer 1: Grey/White Sheet Flooring</td>
<td>Layer 1: ND</td>
</tr>
<tr>
<td></td>
<td>Layer 2: Fibrous Backing Non-Fibrous</td>
<td>Layer 2: ND</td>
</tr>
<tr>
<td></td>
<td>Layer 3: Yellow Mastic</td>
<td>Layer 3: ND</td>
</tr>
<tr>
<td></td>
<td>Layer 4: 12&quot; x 12&quot; White Floor Tile</td>
<td>Layer 4: ND</td>
</tr>
<tr>
<td></td>
<td>Layer 5: Yellow Mastic</td>
<td>Layer 5: ND</td>
</tr>
<tr>
<td></td>
<td>Layer 6: Off-White Backing Non-Fibrous</td>
<td>Layer 6: ND</td>
</tr>
<tr>
<td>QAL 21 - FT - 15</td>
<td>Room 21:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Layer 1: Grey/White Sheet Flooring</td>
<td>Layer 1: ND</td>
</tr>
<tr>
<td></td>
<td>Layer 2: Fibrous Backing Non-Fibrous</td>
<td>Layer 2: ND</td>
</tr>
<tr>
<td></td>
<td>Layer 3: Yellow Mastic</td>
<td>Layer 3: ND</td>
</tr>
<tr>
<td></td>
<td>Layer 4: 12&quot; x 12&quot; White Floor Tile</td>
<td>Layer 4: ND</td>
</tr>
<tr>
<td></td>
<td>Layer 5: Yellow Mastic</td>
<td>Layer 5: ND</td>
</tr>
<tr>
<td></td>
<td>Layer 6: Off-White Backing Non-Fibrous</td>
<td>Layer 6: ND</td>
</tr>
<tr>
<td>QAL 21 - FT - 16</td>
<td>Room 21:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Layer 1: 12&quot; x 12&quot; Black Floor Tile</td>
<td>Layer 1: ND</td>
</tr>
<tr>
<td></td>
<td>Layer 2: Yellow Mastic</td>
<td>Layer 2: ND</td>
</tr>
<tr>
<td>Sample ID</td>
<td>Sampling Locations and Materials Sampled</td>
<td>Laboratory Results</td>
</tr>
<tr>
<td>--------------</td>
<td>----------------------------------------------------------------------------------</td>
<td>------------------------------------</td>
</tr>
</tbody>
</table>
| QAL 21 - FT - 17 | Room 21:  
Layer 1: 12" x 12" Black Floor Tile  
Layer 2: Yellow Mastic                                                                  | Layer 1: ND  
Layer 2: ND                                      |
| QAL 21 - FT - 18 | Room 21:  
Layer 1: 12" x 12" Black Floor Tile  
Layer 2: Yellow Mastic                                                                  | Layer 1: ND  
Layer 2: ND                                      |
| QAL 4 - FT - 19  | Room 4, Middle of the Floor:  
Layer 1: 9" x 9" Grey and White Floor Tile  
Layer 2: Black Mastic                                                                     | Layer 1: 2% Chrysotile  
Layer 2: 7% Chrysotile                             |
| QAL 4 - FT - 20  | Room 4, Middle of the Floor:  
Layer 1: 9" x 9" Grey and White Floor Tile  
Layer 2: Black Mastic                                                                     | Layer 1: 2% Chrysotile  
Layer 2: 7% Chrysotile                             |
| QAL 4 - FT - 21  | Room 4, Under the Cabinet:  
Layer 1: 9" x 9" Grey and White Floor Tile  
Layer 2: Black Mastic                                                                     | Layer 1: 2% Chrysotile  
Layer 2: 7% Chrysotile                             |

ND = No Asbestos was Detected in the Sample and/or Layer Collected

Current EPA standards define an ACM as... “any material containing asbestos in excess of one percent (>1%) by weight”.

Based on the laboratory results and our survey, the laboratory is reporting the samples collected from the 9" x 9" floor tile with black mastic were found to contain in excess of one percent (>1%) asbestos by weight.

The Category II Non Friable and Non Regulated ACM floor tile with black mastic must be abated by a Nevada licensed asbestos abatement contractor in order to comply with Federal, State, and County regulations. After the ACMs have be abated from the subject building, a third party visual and air clearance assessment should be performed by a Nevada OSHA licensed Asbestos Abatement Consultant in order to comply with Nevada Occupational Safety and Health Enforcement Section (OSHES) and Clark County of Air Quality (CCDAQ) regulations.

OSHA regulates worker exposure to airborne asbestos fibers with Permissible Exposure Limits (PELs), and requires that, when disturbing materials containing asbestos, specific work practices and procedures shall be in accordance with 29 CFR 1926.1101. The State of Nevada OSHES protects building occupants and workers from airborne asbestos exposure.
Nevada OSHES and CCDAQ asbestos regulations should be understood and followed during any disturbance of ACMs identified. CCDAQ enforces the EPA NESHAP for asbestos which prohibits visible emissions of asbestos and requires proper disposal of ACM.

Regarding the removal of ACMs found at the subject building, the following steps are recommended to maintain regulatory compliance and minimize liability:

1. A qualified asbestos abatement contractor and workers licensed in the State of Nevada should perform any actions involving the removal of ACMs. Removal activities should conform to local, state, and federal laws, ordinances, and regulations.

2. A qualified asbestos abatement consultant licensed in the State of Nevada should be retained to perform a final visual and air clearance assessment after the abatement activities are performed.

3. Prior to any renovation/demolition activities, notification of the governing agencies (i.e., Nevada OSHES, USEPA, and CCDAQ) regulating the abatement of asbestos will be necessary.

Rooms Inspected Without Sampling:

QAL 20 - Concrete floor with an epoxy paint covering.

QAL 22 - Concrete floor with an epoxy paint covering.

QAL 25 - Concrete floor with an epoxy paint covering.

No potential ACMs (i.e. sheet flooring, floor tile, mastic, etc.) were observed in these rooms.
Lead Based Paint Survey:

On October 16, 2015, UNLV performed a survey of the ceramic floor tiles located in room 18 of the QAL building with the use of a Fluorescent X-Ray (XRF).

The results of the XRF lead identification survey are summarized as follows:

<table>
<thead>
<tr>
<th>Date</th>
<th>Readings</th>
<th>Mode</th>
<th>Pb</th>
<th>Pb +/-</th>
</tr>
</thead>
<tbody>
<tr>
<td>16-Oct-15</td>
<td>BAL 03 soil standard</td>
<td>Soil</td>
<td>76</td>
<td>9</td>
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<tr>
<td>16-Oct-15</td>
<td>Tile 1</td>
<td>Soil</td>
<td>66</td>
<td>18</td>
</tr>
<tr>
<td>16-Oct-15</td>
<td>Tile 2</td>
<td>Soil</td>
<td>63</td>
<td>17</td>
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<tr>
<td>16-Oct-15</td>
<td>Tile 3</td>
<td>Soil</td>
<td>&lt;LOD</td>
<td>44</td>
</tr>
<tr>
<td>16-Oct-15</td>
<td>Tile 4</td>
<td>Soil</td>
<td>85</td>
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<td>16-Oct-15</td>
<td>Tile 5</td>
<td>Soil</td>
<td>42</td>
<td>13</td>
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<tr>
<td>16-Oct-15</td>
<td>Tile 6</td>
<td>Soil</td>
<td>53</td>
<td>14</td>
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<tr>
<td>16-Oct-15</td>
<td>Tile 3 duplicate</td>
<td>Soil</td>
<td>57</td>
<td>17</td>
</tr>
</tbody>
</table>

Tiles 1 through 4 are medium red tiles covering the main floor
Tiles 5 and 6 are dark red tiles from under the counter

Lead in Ceramic Tile Findings:

The XRF results indicated lead in the tiles sampled in room 18. Removal or disturbance of material with any detectable amount of lead must be handled in accordance with OSHA regulation 29 CFR 1923.62. Therefore, "negative" XRF readings i.e. those below the HUD/EPA definition of what constitutes Lead (1.0 mg/cm²) DO NOT relieve contractors from performing exposure assessments (personal air monitoring) on their employees per the OSHA Permissible Exposure Limit (PEL) depending on the work activities.

During the removal of the subject ceramic floor tiles, extreme care should be used in not allowing the tiles to be broken. The tiles should be kept adequately wet during removal to help alleviate as much dust as possible.
After the tiles have been removed and placed in the proper disposal container, a TCLP test on the waste should be performed by a Nevada Certified Environmental Manager (CEM) to determine the proper disposal method.

**Disclaimer**

The sampling of the subject ceramic tiles was performed by an employee of UNLV and was not contracted by Infinity to perform the XRF testing. It should be noted that Infinity does not hold a license for the testing of lead containing materials. Therefore, Infinity should not accountable for the testing results outlined in this report.

This report is for the use of Amec Foster Wheeler Environment & Infrastructure, Inc., Booz Allen Hamilton, Inc., and the Environmental Protection Agency as it applies to the above mentioned building in Las Vegas, Nevada. Infinity is not responsible for any claims or damages associated with interpretation of available information. This assessment should not be regarded as a guarantee that no further asbestos, beyond that which was suspected to be present (and sampled) during our investigation, is present at the property. In addition, asbestos is usually not distributed uniformly throughout a material and Infinity cannot guarantee that the areas sampled are exactly as represented throughout the property.

We thank you for this opportunity to be of service. If you have any questions regarding the information provided in this report, please call the undersigned.

Sincerely,

Infinity Environmental Services, LLC

[Signature]

Steven Havens  
Owner  
Nevada Asbestos Abatement Consultant License No. IM-472

Encl: Infinity, Material Data Chain of Custody Form, Asbestos Forensic Analytical, Laboratory Report, Asbestos Asbestos Abatement Consultant License Asbestos Site Sampling Map XRF Sampling Results Table and Photograph Provided by UNLV
<table>
<thead>
<tr>
<th>SAMPLE ID</th>
<th>MATERIAL DESCRIPTION</th>
<th>SAMPLE LOCATION</th>
<th>SAMPLE NOTES</th>
</tr>
</thead>
<tbody>
<tr>
<td>QAL 18 - CT - 01</td>
<td>1&quot; x 1&quot; Burgundy with White Spots Ceramic Floor Tile with Black Mastic</td>
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<td>QAL 18 - CT - 02</td>
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<td>QAL 18 - TG - 07</td>
<td>Gray Ceramic Floor Tile Grout</td>
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# Material Data

## Chain of Custody Form

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<th>Infinity Inspector</th>
<th>Project Name</th>
<th>Project Number</th>
<th>Date Sampled</th>
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</thead>
<tbody>
<tr>
<td>Steven Havens</td>
<td>EPA - QAL Building</td>
<td>15-0531-01</td>
<td>10-19-15</td>
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<table>
<thead>
<tr>
<th>Infinity Contact</th>
<th>Project Location</th>
<th>Analysis Type</th>
<th>Instructions:</th>
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<tbody>
<tr>
<td>Steven Havens</td>
<td>UNLV</td>
<td>Asbestos Bulk (PLM)</td>
<td>Same Day</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Infinity Phone Number</th>
<th>Infinity Email</th>
<th>Turn Around Time</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>(702) 449-1479</td>
<td><a href="mailto:Lvhavens@gmail.com">Lvhavens@gmail.com</a></td>
<td>Same Day</td>
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## Sample ID

<table>
<thead>
<tr>
<th>SAMPLE ID</th>
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<td>Gray Ceramic Floor Tile Grout</td>
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<tr>
<td>QAL 18 - TG - 09</td>
<td>Gray Ceramic Floor Tile Grout</td>
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<td>QAL 18 - TC - 10</td>
<td>Thin Set Concrete</td>
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<tr>
<td>QAL 18 - TC - 11</td>
<td>Thin Set Concrete</td>
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</tr>
<tr>
<td>QAL 18 - TC - 12</td>
<td>Thin Set Concrete</td>
<td>Under the Ceramic Tiles Middle of Room 18</td>
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<tr>
<td>QAL 21 - FT - 13</td>
<td>Gray and White Sheet Flooring over 12&quot; x 12&quot; White Floor Tile over Yellow Mastic</td>
<td>Room 21</td>
<td>The Sheet Flooring was Located Throughout the Room</td>
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<tr>
<td>QAL 21 - FT - 14</td>
<td>Gray and White Sheet Flooring over 12&quot; x 12&quot; White Floor Tile over Yellow Mastic</td>
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<tr>
<td>QAL 21 - FT - 15</td>
<td>Gray and White Sheet Flooring over 12&quot; x 12&quot; White Floor Tile over Yellow Mastic</td>
<td>Room 21</td>
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## Materials

<table>
<thead>
<tr>
<th>MATERIAL</th>
<th>CONDITION</th>
<th>UNITS</th>
<th>ASBESTOS</th>
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<tbody>
<tr>
<td>PFI - Pipe Fitting Insulation</td>
<td>FT - Floor Tile</td>
<td>WT - Wall Texture</td>
<td>LP - Linear Ft</td>
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<tr>
<td>PFI - Pipe Fitting Insulation</td>
<td>FTM - Floor Tile Mastic</td>
<td>WP - Wall Plaster</td>
<td>SF - Square Ft</td>
</tr>
<tr>
<td>PPI - Pipe Insulation</td>
<td>SF - Sheet Flooring</td>
<td>DW - Drywall</td>
<td>CF - Cubic Ft</td>
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<tr>
<td>PI - Pipe Insulation</td>
<td>CB - Cove Base</td>
<td>JC - Joint Compound</td>
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</tr>
<tr>
<td>TSI - Thermal System Insulation</td>
<td>CBM - Cove Base Adhesive</td>
<td>RN - Roofing Material</td>
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</tr>
<tr>
<td>FPI - Fire Proofing</td>
<td>ACT - Acoustical Ceiling Tile</td>
<td>S - Stucco</td>
<td></td>
</tr>
<tr>
<td>BI - Boiler Insulation</td>
<td>ACS - Acoustical Ceiling Spray</td>
<td>X - Miscellaneous Debris</td>
<td></td>
</tr>
</tbody>
</table>

**Reinquished By:** Steven Havens

**Date/Time:** 10-20-15

**Received By:** 10/22/15 8:30 AM
## Infinity Environmental Services, LLC

9594 Newton Grove Court, Las Vegas, Nevada 89148

### MATERIAL DATA

**CHAIN OF CUSTODY FORM**

<table>
<thead>
<tr>
<th>Infinity Inspector</th>
<th>Project Name</th>
<th>Project Number</th>
<th>Date Sampled</th>
<th>Instructions:</th>
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<tr>
<td>Steven Havens</td>
<td>EPA - OAL Building</td>
<td>15-0531-01</td>
<td>10-19-15</td>
<td>Turn Around Time: Same Day</td>
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<table>
<thead>
<tr>
<th>Infinity Contact</th>
<th>Project Location</th>
<th>Analysis Type</th>
<th>Sample Notes</th>
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<tbody>
<tr>
<td>Steven Havens</td>
<td>UNLV</td>
<td>Asbestos Bulk (PLM)</td>
<td>The Gray and White Sheet Flooring was Located over the Floor Tile</td>
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### SAMPLE ID

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<tr>
<th>SAMPLE ID</th>
<th>MATERIAL DESCRIPTION</th>
<th>SAMPLE LOCATION</th>
<th>Notes</th>
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<td>Room 21</td>
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<tr>
<td>QAL 21 - FT - 17</td>
<td>12&quot; x 12&quot; Black Floor Tile with Yellow Mastic</td>
<td>Room 21</td>
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<tr>
<td>QAL 21 - FT - 18</td>
<td>12&quot; x 12&quot; Black Floor Tile with Yellow Mastic</td>
<td>Room 21</td>
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<tr>
<td>QAL 4 - FT - 19</td>
<td>9&quot; x 9&quot; Gray and White Floor Tile with Black Mastic</td>
<td>Middle of the Floor in Room 4</td>
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<td>9&quot; x 9&quot; Gray and White Floor Tile with Black Mastic</td>
<td>Middle of the Floor in Room 4</td>
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<td>QAL 4 - FT - 21</td>
<td>9&quot; x 9&quot; Gray and White Floor Tile with Black Mastic</td>
<td>Under the cabinet in Room 4</td>
<td></td>
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### MATERIAL

<table>
<thead>
<tr>
<th>MATERIAL</th>
<th>CONDITION</th>
<th>UNITS</th>
<th>ASBESTOS</th>
</tr>
</thead>
<tbody>
<tr>
<td>PFI - Pipe Fitting Insulation</td>
<td>FT - Floor Tile</td>
<td>WT - Wall Texture</td>
<td>G - Good (No maintenance is required currently) &lt;10%</td>
</tr>
<tr>
<td>PPI - Pipe Part Insulation</td>
<td>FTM - Floor Tile Mastic</td>
<td>WP - Wall Plaster</td>
<td>D - Damaged (some repair needed)</td>
</tr>
<tr>
<td>PEI - Pipe Elbow Insulation</td>
<td>SF - Sheet Flooring</td>
<td>DW - Drywall</td>
<td>SD - Significantly Damaged (Repair or replace ASAP)</td>
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<tr>
<td>PI - Pipe Insulation</td>
<td>CS - Cove Base</td>
<td>JC - Joint Compound</td>
<td>LF - Linear Ft</td>
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<tr>
<td>TSI - Thermal System Insulation</td>
<td>CSM - Cove Base Adhesive</td>
<td>RM - Roofing Material</td>
<td>SF - Square Ft</td>
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<td>FP - Fire Proofing</td>
<td>ACT - Acoustical Ceiling Tile</td>
<td>S - Stucco</td>
<td>CF - Cubic Ft</td>
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<tr>
<td>Bi - Boiler Insulation</td>
<td>ACS - Acoustical Ceiling Spray</td>
<td>X - Miscellaneous Debris</td>
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<td>Ch = Chrysotile</td>
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**Relinquished By:** Steven Havens  
**Date/Time:** 10-20-15  
**Received By:** 10/01/15
# Bulk Asbestos Analysis

(EPA Method 600/R-93-116, Visual Area Estimation)

**Infinity Environmental Services**  
Steve Havens  
9594 Newton Grove Court  
Las Vegas, NV 89148

**Job ID/Site:** 15-0531-01, EPA-QAL Building, UNLV  
**Date(s) Collected:** 10/19/2015

<table>
<thead>
<tr>
<th>Sample ID</th>
<th>Lab Number</th>
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<th>Percent in Layer</th>
<th>Asbestos Type</th>
<th>Percent in Layer</th>
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<td>Total Composite Values of Fibrous Components:</td>
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STATE OF NEVADA
DEPARTMENT OF BUSINESS AND INDUSTRY
DIVISION OF INDUSTRIAL RELATIONS
Occupational Safety and Health Administration
Asbestos Control Program

Certifies That Steven Havens
Infinity Environmental Services LLC
is Licensed As  Asbestos Abatement Consultant

License No. IM-472  Expiration Date 06/23/2016
Signature Of Licensee
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</table>

Tiles 1 through 4 are medium red tiles covering the main floor, Tiles 5 and 6 are dark red tiles from under the counter.
Tiles 1–4 are from the exposed floor. Tiles 5 and 6 are from under the cabinetry near the sink.
Mounting Installation Plate to Wall (090HSV4, 120HSV4, 180HSV4)

Follow the procedure and best practices below when mounting the indoor unit’s plate to a wall.

Procedure
1. Before installation of the plate, confirm the position the screw types (A or B) between chassis and installation plate.
2. Mount the installation plate horizontally by aligning the centerline using a leveling tool.
3. Use provided screws when mounting the plating.
   - If mounting the unit on concrete wall, use field supplied anchor bolts.
4. Observe the left and right rear piping clearance when drilling into the wall, as shown in Figure 11 (090HSV4, 120HSV4) and Figure 12 (180HSV4).

Note:
Select location carefully. Unit should be anchored to a strong wall to prevent unnecessary vibration.

⚠️ WARNING
- When choosing a location for the wall mount plate, be sure to take into consideration routing of wiring for power outlets within the wall. Contacting wiring can cause serious bodily injury or death.
- Use caution when drilling holes through the walls for the purposes of piping connections. Power wiring can cause serious bodily injury or death.

Refer to “Drilling Piping Hole in the Wall” on page 16 as you follow procedure to install plate.
GENERAL INSTALLATION GUIDELINES

Mounting of Indoor Unit

Drilling Piping Hole in the Wall
Follow the left or right piping clearance recommendations as shown in Figure 9 and 10.
1. Using a 2-5/8 (ø 65mm) inch hole core drill bit, drill a hole at either the right or left side of the wall mounting (Figure 13).
   • The slant of the hole should be 3/16” to 5/16” from level with the slant being upward on the indoor unit side and downward on the outdoor unit side.
2. Finish off the newly drilled hole as shown with bushing and sleeve covering.
   • Sleeve and bushing prevents damage to the tubing/bundling of the piping.

Mounting the Indoor Unit to the Installation Plate
1. Hook the indoor unit onto the upper portion of the installation plate (Figure 14).
2. Engage the hooks at the top of the indoor unit with the upper edge of the installation plate.
   • Ensure that the hooks are properly seated on the installation plate by moving it left and right.
3. Move the bottom of indoor unit towards the installation plate to anchor to wall (Figure 145).
   • It helps to press the lower left and right sides of the unit against the installation plate until the hooks engage into their slots.
   • You will hear a clicking sound as the bottom attaches to the installation plate successfully.
4. Finish by inserting and tightening two type “C” screws into the bottom of the installation plate (Figure 16).
   • Pay attention to the positioning of the piping through any wall as shown in the figure, as you insert the screws to the indoor unit.

Preparing for Piping/Electrical Connection
1. To prepare indoor unit for piping, disengage bottom on indoor unit from installation plate by reversing step 3 from previous procedure.
   • This step will separate the indoor unit’s bottom side from the wall mount in order to route drain hose correctly. See Figure 17 for a reference of the rear view of the indoor unit.
2. Swing drain hose holder (L-bracket) out and anchor as shown in Figure 15, against installation plate.
3. Optionally, go to Refrigerant Piping Connections section of this manual to continue with piping connections to the indoor unit.
4. Optionally, go to Electrical Connections section of this manual to continue with conduit/electrical wiring to the indoor unit.
SECTION 01 32 16

CONSTRUCTION PROGRESS SCHEDULE

PART 1  GENERAL

1.01  SECTION INCLUDES

A. References.
B. Format.
C. Schedules.
D. Submittals.
E. Updating schedules.

1.02  RELATED SECTIONS

A. Section 01 11 00 - Summary of Work.
B. Section 01 26 00 - Contract Modification Procedures.
C. Section 01 29 00 - Payment Procedures.
D. Section 01 33 00 - Submittal Procedures.

1.03  REFERENCES


1.04  FORMAT

A. Listings: Reading from left to right, in ascending order for each activity.
B. Diagram Sheet Size: Maximum Size 30" x 42".
C. Scale and Spacing: To allow for notations and revisions.

1.05  SCHEDULES

A. Prepare progress schedules and supporting mathematical analyses using the Critical Path Method, under concepts and methods outlined in AGC's "The Use of CPM in Construction - A Manual for General Contractors and the Construction Industry".
B. Diagrams to illustrate order and interdependence of activities and sequence of work; how start of a given activity depends on completion of preceding activities, and how completion of the activity may restrain start of subsequent activities.
C. Illustrate complete sequence of construction by activity, using a level of detail the same as, or greater than, the Schedule of Values. Provide dates for submittals, including those for Owner furnished items; dates for procurement and delivery of products, and dates for installation and provision for testing. Provide legend for symbols and abbreviations used.
D. Coordinate contents with Schedule of Values.
E. Schedule shall be resource loaded to include estimated manpower requirements for the duration of the activity.

F. Allocate appropriate estimated time for asbestos and lead paint abatement, in a manner not affecting work renovation completion time.

1.06 SUBMITTALS

A. Submit proposed preliminary schedules prior to the Pre-Construction meeting. Also submit abbreviated schedule short form.

B. Participate in review of preliminary schedules jointly with Owner and Architect.

C. Within fourteen (14) days of Notice to Proceed, submit schedule incorporating all comments from the joint review.

D. Submit updated schedules with each Application for Payment.

E. Submit three (3) copies.

1.07 UPDATING SCHEDULES

A. Maintain schedules to record actual start and finish dates of completed activities.

B. Indicate progress of each activity to date of revision, with projected completion date of each activity. Update diagrams to graphically depict current status of Work.

C. Identify activities modified since previous submittal, major changes in Work, changes associated with Change Orders, and any other identifiable changes.

D. Indicate changes required to maintain Date of Substantial Completion.

E. Provide narrative report to define problem areas, anticipated delays, and impact on schedule. Report corrective action taken, or proposed, and its effect.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

END OF SECTION
SECTION 01 32 33
PHOTOGRAPHIC DOCUMENTATION

PART 1  GENERAL

1.01  SECTION INCLUDES

A. Photography.
B. Camera.
C. Prints.
D. Technique.
E. Submittals.

1.02  RELATED SECTIONS

A. Section 01 29 00 - Payment Procedures.
B. Section 01 33 00 - Submittal Procedures.
C. Section 01 77 00 - Closeout Procedures

1.03  PHOTOGRAPHY

A. Provide photographs of the site before any construction is started and throughout the progress of the Work. Photographs shall be of a quality acceptable to the Owner and Architect.

B. Photographs should be taken within seven (7) days of each monthly Application for Payment and should represent work completed during the period preceding the Application for Payment. Photographs should be taken throughout the progress of the Work, up to and including Substantial Completion. Include as a minimum, the following:
   1. Site clearing.
   2. Excavations.
   3. Foundations.
   4. Structural framing.
   5. Enclosure of building.
   6. Interior views.
   7. Substantial completion.

1.04  CAMERA

A. Digital.

1.05  PRINTS

A. Color; one print of each view.
B. Minimum size: 4 x 6 inches.

1.06  TECHNIQUE

A. Provide factual presentation.
B. Provide correct exposure and focus, high resolution and sharpness, maximum depth of field,
and minimum distortion.

1.07 SUBMITTALS

A. Deliver prints with each Application for Payment.
   1. Prints to be submitted in an 8-1/2” x 11” format.
   2. Each print to be identified with the project name, number, subject/phase of work, orientation of view, approximate time of view, date and the name of the person taking the photo.

B. Pictures will be taken at approximately the same time of the month, each month.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

END OF SECTION
SECTION 01 33 00

SUBMITTAL PROCEDURES

PART 1    GENERAL

1.01  SECTION INCLUDES

A. Procedures.

B. Construction Progress Schedules.

C. Schedule of Values.

D. Manufacturer's Instructions.

1.02  RELATED REQUIREMENTS

A. Section 01 25 13 - Product Substitution Procedures.

B. Section 01 32 16 - Construction Progress Schedule.

C. Section 01 32 33 - Photographic Documentation.

D. Section 01 33 23 - Shop Drawings, Product Data, and Samples.

E. Divisions 3 through 32.

1.03  PROCEDURES

A. Deliver submittals to Architect at address listed in the Project Manual.

B. Transmit each item with a separate submittal routing form.

C. Identify project, contractor, subcontractor, major supplier.

D. Identify pertinent drawing sheet and detail number.

E. Specification section number, and individual product or other descriptive date as appropriate.

F. Identify deviations from contract documents.

G. Coordinate submittals of related items.

1.04  PROGRESS SCHEDULES

A. Submit initial progress schedules in duplicate at the preconstruction meeting. After review by Architect/Owner, revise and resubmit within fourteen (14) days after receipt of the Notice to Proceed. Submit revised schedules with each Application for Payment, reflecting changes since previous submittal.

1.05  SCHEDULE OF VALUES

A. Submit initial Schedule of Values, in duplicate, prior to the Pre-Construction Meeting. After review by the Architect/Owner, revise and resubmit within fourteen (14) days after receipt of Notice to Proceed.
1.06  SCHEDULE OF SUBMITTALS
   A. Submit initial Schedule of Submittals prior to the Pre-Construction Meeting. Schedule shall be in accordance with Section 01 33 23 - Shop Drawings, Product Data and Samples.

1.07  EXPANDED SUBCONTRACTORS AND MATERIAL SUPPLIES LISTING
   A. Submit expanded list of subcontractor's and material suppliers.

1.08  MANUFACTURER’S INSTRUCTIONS
   A. When required in individual Specification Section, submit manufacturer's printed instructions for delivery, storage, assembly, installation start-up, adjusting, and finishing, in quantities specified for product data, in Section 01 33 23.

PART 2  PRODUCTS
Not Used

PART 3  EXECUTION
Not Used

END OF SECTION
SECTION 01 33 23

SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Shop Drawings.
B. Product data.
C. Samples.
D. Contractor review.
E. Submittal requirements.
F. Re-submittals.
G. Architect review.
H. Distribution.

1.02 RELATED SECTIONS

A. Section 01 25 13 - Product Substitution Procedures.
B. Section 01 33 00 - Submittal Procedures.
C. Section 01 66 00 - Product Storage and Handling Requirements.
D. Section 01 77 00 - Closeout Procedures.
E. Divisions 3 through 32

1.03 SHOP DRAWINGS

A. Present in a clear and thorough manner. Title each drawing with Project name and number; identify each element of drawings by reference to sheet number and detail, schedule, or room number of Contract Documents.
B. Identify field dimensions; show relation to adjacent or critical features or work or products.
C. Minimum Sheet Size: multiples of 8-1/2” x 11” inches.
D. Maximum sheet size: 30 x 42 inches.
E. Required Scale: Unless otherwise specifically directed by the Architect, make all shop drawings accurate to a scale sufficiently large to show all pertinent features of the item and its methods of connection to the Work.

1.04 PRODUCT DATA

A. Submit only pages which are pertinent. Mark each copy of standard printed data to identify pertinent products, referenced to Specification Section and Article number. Show reference standards, performance characteristics, and capacities; wiring and piping diagrams and controls; component parts; finishes; dimensions; and required clearances.
B. Modify manufacturer's standard schematic drawings and diagrams to supplement standard information and to provide information specifically applicable to the Work. Delete information not applicable.

1.05 SAMPLES

A. Submit to Architect full range of manufacturer's standard finishes except when more restrictive requirements are specified, indicating colors, textures, and patterns, for Architect selection. All color charts are to be originals (no photo reproduction copies).

B. Submit samples to illustrate functional characteristics of products, including parts and attachments.

C. Approved samples which may be used in the Work are indicated in the specification section.

D. Label each sample with identification required for transmittal letter.

E. Provide field samples of finishes and assemblies at the site, at location acceptable to the Architect, as required by individual specifications section. Install each sample or assembly complete and finished. Acceptable finishes in place may be retained in completed Work.

F. Architect reviewed samples will set the standard by which all Work performed thereafter will be judged.

G. Include electronic photo of all samples with submittal, in addition to the required physical samples.

1.06 CONTRACTOR REQUIREMENTS

A. All submittals shall be made through the General Contractor or be rejected.

B. Transmit submittals for shop drawings, product data and samples in accordance with the accepted Schedule of Submittals and in sequence to avoid delay in Work.

C. Contractor shall not commence any portion of the Work, which requires a shop drawing or sample submission until the submission has been reviewed and returned by the Architect.

D. Review submittals to determine and verify field measurements, field construction criteria, manufacturer's catalog numbers, and conformance of submittal with requirements of Contract Documents.

E. Contractor shall notify the Architect in of any deviations or changes from the requirements included in the Contract Documents. All deviations or changes must be clearly identified by clouding or highlighting and provide a written descript of the deviation or change.

F. Contractor shall schedule submittals so that the Architect has fourteen (14) calendar days after receipt at Architects office to review each submittal.

G. Coordinate submittals with requirements of Work and of Contract Documents.

H. Sign or initial each sheet of shop drawings and product data, and each sample label to certify compliance with requirements of Contract Documents using the Submittal Stamp (illustrated in paragraph 1.07 of this Section).

I. Do not fabricate products or begin Work, which requires a submittal until submittal is returned with Architect's or Engineer's stamp of review.
J. Make any corrections required by the Architect and resubmit the required number of corrected copies of shop drawings or new samples.

K. Contractor shall direct specific attention in writing or on resubmitted shop drawings to revisions other than correction required by the Architect.

L. Contractor shall not use or allow to be used the Contract Documents to be used or reproduced as submittals or any part thereof.

1.07 SUBMITTAL REQUIREMENTS

A. Transmit submittals in accordance with Schedule of Submittals, and in such sequence to avoid delay in the Work.

B. Contractor is solely responsible for coordinating the delivery and pick-up of submittals, including any necessary corrections and re-submittals, to assure that Architect's review can be obtained without delaying the Work.

C. Number submittals consecutively.

D. Each submittal shall allow for a 4 inch x 5 inch blank space for the Submittal Stamp.

E. Contractor shall have prepared and will use the Submittal Stamp exactly as illustrated below.

By making this Submittal No. ___________ (Contractor)

does hereby approve this submittal and certifies that it has determined and verified all materials, field measurements and field construction criteria related thereto, or will do so, and has checked and coordinated the information contained within this submittal with the requirements of the Work and of the contract documents. Contractor further certifies that, to the best of its knowledge, the materials described for this Submittal does not contain any asbestos containing materials.

F. Coordinate submittals into logical groupings to facilitate interrelation of the several items:
   1. Finishes involving Architect’s selection of colors, textures, or patterns.
   2. Associated items that require correlation for efficient function or for installation.
   3. Provide:
      a. All submittals required by a particular section at one time.
      b. Shop drawing, schedules, product data, coordination drawings, samples, color charts and other information required (whether listed or not) for Architects complete evaluation.
   4. Incomplete information or partial submittals shall be cause for rejection.

G. Submit one (1) electronic copy of shop drawings unless otherwise requested.

H. Submit number of samples specified in individual specification sections, but no less than five (5).
1.08  ARCHITECT REQUIREMENTS
   
A. Review shop drawings, product data, and samples and return submittals to the General Contractor.

B. Perform review of each submittal within twelve (12) working days after receipt. Provide written notice to the Contractor should more time be required for evaluation, coordination, and/or review.

C. Extension of review time shall not constitute a basis to automatically extend the Contract Time.

D. Notify the Contractor of any corrections required, include the number of corrected copies of shop drawings or new samples required.

E. Architect shall reject any submittal not made through the General Contractor, and/or not stamped and signed by General Contractor.

1.09  RE-SUBMITTALS
   
A. Re-submittals shall be identified by means of an alphabetical suffix (beginning with A) after original submittal number.

B. Prepare re-submittals under procedures specified for initial submittals; identify changes made since previous submittal.

C. Architect has fourteen (14) working days after receipt at Architects office to review each re-submittal.

1.10  DISTRIBUTION
   
A. Duplicate and distribute reproductions of shop drawings, copies of product data, and samples, which bear Architect stamp of review, to job site file, record documents file, subcontractors, suppliers, and other entities requiring information.

PART 2  PRODUCTS
   
Not Used

PART 3  EXECUTION
   
3.01  SCHEDULE OF SUBMITTALS
   
A. Submit a Schedule of Submittals.

B. Schedule of Submittals shall be prepared in detail, using one line for each item and sorted by specification section.

C. Format shall clearly indicate the following:
   1. Specification section.
   3. Proposed date scheduled to Architect.
   4. Lead times after approval.
D. Format shall indicate if submittal is a shop drawing, product data or sample.

E. Format shall indicate if submittal includes certificates or manufacturer’s literature.

F. Architect shall have acceptance of the proposed Schedule of Submittals.

END OF SECTION
SECTION 01 35 16
ALTERATION PROJECT PROCEDURES

PART 1 GENERAL

1.01 SECTION INCLUDES
A. Products and installation for patching and extending Work
B. Transition and adjustments
C. Repair of damaged surfaces, finishes, and cleaning

1.02 RELATED SECTIONS
A. Section 01 50 00 - Temporary Facilities and Controls.
B. Section 01 73 29 - Cutting and Patching.
C. Section 01 74 13 - Progress Cleaning.
D. Section 01 74 23 - Final Cleaning.
E. Section 02 41 00 - Selective Demolition.

PART 2 PRODUCTS

2.01 PRODUCTS FOR PATCHING AND EXTENDING WORK
A. New Materials: as specified in product sections; match existing products and Work for patching and extending Work.
B. Type and Quality of Existing Products: determine by inspection and testing products where necessary, referring to existing Work as a standard.

PART 3 EXECUTION

3.01 EXAMINATION
A. Verify that hazardous materials, including asbestos and lead, will not be encountered. Notify the Owner before starting any demolition of unknown and additional discovered locations, and as soon as such suspected materials are encountered.
B. Verify that demolition is complete, and areas are ready for installation of new Work.
C. Beginning of restoration Work means acceptance of existing conditions.

3.02 PREPARATION
A. Cut, move, or remove items as necessary for access to alterations and renovation Work. Replace and restore at completion.
B. Remove unsuitable material not marked for salvage, such as rotted wood, corroded metals, and deteriorated masonry and concrete. Replace materials as specified for finished Work.
C. Remove debris and abandoned items from area and from concealed spaces.

D. Prepare surface and remove surface finishes to provide for proper installation of new Work and finishes.

E. Close openings in exterior surfaces to protect existing Work and salvage items from weather and extremes of temperature and humidity. Insulate ductwork and piping to prevent condensation in exposed areas.

3.03 INSTALLATION

A. Coordinate Work of alternations and renovations to expedite completion and to accommodate Owner occupancy.

B. Remove, cut, and patch Work in a manner to minimize damage and to provide a means of restoring products and finishes to original and specified condition.

C. Refinish visible existing surfaces to remain in renovated rooms and spaces, to specified condition for each material, with a neat transition to adjacent finishes.

D. In addition to specified replacement of equipment and fixtures restore existing plumbing, heating, ventilation, air conditioning, and electrical systems to full operational condition.

E. Install products as specified in individual sections.

3.04 TRANSITIONS

A. Where new Work abuts or aligns with existing, perform a smooth and even transition. Patched work to match existing adjacent Work in texture and appearance.

B. When finished surfaces are cut so that a smooth transition with new Work is not possible, terminate existing surface along a straight line at a natural line of division and make recommendation to Owner/ Architect.

3.05 ADJUSTMENTS

A. Where removal of partitions or walls results in adjacent spaces becoming one, rework floors, walls, and ceilings to a smooth plane without breaks, steps, or bulkheads.

B. Where a change of plane of 1/4 inch or more occurs, submit recommendation for providing a smooth transition for Owner/ Architect review and request instructions from Owner/ Architect.

C. Trim existing doors as necessary to clear new floor finish. Refinish trim as required.

D. Fit Work at penetrations of surfaces as specified in Section 01 73 29.

3.06 REPAIR OF DAMAGED SURFACES

A. Patch or replace portions of existing surfaces, which are damaged, lifted, discolored, or showing other imperfections.

B. Repair substrate prior to patching finish.

3.07 FINISHES

A. Finish surfaces as specified in individual product sections.
B. Finish patches to product uniform finish and texture over entire area. When finish cannot be matched, refinish entire surface to nearest intersections.

3.08 CLEANING

A. As specified in Sections 01 74 13 and 01 74 23.

END OF SECTION
SECTION 01 35 26

SAFETY AND ENVIRONMENTAL REQUIREMENTS

PART 1  GENERAL

1.01  SECTION INCLUDES

A.  Submittals.

B.  Laws, Ordinances and Regulations.

C.  Safety and Health.

D.  Safety Representative.

E.  Safety Training.

F.  Emergency Procedures.

G.  Dust Abatement.

H.  Storm Water Permits.

1.02  SUBMITTALS

A.  The Contractor shall submit, within fifteen (15) days following Notice to Proceed, a work-site specific safety program that includes the following:
   1.  A site–specific Injury and Illness Prevention Program (IIPP) covering all work and Contractor and subcontractor employees at the site.
   2.  The name of the Contractor’s on–site safety representative.
   3.  A written Emergency Action and Fire Protection Plan covering all work and Contractor and subcontractor employees at the site.

B.  In addition to the reports that the Contractor is required to file under the provisions of Nevada State Industrial Insurance System, the Contractor shall file a report with the Owner on or before the 10th calendar day of each month giving:
   1.  The total force employed on the Contract in work days during the previous calendar month.
   2.  The number and character of all accidents resulting in loss of time, medical treatment and first aid treatment.
   3.  Any other information or classification of employee injuries received on the work and disabilities resulting there from that may be required by the Owner.

1.03  LAWS, ORDINANCES, AND REGULATIONS

A.  The Contractor shall comply with the Construction Safety Orders and other applicable safety orders described within the Regulations for the Nevada Occupational Safety and Health Enforcement Program and the Nevada Occupational Safety and Health Act, and such other rules, regulations, and laws applicable during the progress of the work.

B.  The Contractor shall have copies of the following at the work site. The required information shall be made available to the Owner for review upon request:
   1.  A copy of the Nevada Occupational Safety and Health Act, and Regulations for the Nevada Occupational Safety and Health Enforcement Program.
   2.  Material Safety Data Sheets for all chemicals or potentially hazardous materials being used or stored at the site.
   3.  Permits as required for the work.
1.04 SAFETY AND HEALTH

A. The Contractor shall have and implement a written site-specific IIPP and Code of Safe Work Practices covering site work to be performed under the Contract. The IIPP shall be in compliance with the specific requirements of the Nevada Occupational Safety and Health Act and Regulations for the Nevada Occupational Safety and Health Enforcement Program.

B. All persons shall be required to wear hard hats and suitable hard soled work shoes in good repair (safety style steel or fiberglass toe shoes are recommended) while at the work site. Sandals, athletic shoes, and other soft footwear may not be worn on the work site.

C. The Contractor’s Emergency Action and Fire Protection Plan shall be in compliance with the specific requirements of 29 CFR Part 1926, §1926.35.

D. The Contractor shall publish an alcohol and drug-free work site policy statement notifying all employees that the unlawful manufacture, distribution, dispensing, possession, or use of alcohol or a controlled substance is prohibited at the work site and specifying the actions that will be taken against employees for violation of such prohibition. Additionally, the Contractor shall publish a “no smoking on the construction site” policy statement notifying all employees that smoking will not be allowed on the construction site.
   1. The Contractor shall report to the Owner any violations of the substance abuse program and the disposition of the violation within 24 hours of Contractor becoming aware of the violation.

E. The Contractor shall be responsible for initiating, maintaining, and supervising all safety precautions and programs in connection with the work.

F. The Contractor shall continually monitor and audit its compliance and adherence with its safety program.

G. The Contractor shall make every effort to ensure the safety of all inspectors and other employees, consultants, and Owner’s personnel. The Contractor shall not permit inspectors, employees, consultants, and agents to enter any unsafe place for the purpose of making inspections, except where an inspection is required to determine if previously detected unsafe conditions have been corrected. Where work is required to be inspected by the Owner and the inspection is not performed due to the existence of an unsafe condition, such work is subject to rejection, or the work may be suspended in accordance with Document AIA A201, Conditions of the contract.

H. When sufficient time is available, the Contractor shall notify the Owner in advance of safety inspections by Nevada or Federal/OSHA, the fire department, or other governmental agencies. The Owner may attend safety inspections when notice is given sufficiently in advance for the Owner to be present. When the Owner is not present during a safety inspection, the Contractor shall immediately report to the Owner that an inspection has taken place, and describe any violations, or citations, and the Contractor’s abatement actions or salient events arising from the inspection.

I. Whenever deficiencies are noted that have not previously been addressed by the Contractor, the Owner will give the Contractor written notice to correct the deficiency. Noted deficiencies shall be corrected immediately upon observation or notification. Where deficiencies cannot be corrected immediately, the Contractor shall develop a corrective action plan outlining the steps to be taken and when each step will be completed. The next working day following the Contractor’s receipt of the notice, the Contractor shall provide the Owner with a written statement either describing the corrective action taken or corrective action plan developed.
1.05 CONTRACTOR'S SAFETY REPRESENTATIVE

A. The Contractor’s designated safety representative shall be on–site when any work is in progress.

B. The Contractor’s safety representative shall have the authority to correct unsafe conditions and unsafe practices, and shall be responsible for directing the required safety programs. The safety representative shall have the authority to suspend work until safe conditions or practices are corrected.

C. The Contractor’s safety representative shall be charged with the responsibility of daily on–site safety coordination and inspections and shall record the results of the inspections on a weekly report. The weekly report shall be submitted to the Owner not later than the first working day following the work week covered by the report.

1.06 SAFETY TRAINING

A. The Contractor shall conduct a meeting with its employees and subcontractor employees on general safe work practices or on a topic from the Contractor's Code of Safe Work Practices weekly. The meetings shall be scheduled on the same day of the week and at a fixed time. A record of the session including who was in attendance and subjects discussed shall be prepared and made available for review by the Owner.

1.07 EMERGENCY PROCEDURES

A. The Contractor shall designate responsible personnel to make emergency calls. Should an emergency occur, the Contractor shall:
   1. Immediately secure the area and implement the Contractor’s emergency action plan.
   2. Notify the Owner or his representative.
   3. Provide information regarding the emergency to the appropriate authorities and authorized Owner representatives only. Questions from others including the press and media shall be referred to the Owner.

B. Emergency procedures shall ensure that the Contractor’s most senior supervisor present takes charge and directs the handling of the emergency.

C. The Contractor shall immediately notify the Owner of the existence of hazardous conditions. However, it shall be the Contractor’s responsibility to take necessary precautions against injury to persons or damage to property from such hazardous conditions until corrected by the responsible party.

1.08 DUST ABATEMENT

A. The Contractor shall furnish all labor, equipment, and means required and shall carry out effective measures wherever and as often as necessary to prevent its operations from causing visible dust emissions from leaving the work areas. These measures shall include, but are not limited to, providing additional watering equipment, reducing vehicle speed on haul roads, restricting traffic on haul roads, and covering haul vehicles. The Contractor shall be responsible for any damage resulting from any dust originating from operations. The dust abatement measures shall be continued for the duration of the contract.

B. The Contractor shall hose down any vehicle or equipment leaving the project area with water prior to entering the public right of way if the vehicles appear to be transporting excessive amounts of dust. When any material or debris is tracked out from the project area, the Contractor shall clean all paved public roads near the site entrances as often as required to prevent spreading of dust by vehicles.

C. The contractor shall furnish the dust control permit.
1.09 STORM WATER PERMITS

A. The Contractor (permittee) shall obtain the storm water permit required by Federal Law under the provisions of the Clean Water Act, as amended, (33 U.S.C. 1251 et seq: the “Act”) for construction activities that disturb one (1) or more acres. Federal law prohibits discharges of pollutants in storm water from construction activities without a National Pollutant Discharge Elimination System (NPDES) Permit; Operator(s) of construction sites where one (1) or more acres are disturbed must submit a Notice of Intent (NOI) to obtain coverage under an NPDES Storm Water Construction General Permit. Any questions should be directed to the Nevada Division of Environmental Protection (NDEP) Bureau of Water Pollution Control, 333 West Nye Lane, Carson City, Nevada 89710, telephone 775-687-4670.

B. All violations and fines will be the responsibility of the Contractor should the Contractor fail to obtain and/or comply with the regulations of the NDEP Storm Water Pollution Prevention Permit.

C. Follow the instructions included in the Storm Water Pollution Prevention Permit (SWPPP) Package available from the NDEP, which can be obtained at the address noted above or on the Storm Water Website at: http://ndep.state.nv.us/bwpc/storm01.htm. In addition the website contains electronic forms for the Notice of Intent and Notice of Termination (NOT) and other valuable information.

1. Submit a NOI to the NDEP, two (2) days prior to the start of construction.
2. Upon submission to the NDEP provide one copy each of the NOI and the Storm Water Pollution Prevention Plan (SWPPP) to the Architect.
3. An authorization letter will be sent by the NDEP to the Contractor (general permit holder) stating the authorization date. Contractor shall comply with any special conditions as required by the NDEP. Upon receipt of the Authorization Letter, forward one copy each to the Architect.
4. By signing the NOI the Contractor certifies that the Contractor’s SWPPP has been completed, and that the SWPPP will be stored and maintained at the Construction site.
5. Continuation of coverage: If project has not reached completion prior to June 30, (Fiscal Year - July 1) a new NOI must be submitted to NDEP. Permittee must include the previously supplied permit I.D. number (3xxxx) with the submittal of the new NOI. All permits must be renewed annually until project is completed. Contractor must submit a new Notice of Intent thirty days prior to the renewal date (Fiscal Year - July 1).

D. Upon completion of the project (final stabilization) the Contractor must submit an NOT to the NDEP.

1. Provide a copy of NOT to the Architect.

E. Implement the approved plan.

1. Include line item in the Schedule of Values indication full value of SPPP practices.
2. Certification of monthly payment for this work is contingent upon successful maintenance of SPPP mitigation practices.

PART 2 PRODUCTS

Not Used
PART 1  GENERAL

1.01  SECTION INCLUDES
A. Quality assurance and control of installation
B. References
C. Inspection and testing laboratory/agency services

1.02  RELATED SECTIONS
A. Section 01 33 00 - Submittal Procedures.
B. Section 01 43 26 - Testing and Inspecting Agency.
C. Section 01 66 00 - Product Storage and Handling Requirements.
D. Section 01 75 10 - Demonstration and Training.

1.03  QUALITY ASSURANCE/CONTROL OF INSTALLATION
A. Monitor quality control over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce Work of specified quality.
B. Comply fully with manufacturers’ instructions, including each step in sequence.
C. Should manufacturers' instructions conflict with Contract Documents, request clarification from the Architect before proceeding.
D. Comply with specified standards as a minimum quality for the Work except when more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.
E. Perform Work by persons qualified to produce workmanship of specified quality.
F. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion or disfigurement.

1.04  REFERENCES
A. Conform to reference standard by date of issue current on date of Contract Documents.
B. Should specified reference standards conflict with Contract Documents, request clarification from the Architect before proceeding.
C. The contractual relationship of the parties to the Contract shall not be altered from the Contract Documents by mention or inference otherwise in any reference document.

1.05  INSPECTION AND TESTING LABORATORY/AGENCY SERVICES
A. Owner will appoint, employ, and pay for services of an independent firm to perform inspection and testing, unless noted otherwise.
B. The independent firm will perform inspections, tests, and other services specified in individual specification sections and as required by the Architect and Owner.

C. Reports will be submitted by the independent firm to the Owner with copies to the Architect, indicating observations and results of tests and indicating compliance or non-compliance with Contract Documents.

D. Cooperate with independent firm; furnish samples of materials, design mix, equipment, tools, storage, copies of equipment and product submittals, performance data, and assistance as requested.
   1. Contractor will notify the Architect and independent firm a minimum of 48 hours prior to expected time for operations requiring services. Contractor to cooperate with the inspector.
   2. Make arrangements with independent firm and pay for additional samples and tests required for Contractor's use.

E. Retesting performed by the independent agency required because of non-conformance to specified requirements or because of lack of preparation preventing testing will be back-charged to the Contractor. Payment due the Owner because of failed testing shall be attained by deducting the testing charges from the Contract Sum.

PART 2  PRODUCTS

Not Used

PART 3  EXECUTION

Not Used

END OF SECTION
PART 1 GENERAL

1.01 SECTION INCLUDES

A. Quality assurance.

B. Schedule of references.

C. Statutory requirements for Construction Contract and subcontracts.

1.02 QUALITY ASSURANCE

A. For products or workmanship specified by association, trade, or Federal Standards, comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable codes.

B. Conform to reference standard by date of issue current on date of Contract Documents unless a date is specified in a product section.

C. Should specified reference standards conflict with Contract Documents, request clarification from Owner before proceeding.

D. The contractual relationship of the parties to the Contract shall not be altered from the Contract Documents by mention or inference otherwise in any reference document.

1.03 SCHEDULE OF REFERENCES

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
</tr>
</thead>
</table>
| AA      | Aluminum Association  
          818 Connecticut Avenue, N.W.; Washington, D.C. 20006 |
| AABC    | Associated Air Balance Council  
          1518 K Street N.W.; Washington, D.C. 20005 |
| AASHTO | American Association of State Highway and Transportation Officials  
          444 North Capitol Street, N.W.; Washington, D.C. 20001 |
| ACI     | American Concrete Institute  
          Box 19150, Redford Station, Detroit, MI 48219 |
| ADA     | American Disability Act  
          1331 F Street, N.W., Washington, D.C. 20004-1111 |
| ADC     | Air Diffusion Council  
          230 North Michigan Avenue; Chicago, IL 60601 |
| AFBMA   | Anti Friction Bearing Manufacturing Association  
          1101 Connecticut Avenue, NW #700, Washington, D.C. 20036 |
| AGC     | Associated General Contractors of America  
          1957 E Street, N.W.; Washington, D.C. 20006 |
| AI      | Asphalt Institute  
          Asphalt Institute Building, College Park, Maryland 20740 |
<table>
<thead>
<tr>
<th>Code</th>
<th>Name</th>
<th>Address</th>
</tr>
</thead>
<tbody>
<tr>
<td>AIA</td>
<td>American Institute of Architects</td>
<td>1735 New York Avenue, N.W.; Washington, D.C. 20006</td>
</tr>
<tr>
<td>AISC</td>
<td>American Institute of Steel Construction</td>
<td>400 North Michigan Avenue, Eighth Floor Chicago, IL 60611</td>
</tr>
<tr>
<td>AISI</td>
<td>American Iron and Steel Institute</td>
<td>1000 16th Street, N.W.; Washington, D.C. 20036</td>
</tr>
<tr>
<td>AITC</td>
<td>American Institute of Timber Construction</td>
<td>333 W. Hampden Avenue, Englewood, CO 80110</td>
</tr>
<tr>
<td>AMCA</td>
<td>Air Movement and Control Association</td>
<td>30 West University Drive, Arlington Heights, IL 60004</td>
</tr>
<tr>
<td>ANSI</td>
<td>American National Standards Institute</td>
<td>1430 Broadway, New York, NY 10018</td>
</tr>
<tr>
<td>APA</td>
<td>American Plywood Association</td>
<td>Box 11700, Tacoma, WA 98411</td>
</tr>
<tr>
<td>ARI</td>
<td>Air-Conditioning and Refrigeration Institute</td>
<td>1501 Wilson Boulevard, Arlington, VA 22209</td>
</tr>
<tr>
<td>ASHRAE</td>
<td>American Society of Heating, Refrigerating and Air Conditioning Engineers</td>
<td>1791 Tullie Circle, N.E.; Atlanta, GA 30329</td>
</tr>
<tr>
<td>ASME</td>
<td>American Society of Mechanical Engineers</td>
<td>345 East 47th Street, New York, NY 10017</td>
</tr>
<tr>
<td>ASPA</td>
<td>American Sod Producers Association</td>
<td>4415 West Harrison Street, Hillside, IL 60162</td>
</tr>
<tr>
<td>ASTM</td>
<td>American Society for Testing and Materials</td>
<td>1916 Race Street, Philadelphia, PA 19103</td>
</tr>
<tr>
<td>AWI</td>
<td>Architectural Woodwork Institute</td>
<td>2310 South Walter Reed Drive, Arlington, VA 22206</td>
</tr>
<tr>
<td>AWPA</td>
<td>American Wood-Preservers’ Association</td>
<td>7735 Old Georgetown Road, Bethesda, Maryland 20014</td>
</tr>
<tr>
<td>AWS</td>
<td>American Welding Society</td>
<td>550 LeJeune Road, N.W.; Miami, FL 33135</td>
</tr>
<tr>
<td>AWWA</td>
<td>American Water Works Association</td>
<td>6666 West Quincy Avenue, Denver, CO 80235</td>
</tr>
<tr>
<td>BIA</td>
<td>Brick Institute of America</td>
<td>11490 Commerce Park Drive, Reston, VA 22091</td>
</tr>
<tr>
<td>CDA</td>
<td>Copper Development Association</td>
<td>57th Floor, Chrysler Building, 405 Lexington Avenue New York, NY 10174</td>
</tr>
<tr>
<td>CLFMI</td>
<td>Chain Link Fence Manufacturers Institute</td>
<td></td>
</tr>
</tbody>
</table>
CRSI  Concrete Reinforcing Steel Institute  
933 Plum Grove Road, Schaumburg, IL  60195

DHI  Door and Hardware Institute  
7711 Old Springhouse Road, McLean, VA  22102

EJCDC  Engineers' Joint Contract Documents Committee  
American Consulting Engineers Council  
1015 15th Street, N.W.; Washington, D.C.  20005

EJMA  Expansion Joint Manufacturers Association  
25 North Broadway, Tarrytown, NY  10591

FGMA  Flat Glass Marketing Association  
3310 Harrison, White Lakes Professional Building  
Topeka, KS  66611

FM  Factory Mutual System  
1151 Boston-Providence Turnpike  
P.O. Box 688, Norwood, MA  02062

FS  Federal Specification General Services Administration Specifications and Consumer Information, Distribution Section (WFSIS); Washington Navy Yard, Bldg. 197, Washington, D.C.  20407

GA  Gypsum Association  
1603 Orrington Avenue, Evanston, IL  60201

IAPMO  International Association of Plumbing and Mechanical Officials  
20001 Walnut Drive South, Walnut, CA  91789

ICBO  International Conference of Building Officials,  
5360 S. Workman Mill Road, Whittier, CA  90601

IEEE  Institute of Electrical and Electronics Engineers  
345 East 47th Street, New York, NY  10017

IMIAC  International Masonry Industry All-Weather Council - International Masonry Institute  
815 15th Street, N.W.; Washington, D.C.  20005

MBMA  Metal Building Manufacturer's Association  
1230 Keith Building, Cleveland, OH  44115

MFMA  Maple Flooring Manufacturers Association  
60 Rivere Drive, Northbrook, IL  60062

MIL  Military Specification Naval Publications and Forms Center  
5801 Tabor Avenue, Philadelphia, PA  19120

ML/SFA  Metal Lath/Steel Framing Association  
221 North LaSalle Street, Chicago, IL  60601

NAAMM  National Association of Architectural Metal Manufacturers  
221 North LaSalle Street, Chicago, IL  60601
NCMA  National Concrete Masonry Association  
P.O. Box 781, Herndon, VA 22070

NEBB  National Environmental Balancing Bureau  
8224 Old Courthouse Road, Vienna, VA 22180

NEMA  National Electrical Manufacturer’s Association  
2101 L Street, N.W.; Washington, D.C. 20037

NETA  International Electrical Testing Association  
Electrical Acceptance Testing Specifications  
P. O. Box 687, Morrison, CO 80465

NFPA  National Fire Protection Association  
Battery March Park, Quincy, MA 02269

NFPA  National Forest Products Association  
1619 Massachusetts Avenue, N.W.; Washington, D.C. 20036

NSWMA  National Solid Wastes Management Association  
1730 Rhode Island Ave., N.W.; Washington, D.C. 20036

NTMA  National Terrazzo and Mosaic Association  
3166 Des Plaines Avenue, Des Plaines, IL 60018

NWMA  National Woodwork Manufacturers Association  
205 W. Touhy Avenue, Park Ridge, IL 60068

PCA  Portland Cement Association  
5420 Old Orchard Road, Skokie, IL 60077

PCI  Prestressed Concrete Institute  
201 North Wells Street, Chicago, IL 60606

PS  Product Standard U. S. Department of Commerce  
Washington, D.C. 20203

RIS  Redwood Inspection Service  
One Lombard Street, San Francisco, CA 94111

RCSHSB  Red Cedar Shingle and Handsplit Shake Bureau  
515 116th Avenue, Bellevue, WA 98004

SDI  Steel Deck Institute  
P.O. Box 9506, Canton, OH 44711

SDI  Steel Door Institute  
712 Lakewood Center North  
14600 Detroit Avenue, Cleveland, OH 44107

SIGMA  Sealed Insulating Glass Manufacturers Association  
111 East Wacker Drive, Chicago, IL 60601

SJI  Steel Joist Institute  
1205 48th Avenue North, Suite A  
Myrtle Beach, SC 29577

SMACNA  Sheet Metal and Air Conditioning Contractors’ National Association  
8224 Old Courthouse Road, Vienna, VA 22180
1.04 STATUTORY REQUIREMENTS FOR CONSTRUCTION CONTRACTS AND SUBCONTRACTS

Each contractor or subcontractor shall comply with laws and all applicable standards, orders, or regulations issued pursuant thereto: including, but not limited to the following:

A. The Copeland Anti-Kickback Act, as amended (18 USC 874) as supplemented in Department of Labor regulations (41 CFR Chapter 60).

B. Nondiscrimination, Title VI of the Civil Rights Act of 1964 (P.L. 88-352), as amended, (42 USC 2000d) and the requirements imposed by the regulations of the Department of Commerce (15 CFR Part 8) issued pursuant to that title.


D. Architectural Barriers Act (P.L. 90-480), 42 USC 4151, as amended.

E. Rehabilitation Act of 1973, 29 USC 794, Executive Order 11914, 12250. Delete upon confirmation that Rehabilitation Act has been revoked.


H. Equal Employment Opportunity, Executive Order 11246, as amended by Executive Order 11478, and as supplemented in Department of Labor regulations (41 CFR Chapter 60).


J. The Clean Air Act, as amended, 42 USC 1857 et seq., the Federal Water Pollution Control Act, as amended, 33 USC 1251 et seq, and the regulations of the Environmental Protection Agency with respect thereto, at 40 CFR Part 15, as amended from time to time.


PART 2

PRODUCTS

Not Used

PART 3

EXECUTION

Not Used

END OF SECTION
SECTION 01 43 26

TESTING AND INSPECTING AGENCY

PART 1  GENERAL

1.01  SECTION INCLUDES

A. Selection and payment.
B. Laboratory and testing agency reports.
C. Limits on testing laboratory/agency authority.
D. Contractor responsibilities.
E. Schedule of inspections and tests.

1.02  RELATED SECTIONS

A. Section 01 33 00 - Submittal Procedures.
B. Section 01 40 00 - Quality Control.
C. Section 01 75 00 - Starting and Adjusting.
D. Section 01 75 10 - Demonstration and Training.
E. Section 01 77 00 - Closeout Procedures.
F. Division 3 – Concrete.
G. Division 22 - Plumbing.
H. Division 23 – Heating, Ventilating, and Air Conditioning.
I. Individual Specification Sections: Inspections and tests required, and standards for testing.

1.03  REFERENCES

B. ANSI/ASTM E329 - Recommended Practice for Inspection and Testing Agencies for Concrete, Steel, and Bituminous Materials as Used in Construction.
C. AABC - Associated Air Balance Council, National Standards for Total Balance, 1982 Rev. 4: Criteria for AABC Certified Independent Agencies in their testing, adjusting and balancing of building environmental systems.
D. AABC - National Project Certification Performance Guarantee: The requirement of a guarantee issued and backed by a national organization on the performance of the certified independent testing agency.
1.04 SELECTION AND PAYMENT

A. Owner shall employ and pay for services of an independent testing laboratory/agency to perform specified inspection and testing, unless otherwise noted.

1.05 LABORATORY/AGENCY REPORTS

A. After each inspection and test, the laboratory will submit a copy of the laboratory/agency report to the Contractor, Owner, and the Architect.

B. Include:
   1. Date issued.
   2. Project title and number.
   3. Name of inspector or certified testing engineer.
   4. Date and time of sampling or inspection,
   5. Identification of product and specifications section.
   6. Location in the Project.
   7. Type of inspection or test.
   8. Date of test.
   9. Results of tests.

C. When requested by the Architect or Owner, the laboratory/agency will provide interpretation of test results.

1.06 LIMITS ON TESTING LABORATORY/AGENCY AUTHORITY

A. Laboratory/agency may not release, revoke, alter, or enlarge on requirements of Contract Documents.

B. Laboratory/agency may not approve or accept any portion of the Work.

C. Laboratory/agency may not assume any duties of Contractor.

D. Laboratory/agency has no authority to stop the Work.

1.07 CONTRACTOR RESPONSIBILITIES

A. Deliver to laboratory/agency at designated location, adequate samples of materials proposed to be used which require testing, along with proposed mix designs. Deliver to the independent testing laboratory/agency copies of submittals.

B. Cooperate with laboratory/agency personnel, and provide access to the Work.

C. Provide incidental labor and facilities to provide access to Work to be tested, to obtain and handle samples at the site or at source of products to be tested, to facilitate tests and inspections, storage and curing of test samples.

D. Contractor to notify the Architect, 48 hours prior to expected time for operations requiring inspection and testing services.

E. Maintain organized records of all testing agency reports at the project site.

1.08 SCHEDULE OF INSPECTIONS AND TESTS

A. Inspection and testing requirements are as specified in individual specification sections.

PART 2 PRODUCTS
PART 3  EXECUTION
Not Used

END OF SECTION
SECTION 01 66 00

PRODUCT STORAGE AND HANDLING REQUIREMENTS

PART 1  GENERAL

1.01  SECTION INCLUDES

A. Products.
B. Transportation and Handling.
C. Storage and Protection.

1.02  RELATED SECTIONS

A. Section 01 77 00 - Closeout Procedures.
B. Individual Specification Sections - Requirements for materials and equipment.

1.03  PRODUCTS

A. Products include material, equipment, and systems.
B. Comply with Specifications and referenced standards as minimum requirements.
C. Components required to be supplied in quantity within a specification section shall be of one manufacturer for the same product.

1.04  TRANSPORTATION AND HANDLING

A. Transport products by methods to avoid product damage; deliver in undamaged condition in manufacturer's unopened containers or packaging.
B. Provide equipment and personnel to handle products by methods to prevent soiling or damage.
C. Promptly inspect shipments to assure that products comply with requirements, quantities are correct, and products are undamaged.

1.05  STORAGE AND PROTECTION

A. Store products in accordance with manufacturer’s instructions, with seals and labels intact and legible. Store sensitive products in weather-tight enclosures; maintain within temperature and humidity ranges required by manufacturer’s instructions.
B. For exterior storage of fabricated products, place on sloped supports above ground. Cover products subject to deterioration with impervious sheet covering; provide ventilation to avoid condensation.
C. Store loose granular materials on solid surfaces in a well-drained area; prevent mixing with foreign matter.
D. Arrange storage to provide access for inspection. Periodically inspect to assure products are undamaged, and are maintained under required conditions.
PART 2 PRODUCTS
Not Used

PART 3 EXECUTION
Not Used

END OF SECTION
SECTION 01 73 29
CUTTING AND PATCHING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Requirements and limitations for cutting and patching of Work

B. NOTE: Nothing in this section is meant to override specific asbestos abatement control procedures and/or Section 02 41 13 – Selective Demolition.

1.02 RELATED SECTIONS

A. Section 02 41 00 - Selective Demolition.

B. Individual Specifications Sections:
   1. Cutting and patching incidental to Work of the section
   2. Advance notification to other sections of openings required in Work of those sections
   3. Limitations on cutting structural members

1.03 SUBMITTALS

A. Submit written request to the Owner for approval prior to proceeding in advance of cutting or alteration which affects:
   1. Structural integrity of any element of Project.
   2. Integrity of weather-exposed or moisture-resistant element.
   3. Efficiency, maintenance, or safety of any operational element.

B. Include in request:
   1. Identification of Project.
   2. Location and description of affected Work.
   3. Necessity for cutting or alteration.
   4. Description of proposed Work, and products to be used.
   5. Alternatives to cutting and patching.
   6. Effect on Work of Owner or separate contractor.
   7. Date and time Work will be executed.

PART 2 PRODUCTS

2.01 MATERIALS

A. Those required for original installation.

PART 3 EXECUTION

3.01 EXAMINATION

A. Inspect existing conditions, including elements subject to damage or movement during cutting and patching.

B. After uncovering, inspect conditions affecting performance of Work.
C. By starting cutting or patching operations, the Contractor acknowledges acceptance of existing conditions and the responsibility to restore cut and patched area to its original condition.

D. Verify that hazardous materials, including asbestos, will not be encountered. Notify the Owner before starting any demolition, and as soon as such suspected materials are encountered.

3.02 PREPARATION

A. Provide supports to assure structural integrity of surroundings, devices and methods to protect other portions of Project from damage.

B. Provide protection from elements for areas, which may be exposed by uncovering Work.

C. Maintain excavations free of water.

3.03 CUTTING AND PATCHING

A. Execute cutting, fitting, and patching to complete Work, and to fit the several parts together to integrate with other Work.

B. Uncover Work to install ill-timed Work.

C. Remove and replace defective and non-conforming Work.

D. Remove samples of installed Work for testing.

E. Provide openings in elements of Work for penetrations of mechanical and electrical work.

3.04 PERFORMANCE

A. Execute Work by methods to avoid damage to other Work, and which will provide proper surfaces to receive patching and finishing.

B. Employ experienced installers to perform cutting and patching for weather-exposed and moisture-resistant elements, and sight-exposed surfaces.

C. Cut rigid materials using masonry saw or core drill. Pneumatic tools are not allowed without prior approval.

D. Restore Work with new products in accordance with requirements of Contract Documents.

E. Fit Work airtight and watertight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.

F. At penetrations of fire-rated wall, ceiling, or floor construction, completely seal voids with fire-resistant material, full thickness of the construction element.

G. Refinish surfaces to match adjacent finishes. For continuous surfaces, refinish to nearest intersection; for an assembly, refinish entire unit.

END OF SECTION
SECTION 01 74 13
PROGRESS CLEANING

PART 1  GENERAL

1.01  SECTION INCLUDES
A. Cleaning and disposal of waste materials, debris, and rubbish during construction.

1.02  RELATED SECTIONS
A. Section 01 74 19 - Construction Waste Management.
B. Section 01 74 23 - Final Cleaning.
C. Individual Specification Sections: Specific cleaning for product or Work.

PART 2  PRODUCTS

2.01  EQUIPMENT
A. Provide covered containers for deposit of waste materials, debris, and rubbish.

PART 3  EXECUTION

3.01  CLEANING
A. Maintain areas under Contractor's control free of waste materials, debris, and rubbish. Maintain site in a clean and orderly condition. Site to be broom swept once a week minimum. Shared areas of work with owner and building users shall be clean daily.
B. Remove debris and rubbish from pipe chases, plenums, attics, crawl spaces, and other closed or remote spaces, prior to closing the space.
C. Daily clean interior areas to provide suitable conditions for Work.
D. Broom clean interior areas prior to start of surface finishing, and continue cleaning on an as-needed basis.
E. Control cleaning operations so that dust and other particles will not adhere to wet or newly-coated surfaces.

3.02  DISPOSAL
A. Remove waste materials, debris, and rubbish from site at least weekly and dispose of off-site in a legal manner.
B. Salvage, recycle and dispose waste materials under provisions of Section 01 74 19.

END OF SECTION
PART 1  GENERAL

1.01  SECTION INCLUDES

A. Administrative and procedural requirements for the following:
   1. Salvaging non-hazardous demolition and construction waste.
   2. Recycling non-hazardous demolition and construction waste.
   3. Disposing of non-hazardous demolition and construction waste.

1.02  RELATED SECTIONS

A. Section 02 41 00 - Selective Demolition.
B. Section 02 41 15 – Landscape Demolition.

1.03  DEFINITIONS

A. Clean: Untreated and unpainted; not contaminated with oils, solvents, caulk, paint, or the like.
B. Construction Waste: Building and site improvement materials and other solid waste resulting from construction, remodeling, renovation, or repair operations. Construction waste includes packaging.
C. Demolition Waste: Building and site improvement materials resulting from demolition or selective demolition operations.
D. 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.
E. Diversion: Avoidance of demolition and construction waste sent to landfill or incineration. Diversion does not include using materials for landfill, alternate daily cover on landfills, or materials used as fuel in waste-to-energy processes.
F. Hazardous: Exhibiting the characteristics of hazardous substances, i.e., ignitability, corrosiveness, toxicity or reactivity.
G. Recycle: Recovery of demolition or construction waste for subsequent processing in preparation for reuse.
H. Recycling: The process of sorting, cleansing, treating, and reconstituting solid waste and other discarded materials for the purpose of using the altered form. Recycling does not include burning, incinerating, or thermally destroying waste.
I. Salvage: Recovery of demolition or construction waste and subsequent reuse or sale in another facility.
J. Reuse: Recovery of demolition or construction waste and subsequent incorporation into the Work.
K. Source Separation: The act of keeping different types of waste materials separate beginning from the first time they become waste.
L. Toxic: Poisonous to humans either immediately or after a long period of exposure.

M. Trash: Any product or material unable to be reused, returned, recycled, or salvaged.

N. Waste: Extra material or material that has reached the end of its useful life in its intended use. Waste includes salvageable, returnable, recyclable, and reusable material.

1.04 PERFORMANCE REQUIREMENTS

A. The Owner has established that this Project shall generate the least amount of waste possible and that processes that ensure the generation of as little waste as possible due to error, poor planning, breakage, mishandling, contamination, or other factors shall be employed.

B. Of the waste that is generated, as many of the waste materials as economically feasible shall be reused, salvaged, or recycled. Waste disposal in landfills or incinerators shall be minimized, thereby reducing disposal costs.

C. Develop a construction waste management plan that results in end-of-Project rates for salvage/recycling of 30% (by weight) of construction and demolition waste. Indicate on Site Plan location of demolition and construction waste and recycling receptacles for Owner’s approval prior to placement.

D. Salvage/Recycle Requirements: Salvage and recycle as much non-hazardous demolition and construction waste as possible, including the following materials:

1. Demolition Waste:
   a. Asphal tic concrete paving
   b. Concrete
   c. Concrete reinforcing steel
   d. Concrete masonry units
   e. Wood studs
   f. Plywood and oriented strand board
   g. Wood paneling
   h. Wood trim
   i. Structural and miscellaneous steel
   j. Rough hardware
   k. Insulation
   l. Doors and frames
   m. Door hardware
   n. Windows
   o. Glazing
   p. Metal studs
   q. Gypsum board
   r. Acoustical tile and panels
   s. Carpet
   t. Carpet pad
   u. Demountable partitions
   v. Equipment
   w. Cabinets
   x. Plumbing fixtures
   y. Piping
   z. Supports and hangers
   aa. Valves
   bb. Sprinklers
   cc. Mechanical equipment
   dd. Refrigerants
   ee. Electrical conduit
   ff. Copper wiring
   gg. Lighting fixtures
hh. Lamps
ii. Ballasts
jj. Electrical devices
kk. Switchgear and panelboards

2. Construction Waste:
   a. Masonry and CMU
   b. All untreated wood, including lumber and finish materials
   c. Wood sheet materials
   d. Wood trim
   e. Metals
   f. Insulation
g. Carpet and pad
h. Gypsum board
i. Unused (leftover) paint
j. Piping
k. Electrical conduit
l. Packaging: Regardless of salvage/recycle goal indicated above, salvage or recycle 100 percent of the following uncontaminated packaging materials:
   1) Paper
   2) Cardboard
   3) Boxes
   4) Plastic sheet and film
   5) Polystyrene packaging
   6) Wood crates
   7) Plastic pails
m. Beverage and packaged food containers

1.05 SUBMITTALS

A. Construction Waste Management Plan (CWMP): It is the intent of this specification to maximize the diversion of demolition and construction waste from landfill disposal. Accordingly, not more than 10 days after receipt of Notice to Proceed and prior to the generation of any waste, prepare and submit a draft Construction Waste Management Plan in accordance with this Section including, but not limited to, the following:
1. Procedures for Recycling/Reuse Program to divert a minimum of 30% (by weight) of construction and demolition waste from landfill disposal, including waste resulting from demolition of any existing building and site paving scheduled for demolition; any site paving is required to be ground on site and reused as granulated fill on site.
2. Approval of the Contractor’s CWMP shall not relieve the Contractor of responsibility for adequate and continuing control of pollutants and other environmental protection measures.

B. Submit a 3-ring binder with calculations on end-of-project recycling rates, salvage rates, and landfill rates itemized by waste material, demonstrating that a minimum of 30% of construction wastes were recycled or salvaged and diverted from landfill. Include documentation of recovery rate (if commingled), waste hauling certificates or receipts, and a brief narrative explaining how and to where each waste type has been diverted.

C. Construction Waste Management Plan: Submit four (4) copies of plan within 20 days of date established for the Notice to Proceed.

D. Waste Reduction Progress Reports: Concurrent with each Application for Payment, submit four copies of the following reports:
1. Project Demolition.
Include separate reports for demolition and construction waste. Include the following information in each Waste Reduction Progress Report:

1. Material category.
2. Generation point of waste.
3. Total quantity of waste in tons.
4. Quantity of waste salvaged, both estimated and actual in tons.
5. Quantity of waste recycled, both estimated and actual in tons.
6. Total quantity of waste recovered (salvaged plus recycled) in tons.
7. Total quantity of waste recovered (salvaged plus recycled) as a percentage of total waste.
8. Include up-to-date records of donations, sales, recycling and landfill/incinerator manifests, weight tickets, hauling receipts, and invoices.

E. Waste Reduction Calculations: Before request for Substantial Completion, submit four copies of calculated end-of-project rates for salvage, recycling, and disposal as a percentage of total waste generated by the Work. Complete a table similar to the example below.

<table>
<thead>
<tr>
<th>Recycled/Salvaged/Diverted Materials</th>
<th>Hauler or Location</th>
<th>Quantity of Material (tons)</th>
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<tr>
<td>Total Construction Waste Diverted</td>
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<tr>
<td>Landfilled Materials</td>
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<td></td>
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<tr>
<td>Total Construction Waste Landfilled</td>
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<td></td>
</tr>
</tbody>
</table>

F. Records of Donations: Indicate receipt and acceptance of salvageable waste donated to individuals and organizations. Indicate whether organization is tax-exempt.
G. Records of Sales: Indicate receipt and acceptance of salvageable waste sold to individuals and organizations. Indicate whether organization is tax-exempt.

H. Recycling and Processing Facility Records: Indicate receipt and acceptance of recyclable waste by recycling and processing facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.

I. Landfill and Incinerator Disposal Records: Indicate receipt and acceptance of waste by landfills (or transfer stations) and incinerator facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.

1.06 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with all applicable local ordinances and regulations.

B. Waste Management Meetings: Conduct an initial conference at project site. Contractor shall include discussions on construction waste management requirements in the pre-construction meeting. Contractor shall include discussions on construction waste management requirements in the regular progress meetings conducted during the course of the project; at these meetings, 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 the Waste Management Coordinator.
   2. Review requirements for documenting quantities of each type of waste and its disposition.
   3. Review and finalize procedures for materials separation and verify availability of containers and bins needed to avoid delays.
   4. Review procedures for periodic waste collection and transportation to recycling and disposal facilities.
   5. Review waste management requirements for each trade.

1.07 CONSTRUCTION WASTE MANAGEMENT PLAN

A. General: Develop and implement a CWMP consisting of waste identification, waste reduction work plan, and cost/revenue analysis. Include separate sections in plan for demolition and construction waste. Indicate quantities by weight or volume, but use the same units of measure throughout the CWMP.

B. Draft Construction Waste Management Plan: Within 20 days after receipt of Notice to Proceed, or prior to any waste removal, whichever occurs sooner, the Contractor shall submit to the Owner and Architect a Draft Waste Management Plan.

C. Final Construction Waste Management Plan: Once the Owner has determined which of the recycling options addressed in the draft Waste Management Plan are acceptable, the Contractor shall submit, within 10 calendar days, a Final Waste Management Plan.

D. Waste Identification: Indicate anticipated types and quantities of demolition, site-clearing, and construction waste generated by the Work. Include estimated quantities and assumptions for estimates.

E. Landfill Options: Indicate the name of the landfill(s) and/or transfer station(s) and/or incinerator(s) where trash will be disposed of, the applicable landfill tipping fee(s), and the projected cost of disposing of all Project waste in the landfill(s).

F. Waste Reduction Work Plan: List each type of waste and whether it will be salvaged, reused, recycled, or disposed of in landfill or incinerator. Include points of waste generation, total quantity of each type of waste, quantity for each means of recovery, and handling and transportation procedures.
   1. Salvaged Materials for Reuse: For materials that will be salvaged and reused in this Project, describe methods for preparing salvaged materials before incorporation into the Work.
2. Salvaged Materials for Sale: For materials that will be sold to individuals and organizations, include list of their names, addresses, and telephone numbers.

3. Salvaged Materials for Donation: For materials that will be donated to individuals and organizations, include list of their names, addresses, and telephone numbers.

4. Recycled Materials: Include list of local receivers and processors and type of recycled materials each will accept. Include names, addresses, and telephone numbers.

5. Disposed Materials: Indicate how and where materials will be disposed of. Include name, address, and telephone number of each landfill and incinerator facility.

6. Handling and Transportation Procedures: Describe method that will be used for separating recyclable waste, including sizes of containers, container labeling, and designated location on Project Site where materials separation will be located.

G. Materials: The following list of required materials, at a minimum, must be included for salvaging/recycling:
   1. Cardboard
   2. Clean dimensional wood
   3. Beverage and food containers
   4. Paper
   5. Concrete
   6. Concrete Masonry Units (CMUs)
   7. Asphalt: Include the approximate weight of the asphalt paving to be crushed and utilized as granulated fill from the existing paving as a component of waste material diverted from the landfill.
   8. Ferrous and non-ferrous metals (banding, stud trim, ductwork, piping, rebar, roofing, other trim, steel, iron, galvanized sheet steel, stainless steel, aluminum, copper, zinc, lead, brass, and bronze)
   9. Stretch and shrink wrap
   10. Gypsum wallboard
   11. Paint containers and other clean, empty plastic containers

H. Meetings: Provide a description of the regular meetings to be held to address waste management.

I. Materials Handling Procedures: Provide a description of the means by which any waste materials identified will be protected from contamination, and a description of the means to be employed in recycling the above materials consistent with requirements for acceptance by designated facilities.

J. Transportation: Provide a description of the means of transportation of the recyclable materials (whether materials will be site-separated and self-hauled to designated centers, or whether mixed materials will be collected by a waste hauler and removed from the site) and destination of materials.

PART 2  PRODUCTS
Not Used.

PART 3  EXECUTION
3.01 PLAN IMPLEMENTATION

A. General: Implement waste management plan as approved by Architect and Owner. Provide handling, containers, storage, signage, transportation, and other items as required to implement waste management plan during the entire duration of the Contract.
B. Waste Management Coordinator: Engage a waste management coordinator to be responsible for implementing, monitoring, and reporting status of waste management work plan. Coordinator shall be present at the Project Site full-time for duration of Project.

C. 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 within three days of submittal return.
   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.

D. Site Access and Temporary Controls: Conduct waste management operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
   1. Designate and label specific areas on Project Site necessary for separating materials that are to be salvaged, recycled, reused, donated, and sold.
   2. Recycling and waste bin areas are to be kept neat, and clean, and clearly marked in order to avoid contamination of materials.

E. Hazardous Wastes: Hazardous wastes shall be separated, stored, and disposed of according to local regulations and should not be included in Construction Waste Management Plan's calculations of waste.

3.02 SALVAGING DEMOLITION WASTE

A. Salvaged Items for Reuse in the Work:
   1. Clean salvaged items.
   2. Pack or crate items after cleaning. Identify contents of containers.
   3. Store items in a secure area until installation.
   4. Protect items from damage during transport and storage.
   5. Install salvaged items to comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make items functional for use indicated.

B. Salvaged Items for Owner's Use:
   1. Clean salvaged items.
   2. Pack or crate items after cleaning. Identify contents of containers.
   3. Store items in a secure area until delivery to Owner.
   4. Transport items to Owner's storage area designated by Owner.
   5. Protect items from damage during transport and storage.

C. Doors and Hardware: Brace open end of door frames. Except for removing door closers, leave door hardware attached to doors.

3.03 RECYCLING DEMOLITION AND CONSTRUCTION WASTE, GENERAL

A. General: Recycle paper and beverage containers used by on-site workers.

B. Recycling Receivers and Processors: List below is provided for information only; available recycling receivers and processors include, but are not limited to, the following:
   1. List to be developed by Contractor.

C. Recycling Incentives: Revenues, savings, rebates, tax credits, and other incentives received for recycling waste materials shall accrue to Contractor.

D. 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.

### 3.04 RECYCLING DEMOLITION WASTE

A. Asphaltic Concrete Paving: Break up and transport paving to asphalt-recycling facility or recycle on-site into new paving.

B. Concrete: Remove reinforcement and other metals from concrete and sort with other metals.
   1. Pulverize concrete to maximum 4-inch size.
   2. Crush concrete and screen to comply with requirements in Section 31 20 01 for use as satisfactory soil for fill or subbase.

C. Masonry: Remove metal reinforcement, anchors, and ties from masonry and sort with other metals.
   1. Pulverize masonry to maximum 1-1/2-inch size.
      a. Crush masonry and screen to comply with requirements in Division 2 Section “Earthwork” for use as general fill or subbase.
      b. Crush masonry and screen to comply with requirements in Division 2 Section “Exterior Plants” for use as mineral mulch.
   2. Clean and stack undamaged, whole masonry units on wood pallets.

D. Wood Materials: Sort and stack members according to size, type, and length. Separate lumber, engineered wood products, and panel products for reuse and/or recycling. Separate wood material treated with heavy metal preservatives for reuse or landfill disposal.

E. Metals: Separate metals by type.
   1. Structural Steel: Stack members according to size, type of member, and length.
   2. Remove and dispose of bolts, nuts, washers, and other rough hardware.

F. Gypsum Board: Stack large, clean pieces on wood pallets and store in a dry location for recycling off-site. Remove edge trim and sort with other metals. Remove and dispose of fasteners.

G. Acoustical Ceiling Panels and Tile: Stack large, clean pieces on wood pallets and store in a dry location.
   1. Separate suspension system, trim, and other metals from panels and tile and sort with other metals.

H. Resin Countertops: Remove edge trim and non-fused pieces, inclusive of backsplash where possible.

I. Carpet and Pad: Roll large pieces tightly after removing debris, trash, adhesive, and tack strips.
   1. Store clean, dry carpet and pad in a closed container or trailer provided by a carpet recycler or manufacturer-related carpet reclamation agency.

J. Equipment: Drain tanks, piping, and fixtures. Seal openings with caps or plugs. Protect equipment from exposure to weather.
K. Plumbing Fixtures: Separate by type and size.

L. Piping: Reduce piping to straight lengths and store by type and size. Separate supports, hangers, valves, sprinklers, and other components by type and size.

M. Lighting Fixtures: Separate lamps by type and protect from breakage.

N. Electrical Devices: Separate switches, receptacles, switchgear, transformers, meters, panelboards, circuit breakers, and other devices by type.

O. Conduit: Reduce conduit to straight lengths and store by type and size.

3.5 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.

B. Site-Clearing Wastes: Chip brush, branches, and trees on-site.

C. Wood Materials:
   1. Clean Cut-Offs of Lumber: Grind or chip into material appropriate for mulch or erosion control.
   2. Lumber Treated with Heavy-Metal Preservatives: Do not grind, chip, or incinerate; must be reused or landfilled.

D. Gypsum Board: Stack large, clean pieces on wood pallets and store in a dry location for recycling and/or reuse on-site or off-site.

E. Miscellaneous: Anything called out to be ground and used on site should utilize an on-site grinder.
   1. Grinder should be able to accommodate a variety of materials including masonry, asphalt, wood, and drywall.

3.06 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 to accumulate on site.
   2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
   3. Do not burn or bury waste materials on or off site. Appropriate on-site topical application of ground gypsum or wood, or use of site paving as granulated fill is considered reuse, not waste.

END OF SECTION
SECTION 01 74 23

FINAL CLEANING

PART 1  GENERAL

1.01  SECTION INCLUDES

A. Cleaning Material.
B. Cleaning.

1.02  RELATED SECTIONS

A. Section 01 74 13 - Progress Cleaning.
C. Section 01 77 00 - Closeout Procedures.
C. Individual Specifications Sections and Notes: Specific cleaning for product or work.

1.03  DESCRIPTION

A. Execute cleaning prior to inspection for Substantial Completion of each designated portion of the Work.
B. Execute cleaning prior coordination with the owner and users of the occupied portion of the building.

PART 2  PRODUCTS

2.01  CLEANING MATERIALS

A. Use materials which will not create hazards to health or property, and which will not damage surfaces.
B. Use only materials and methods recommended by manufacturer of material being cleaned.

PART 3  EXECUTION

3.01  CLEANING

A. In addition to removal of debris and cleaning specified in other sections, clean interior and exterior surfaces. Clean entire exterior of existing building and new work, including all surfaces.
B. Remove temporary protection and labels not required to remain.
C. Replace filters of the HVAC Systems
D. Clean finishes free of dust, stains, films and other foreign substances.
E. Clean transparent and glossy materials to a polished condition; remove foreign substances. Polish reflective surfaces to a clear shine.
F. Vacuum clean carpeted and similar soft surfaces.
G. Clean permanent filters of ventilating equipment and replace disposable filters when units have been operated during construction; in addition, clean ducts, blowers, and coils when units have been operated without filters during construction.

H. Clean light fixtures and lamps.

I. Maintain cleaning until Final Completion.

J. Remove waste, debris, and surplus materials from site. Clean grounds; remove stains, spills, and foreign substances from paved areas and sweep clean. Rake clean other exterior surfaces.

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

END OF SECTION
SECTION 01 75 00
STARTING AND ADJUSTING

PART 1 GENERAL

1.01 SECTION INCLUDES
A. Starting systems.

1.02 RELATED SECTIONS
A. Section 01 40 00 - Quality Control
B. Section 01 43 26 - Testing and Inspecting Agency.
C. Section 01 75 10 - Demonstration and Training.
D. Section 01 77 00 - Closeout Procedures.
E. Divisions 21, 22 and 23.
F. Division 26 and 28.

1.03 STARTING SYSTEMS
A. Coordinate schedule for start-up of various equipment and systems.
B. Notify in writing the Owner's representative, Architect/Engineer, and testing agency seven (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 each component of each system performs as designed and in conformance to manufacturer's recommendations to comprise complete and fully functional environmental systems.
E. Verify that tests, meter readings, and specified electrical characteristics agree with those required by the equipment or system manufacturer.
F. Verify wiring and support components for equipment are complete and tested i.e. electrical systems are properly open without restriction, all normally open positions are active, controls safely operational.
G. All mechanical equipment shall be started and placed into operation by the manufacturer's authorized representative under the supervision of responsible Contractor's personnel and the Owner's representative. Any equipment requiring field assembly fabrication or wiring shall have such work done under the direct supervision of the manufacturer's representative. Prior to final approval, the Contractor shall submit letters of evidence from the manufacturer verifying conformance with these requirements.
H. The operation and function of all air conditioning equipment and controls shall be fully understood by the air conditioning contractor's project representative. This representative shall be present at the site on a full time basis during start-up. Prior to final approval, contractor shall submit in triplicate copies of the "system start-up report". This report shall contain a daily log prepared by the project representative of all events involving the system during start-up.
PART 2  PRODUCTS
Not Used

PART 3  EXECUTION
Not Used

END OF SECTION
PART 1    GENERAL

1.01  SECTION INCLUDES

A. Procedures for demonstration of equipment operation and instruction of Owner's personnel.

1.02  RELATED SECTIONS

A. Section 01 40 00 - Quality Control.
B. Section 01 43 26 - Testing and Inspecting Agency.
C. Section 01 75 00 - Starting and Adjusting.
D. Section 01 77 00 - Closeout Procedures.
E. Section 01 78 23 - Operation and Maintenance Data.
F. Other and/or Individual Notes/ Sections: Specific requirements for demonstrating systems and equipment.

1.03  QUALITY ASSURANCE

A. When specified in individual Sections, require manufacturer to provide authorized representative to demonstrate operation of equipment and systems, instruct Owner's personnel, and provide written report that demonstrations and instructions have been completed.
B. Owner will provide list of personnel to receive instructions, and will coordinate their attendance at agreed-upon times.

1.04  SUBMITTALS

A. Submit preliminary schedule for Architect/ Engineer and Owner's approval, listing times and dates for demonstration of each item of equipment and each system, two weeks prior to proposed dates.
B. Submit reviewed and approved by Architect/ Engineer/ Owner the O&M Manuals two (2) weeks prior to scheduled demonstrations.
C. Submit reports within one week after completion of demonstrations, that demonstrations and instructions have been satisfactorily completed. Give time and date of each demonstration, and hours devoted to demonstration, with a list of persons present, signed by the attendants.

PART 2    PRODUCTS

Not Used

PART 3    EXECUTION

3.01  PREPARATION

A. Verify equipment has been inspected and put into operation in accordance with Section 01 75.
00; testing, adjusting, and balancing has been performed and equipment and systems are fully operational.

B. Have copies of completed operation and maintenance manuals at hand for use in demonstrations and instructions.

3.02 DEMONSTRATION AND INSTRUCTIONS

A. Demonstrate operation and maintenance of equipment and systems to Owner's personnel two weeks prior to date of final inspection. For equipment requiring seasonal operation, perform instructions for other seasons within nine months.

B. Use operation and maintenance manuals and HVAC test and balance reports as basis of instruction. Review contents of manual and reports with personnel in detail to explain all aspects of operation and maintenance.

C. Demonstrate start-up, operation, control, adjustment, troubleshooting, servicing, maintenance, and shutdown of each item of equipment at agreed-upon times, at equipment location.

D. Prepare and insert additional data in operations and maintenance manuals when need for additional data becomes apparent during instructions.

END OF SECTION
PART 1  GENERAL

1.01  SECTION INCLUDES
   A.  Substantial completion.
   B.  Final completion.
   C.  Re-inspection fees.
   D.  Closeout submittals.
   E.  Statement of Adjustment of Accounts.
   F.  Application for Final Payment.

1.02  RELATED SECTIONS
   A.  Section 01 11 00 - Summary of Work.
   B.  Section 01 29 00 - Payment Procedures.
   C.  Section 01 40 00 - Quality Control.
   D.  Section 01 43 26 - Testing and Inspecting Agency.
   E.  Section 01 74 23 - Final Cleaning.
   F.  Section 01 78 23 - Operation and Maintenance Data.
   G.  Section 01 78 36 - Warranties.
   H.  Section 01 78 39 - Project Record Documents.
   I.  Section 01 78 43 - Spare Parts and Extra Materials.

1.03  PRE-CLOSEOUT CONFERENCE
   A.  The Contractor and his major subcontractors shall attend a pre-closeout conference with the Owner and Architect to review, and schedule the contractual obligations such as the substantial completion inspection, punch list, temporary certificate of occupancy, certificate of occupancy, final cleaning, project record documents, operations and maintenance data, spare parts, and closeout certificates.
   B.  The Owners Representative shall prepare minutes from the conference and shall make distribution to all attendees.

1.04  SUBSTANTIAL COMPLETION
   A.  Courtesy Walk: Notify the Owner and Architect Twenty (20) days prior to the anticipated
courtesy inspection. When the Contractor considers the Work or a designated portion of the Work nearly complete, he may submit a written request to the Architect and Owner to walk the Project with the Contractor. The Architect will select various rooms or portions of the project at random, pointing out typical deficiencies and describing quality and level of work which will be required to at the time of Substantial Completion inspection.

B. Written Notice: When Contractor considers the Work or a designated portion of Work substantially complete, he shall submit two weeks written notice to the Architect and Owner requesting the Substantial Completion inspection.

C. The Contractor shall prepare and submit to the Architect a comprehensive list of items to be completed or corrected at least one week prior to the scheduled substantial completion inspection. The Contractor shall proceed promptly to complete and correct items on the list to cover, if not all, the majority of them.

D. Upon receipt of the Contractor's deficiency list, the Architect will make an inspection to determine whether the Work or designated portion thereof is substantially complete.

E. Substantial Completion Inspection: The Architect will inspect the project with the Contractor and Owner in attendance.

F. Deficiencies will be noted and a comprehensive list of items to be completed or corrected shall be prepared by the Architect and submitted to the Contractor for immediate completion or correction.
   1. The Contractor shall have 30 days from the Substantial Completion Date to complete or correct all items listed in the deficiency list.

G. During the inspection, should the list become too extensive in the judgment of the Architect to constitute Substantial Completion, the inspection may be terminated and the Contractor notified in writing.

H. Should the Architect find the Work is substantially complete, and after reviewing the deficiencies list, a Certificate of Substantial Completion shall be prepared in accordance with provisions of the General Conditions of the Contract Documents. The list of deficiencies shall be attached to the Certificate of Substantial Completion.

I. Should the Architect's inspection find Work that is not substantially complete, he will promptly notify Contractor in writing, listing observed deficiencies.

J. Contractor shall remedy deficiencies and send a second written notice of Substantial Completion.

K. When the Architect finds the Work is Substantially Complete a Certificate of Substantial Completion will be prepared in accordance with provisions of Contract Documents.

L. Submit certificates of Contractor and Subcontractors, certifying that products repaired, refinshed, furnished and installed do not contain asbestos.

M. All outstanding payments due, including retainage, with any interest due, shall be paid within 30 days of the Owner occupying or partially occupying a portion of the project. The amount paid must be in the proportion that the value of the portion of the work which is used or occupied bears to the total value of the work. However, the Owner may withhold from a progress payment or retainage payment an amount sufficient to pay the expenses the Owner reasonably expects to incur as a result of the Contractor's failure to correct or complete the work. The Owner will provide written notice to the Contractor of the amount being withheld and an explanation of the reason the amount is being withheld. The Contractor shall provide written notice of the correction of the conditions that are the reasons for the withholding, signed by an authorized agent of the Contractor. Once written notice has been received and verified by the Owner, the Contractor may include the amount on next progress payment in
accordance with Section 01 29 00 - Payment Procedures.

1.05 TEMPORARY CERTIFICATE OF OCCUPANCY

A. Before the Temporary Certificate of Occupancy can be issued for the Project, the Contractor must submit proof to the Architect and Owner of the following requirements:
   1. The Contractor must have an approved inspection by the Authority Having Jurisdiction for sprinkler and fire alarm/life safety.
   2. All life/safety work must be inspected and passed by the Authority Having Jurisdiction as indicated on the Permit Card.
   3. The telephone system must be operational for fire alarm tie-in and emergencies.
   4. Certificate of Asbestos and Lead Paint Removal Completion issued by the Authority Having Jurisdiction.

1.06 CERTIFICATE OF OCCUPANCY

A. Before the Certificate of Occupancy can be issued for the Project, the Contractor must submit proof to the Architect and Owner of the following requirements:
   1. Items 1 through 4 of the Temporary Certificate of Occupancy requirements must be obtained.
   2. HVAC balance report must be reviewed and approved by the mechanical consultant.
   3. Final sign-off approval on the Inspection Permit Card.

1.07 FINAL COMPLETION

A. When Contractor considers Work is complete, submit written certification:
   1. Contract Documents have been reviewed.
   2. Work has been inspected for compliance with Contract Documents.
   3. Work has been completed in accordance with Contract Documents, and deficiencies listed with Certificate of Substantial Completion have been corrected.
   4. Equipment and systems have been tested adjusted, and balanced, and are fully operational.
   5. Operation of systems has been demonstrated to Owner's personnel.
   6. Work is complete and ready for final inspection.

B. Should the Architect find Work incomplete, he will promptly notify Contractor in writing listing observed deficiencies.

A. Contractor shall remedy deficiencies and send a second certification of final completion.

1.08 RE-INSPECTION FEES

A. Should status of completion of Work require re-inspection by the Architect due to failure of Work to comply with Contractor's claims on initial inspection, Owner will deduct the amount of Architect's compensation for re-inspection services from final payment to Contractor.

1.09 CLOSEOUT SUBMITTALS

A. Evidence of Compliance with requirements of governing authorities and entities, and utility companies:
   2. Certificates of Inspection for the following: fire alarm, sprinkler, mechanical, and electrical systems.
   3. Certificate of Asbestos and Lead Paint Removal Completion issued by the Authority Having Jurisdiction.
4. Letters of Acceptance from the following: sanitation district, water district, electric company, gas company, and telephone company.
5. Completion of Final Inspection Punch list items.

B. Project Record Documents: Under provisions of Section 01 78 39.

C. Operation and Maintenance Data: Under provisions of Section 01 78 23.

D. Warranties and Bonds: Under provisions of Section 01 78 36.

E. Non-Use of Asbestos Certificates.
   1. Due one week PRIOR of the Owner’s occupancy of the Project.

F. Spare Parts and Extra Materials: Under provisions of Section 01 78 43.

G. Keys and Keying Schedule: Under provisions of Section 08 71 00.

H. Contractor’s Affidavit of Release of Liens (AIA G706A).

I. Consent of Surety Company to Final Payment (AIA G707).

J. Certificates of Insurance for Products and Completed Operations.

1.10 STATEMENT OF ADJUSTMENT OF ACCOUNTS

A. Submit final statement reflecting adjustments to Contract Sum indicating:
   1. Original Contract Sum.
   2. Previous change orders.
   3. Changes under unit prices.
   4. Deductions for uncorrected work.
   5. Deductions for liquidated damages.
   6. Deductions for re-inspection fees.
   7. Other adjustments to Contract Sum.
   8. Total Contract Sum as adjusted.
   9. Previous payments.
   10. Sum remaining due.

B. The Architect will issue a final Change Order reflecting approved adjustments to Contract Sum not previously made by change orders.

1.11 APPLICATION FOR FINAL PAYMENT

A. Submit Application for Final Payment in accordance with provisions of the Contract Documents.

B. Final payment will be made to the Contractor after all listed deficiencies have been corrected, all closeout submittals have been received, all certification(s) and/or authorization(s) from the Nevada State Labor Commission, (if applicable) and the State Industrial Insurance System (SIIS) have been received and approved by the Owner.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION
Not Used

END OF SECTION
PART 1  GENERAL

1.01  SECTION INCLUDES

A. Format.
B. Contents.
C. Equipment and Systems.
D. Submittals.

1.02  RELATED SECTIONS

A. Section 01 33 00 - Submittal Procedures.
B. Section 01 66 00 - Product Storage and Handling Requirements.
C. Section 01 75 10 - Demonstration and Training.
D. Section 01 77 00 - Closeout Procedures.
E. Section 01 78 36 - Warranties.
F. Individual Specifications Sections: Specific requirements for operation and maintenance data

1.03  QUALITY ASSURANCE

A. Provide complete instruction manuals and data prepared by personnel experienced in maintenance and operation of described products.

1.04  FORMAT

A. Provide data in the form of an equipment and system instructional manual.
B. Binders: Commercial quality, 8-1/2 x 11 inch three-ring binders with hardback, cleanable, plastic covers; three inch maximum ring size. When multiple binders are used, correlate data into related consistent groupings.
C. Cover: Identify each binder with typed or printed title OPERATION AND MAINTENANCE INSTRUCTIONS; list title of Project and identify subject matter of contents.
D. Arrange content by systems under section numbers and sequence of Specification Index of the Project Manual.
E. Provide tabbed numbered fly leaf for each separate product and system, by corresponding number as listed in Specification Index of the Project Manual.
F. Text: Manufacturer's printed data and Contractor provided documentation.
G. Drawings: provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.
1.05 CONTENTS, EACH VOLUME

A. Table of Contents: Provide title of Project; names, addresses, and telephone numbers of Architect, sub-consultants, and Contractor with name of responsible parties; schedule of products and systems, indexed to content of the volume.

B. For each product or system: list names, addresses, and telephone numbers of subcontractors and suppliers, including local source of supplies and replacement parts.

C. Product data: mark each sheet to clearly identify specific products and component parts, and data applicable to installation. Delete inapplicable information.

D. Drawings: supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams. Do not use project Record Documents as maintenance drawings.

E. Type text: as required to supplement product data.

F. Additional requirements: as specified in individual product specification sections.

1.06 MANUAL FOR EQUIPMENT AND SYSTEMS

A. Each item of equipment and each system: include description of unit or system, and component parts. Identify function, normal operating characteristics, and limiting conditions. Include performance curves, with engineering data and tests, and complete nomenclature and commercial number of replaceable parts.

B. Panel board circuit directories: provide electrical service characteristics, controls, and communications.

C. Include color-coded wiring diagrams as installed.

D. Operating procedures: include manufacturer's start-up, break-in, and routine normal operating instructions and sequences. Include regulation, control, stopping, shut-down, and emergency instructions. Include summer, winter, and any special operating instructions.

E. Maintenance requirements: include manufacturer's routine procedures and guide for trouble-shooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.

F. Provide servicing and lubrication schedule, and list of lubricants required.

G. Include sequence of operation by controls manufacturer.

H. Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.

I. Provide control diagrams by controls manufacturer as installed.

J. Provide Contractor's coordination drawings, with color-coded piping diagrams as installed.

K. Provide list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.

L. Include specified Testing and Balancing reports.

M. Additional requirements: as specified in individual product specification sections.
1.07 SUBMITTALS

A. In accordance with Section 01 78 39, provide two (2) complete manuals containing all equipment and system manufacturer product data. Manual contents and organization shall be as required above.

B. For equipment, or component parts of equipment put into service during construction and operated by Owner, submit documents within ten days after acceptance. Additional copies of any such documents shall also be provided in final manual.

C. Non-Use of Asbestos Certificates shall be included with the Record Documents due upon the Owner’s occupancy as required in Section 01 77 00.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

END OF SECTION
SECTION 01 78 36
WARRANTIES

PART 1  GENERAL

1.01  SECTION INCLUDES

A.  Warranties.
B.  Contractor's one-year warranty.
C.  Product and services warranties.
D.  Form of submittals.
E.  Preparation of submittals.
F.  Time of submittals.

1.02  RELATED SECTIONS

A.  Section 01 77 00 - Closeout Procedures.
B.  Section 01 78 23 – Operation and Maintenance Data.

1.03  WARRANTIES

A.  Warranties required by 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.

B.  Submit three (3) sets of volumes containing written warranties and related documents required by Contract Documents.

C.  If, within one (1) year after the date of Substantial Completion of the Work or designated portion thereof, or after the date of commencement of warranties established herein, or by terms of an applicable special warranty required by Contract Documents, any of the Work is found to be not in accordance with the requirements of Contract Documents, Contractor shall correct it promptly after receipt of written notification of such condition.

   1.  This period of one (1) year 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 performance of the Work.

   2.  This obligation shall survive acceptance of the Work under the Contract and termination of the Contract.

   3.  Owner will give such notice promptly after discovery of the condition.

D.  Nothing contained in this Section shall be construed to establish a period of limitation with respect to other obligations within Contract Documents.

E.  Establishment of the time period of one (1) year as described herein relates only to the specific obligation of Contractor to correct the Work, and has no relationship to the time within which the obligation to comply with Contract Documents may be sought to be enforced, not to the time within which proceedings may be commenced to establish Contractor's liability with respect to Contractor's obligations other than specifically to correct the Work.
1.04 CONTRACTOR’S ONE-YEAR WARRANTY

A. Unless otherwise provided elsewhere in the Contract, all materials and equipment incorporated into any Work covered by the Contract shall be new and where not specified, of the most suitable grade of their respective kinds for their intended use, and all workmanship shall be in accordance with construction practices acceptable to Owner.

B. Unless otherwise provided in the Contract, Contractor warrants all equipment, materials, and labor furnished or performed under this Contract against defects in design, materials, and workmanship (unless furnished by Owner), for a period of 12 months (unless longer guarantees or warranties are provided for elsewhere in Contract Documents in which case the longer periods of time shall prevail) from and after final acceptance under the Contract, regardless of whether the same were furnished or performed by Contractor or by any of Contractor’s subcontractors of any tier. Upon receipt of written notice from Owner of any defect in any such equipment, materials, or labor during the applicable warranty period, due to defective design, materials, or workmanship, the affected item or parts thereof shall be redesigned, repaired, or replaced by Contractor at a time acceptance to Owner.

C. Contractor shall perform such tests as Owner may require to verify that such redesign, repairs, and replacements comply with the requirements of this Contract. All costs incidental to such redesign, repair, replacement, and testing, including the removal necessary to gain access shall be borne by Contractor.

D. Contractor warrants such redesigned, repaired, or replaced work against defective design, materials, and workmanship for a period of twelve (12) months from and after date of acceptance thereof.
   1. Should Contractor fail to promptly make the necessary redesign, repair, replacement, and tests, Owner may perform or cause to be performed the same at Contractor’s expense.
   2. Contractor and Contractor’s surety or sureties shall be liable for the satisfaction and full performance of the warranties as set forth herein.

1.05 PRODUCT AND SERVICES WARRANTIES

A. Contractor warrants to Owner that materials and equipment furnished under the Contract will be of good quality and new unless otherwise required or permitted by Contract Documents, that the Work will be free from defects not inherent in the quality required or permitted, and the Work will conform with the requirements of Contract Documents.

B. Work not conforming to these requirements, including substitutions not properly approved and authorized, may be considered defective.

C. The Contract warranty excludes remedy for damage or defect caused by abuse, modifications not executed by Contractor, improper or insufficient maintenance, improper operation, or evidence as to the kind and quality of materials and equipment.

PART 2 PRODUCTS

2.01 FORM OF SUBMITTALS

A. Bind in commercial quality 8-1/2” three D-side ring binders with durable plastic covers.

B. Cover: Identify each binder with typed or printed title WARRANTIES with title of project; name, address, and telephone number of Contractor and equipment supplier; and name of responsible company principal.
C. Table of Contents: Neatly typed, in the sequence of the Table of Contents of the Project Manual, with each item identified with the number and title of the specification section in which specified, and the name of Product or Work item.

D. Separate each warranty with index tab sheets keyed to the Table of Contents listing. Provide full information, using separate typed sheets as necessary. List subcontractor, supplier, and manufacturer with name, address, and telephone number of responsible principal.

E. Provide a summary of warranties indicating, as a minimum, the following information:
   1. Warranty start date.
   2. Warranty duration.
   3. Warranty end date.
   4. Serial Number and/or Product Number.
   5. Supplier/Manufacturer.
   6. Subcontractor name and contact information.

PART 3 EXECUTION

3.01 PREPARATION SUBMITTALS
   A. Obtain warranties, notarized and executed in duplicate by responsible subcontractors, suppliers, and manufacturers, within ten (10) days after completion of the applicable item of work. Except for items put into use with Owner’s permission, leave date of beginning of time of warranty until the date of Substantial Completion is determined.

   B. Verify that documents are in proper form, contain full information, and are notarized.

   C. Co-execute submittals when required.

   D. Retain warranties and bonds until time specified for submittal.

3.02 TIME OF SUBMITTALS
   A. For equipment or component parts of equipment put into service during construction with Owner permission, submit documents within ten (10) days after acceptance.

   B. Make other submittals within ten (10) days after date of Substantial Completion, prior to final Application for Payment.

   C. For items of work for which acceptance is delayed beyond date of Substantial Completion, submit within ten (10) days after acceptance, listing the date of acceptance as the beginning of the warranty period.

END OF SECTION
PART 1  GENERAL

1.01  SECTION INCLUDES

A. Maintenance of Record Documents.
B. Submittal of Record Documents.

1.02  RELATED SECTIONS

A. Section 01 33 00 - Submittal Procedures.
B. Section 01 77 00 - Closeout Procedures.
C. Individual Specifications Sections: Manufacturer's certificates and certificates of inspection.

1.03  MAINTENANCE OF DOCUMENTS AND SAMPLES

A. In addition to requirements indicated by the Contract and General Conditions, maintain at the site one record copy of:
   1. Contract Drawings
   2. Specifications
   3. Addenda
   4. Change Orders and other modifications to the Contract
   5. Reviewed shop drawings, product data, and samples
   6. Inspection certificates
   7. Manufacturer's certificates

B. Store record documents and samples in field office apart from documents used for construction. Provide files, racks, and secure storage for record documents and samples.

C. Label and file record documents and samples in accordance with section number listings in Table of Contents of this Project Manual. Label each document “PROJECT RECORD” in neat, large, printed letters.

D. Maintain record documents in a clean, dry and legible condition. Do not use record documents for construction purposes.

E. Keep record documents and samples available for inspection by Architect.

1.04  RECORDING

A. Contract drawings and shop drawings: legibly mark each item to record actual construction, including:
   1. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of construction.
   2. Field changes of dimension and detail.
   3. Changes made by modifications.
   4. Details not on original contract drawings.
   5. References to related shop drawings and modifications.
   6. Daily record information on a set of black line opaque drawings, and in a copy of a Project Manual, provided by Owner.

B. Specifications: legibly mark each item to record actual construction, including:
1. Manufacturer, trade name, and catalog number of each product actually installed, particularly optional items and substitute items.
2. Changes made by addenda and modifications.
3. Daily record information on a set of blue line opaque drawings, and in a copy of a Project Manual, provided by Owner.

C. Provide felt tip marking pens, maintaining separate colors for each major system, for recording information.

D. Record information concurrently with construction progress. Do not conceal any work until required information is recorded.

E. Other documents: maintain manufacturer's certifications, inspection certifications required by individual specifications sections.

1.05 SUBMITTALS

A. At Contract closeout, deliver record documents and samples under provisions of Section 01 77 00 to the Architect.

B. Record documents required, include but are not limited to the following list:
   1. Record drawings.
   2. Record specifications.
   3. Record survey.
   4. Contractor's certified punch list.
   5. Record Submittals including shop drawings, product data and samples.

C. Transmit with cover letter in duplicate, listing:
   1. Date.
   2. Project title and number.
   3. Contractor's name, address, and telephone number.
   4. Number and title of each record document.
   5. Signature of Contractor or authorized representative.
   6. Record Submittals shall be organized and submitted in specification order.

D. Contractor is to sign each sheet of the record drawings that are turned over to the Architect. Subcontractors are to sign their respective sheets of the Work.

E. When the Architect has completed the reproducible record drawings the Contractor and his subcontractors (as appropriate) are to sign the reproducible before they are turned over to the Owner.

F. Final payment to the Contractor is contingent on the satisfactory completion of items D and E above.

PART 2 PRODUCTS
Not Used

PART 3 EXECUTION
Not Used

END OF SECTION
PART 1    GENERAL

1.01  SECTION INCLUDES

A.  Products required.

B.  Storage and delivery of products.

1.02  RELATED SECTIONS

A.  Section 01 66 00 - Product Storage and Handling Requirements.

B.  Section 01 77 00 - Closeout Procedures.

C.  Section 01 78 23 - Operation and Maintenance Data.

D.  Individual Specifications Sections: Specific spare parts and materials required.

1.03  PRODUCTS REQUIRED

A.  Provide quantities of products, spare parts, maintenance tools, and maintenance materials specified in individual sections to be provided to Owner, in addition to that required for completion of Work.

B.  Products: Identical to those installed in the Work. Include quantities in original purchase from supplier to avoid variations in manufacture.

1.04  STORAGE AND MAINTENANCE

A.  Store products with products to be installed in the Work, under provisions of Section 01 66 00.

B.  When adequate, secure storage facilities are available at site, capable of maintaining conditions required for storage and not required for Contract work or storage, spare products may be stored in available space.

C.  Maintain spare products in original containers with labels intact and legible, until delivery to Owner.

1.05  DELIVERY

A.  Coordinate with Architect and Owner. Deliver and unload spare products to Owner at project site and obtain receipt prior to final payment.
1.06 SCHEDULE OF SPARE PARTS AND MAINTENANCE MATERIALS
Spare parts and maintenance materials shall be as noted in each section.

PART 2 PRODUCTS
Not Used

PART 3 EXECUTION
Not Used

END OF SECTION
PART 1 GENERAL

1.01 SECTION INCLUDES

A. Site and building demolition. Protection of existing and removal of indicated items, including, but not limited to:
   2. Identification of utilities.
   3. Capping, removal, relocation, and/or abandonment of designated utilities.
   4. Off-site disposal or recycling of demolition debris.
   5. Removal of asphalt and concrete paving.
   6. Removal of concrete curb work.

1.02 RELATED SECTIONS

A. Division 1 - General Conditions.

1.03 HAZARDOUS MATERIALS:

A. Before authorizing start of work, the Contractor shall have notified the Owner's Hazardous Materials Inspectors clearance stating that Hazardous Materials work is beginning. Asbestos removal is included in this contract.

B. In the areas of work where lead-based paint is present, the Contractor is responsible for adhering to the OSHA Construction Standard for Lead (29 CFR 1926.62). It requires an initial determination concerning whether any employee may be exposed to lead at or above the action level.

C. The Owner has established a hazardous materials abatement program. Should any other hazardous materials be encountered during the course of demolition, immediately notify the Owner and follow project requirements.

1.04 QUALITY ASSURANCE

A. Regulatory Requirements, Codes, and Standards:
   1. Conform to applicable federal, state, and local codes for demolition work, health and safety requirements, dust control, and debris removal.
   2. Obtain required permits from authorities including but not limited to dust control permit, demolition permit, and storm water permit.
   3. ANSI A10.6 - Safety Requirements for Demolition.
   4. Requirements of affected utility companies.
   5. Conform to applicable codes for procedures when hazardous or contaminated materials are discovered.

B. Structural Integrity: At all times maintain structural integrity of all items designated to remain.
1.05 SUBMITTALS

A. Schedule: Per provisions of Section 01 33 00, submit sequence of demolition operations to Owner for review prior to start of work to prevent interruption of on-site business operations of buildings designated to remain.
   1. Coordinate shutoff, capping, continuation, abandonment, and/or new construction of utility services as required, together with details for dust and noise control protection.

B. Shop Drawings: Indicate location and construction of temporary work, barricades and fences.

C. Design Data: Submit calculations for bracing, shoring, and underpinning signed and sealed by a Professional Engineer in the State of Nevada.

D. Project Record Documentation: Accurately record and submit actual locations of capped utilities, subsurface obstructions, and related details.

1.06 PROJECT CONDITIONS

A. Condition of Structures: Owner assumes no responsibility for actual condition of items or structures to be demolished.

B. Notify Architect and Owner upon discovery of hazardous materials.

C. Protections: Provide temporary barriers to protect Owner’s personnel and the public from injury from demolition work.
   1. Provide shoring, bracing, or support to prevent movement, settlement, or collapse of structure or element to be demolished and adjacent facilities.
   2. It is the Contractor’s responsibility to furnish, install, and maintain throughout the demolition and utility relocation a substantial temporary fence around the site in order to ensure public safety and protect the site.
      a. A substantial temporary fence is at a minimum, an 8-foot T-post fence with 6-foot chain link fabric and posts buried at least 18 inches, or an Owner-approved equivalent fence. The fence shall include a minimum of two locked gates, each with a minimum 20-foot width.
      b. Maintain existing sidewalks to greatest extent possible.
      c. If damaged during demolition work, the Contractor shall repair the fence.
   3. At the completion of demolition work, the substantial temporary fence shall be left in place for future school construction.

D. Damages: Promptly repair damages caused to adjacent facilities by demolition work at no expense to the Owner.

E. Traffic: Conduct operations and debris removal to ensure minimum interference with roads, streets, parking, walks, and other adjacent areas occupied or used facilities.
   1. Do not close, block, or otherwise obstruct streets, walks or parking facilities, of occupied or used facilities without written permission from authorities having jurisdiction. Provide alternate routes around obstructed traffic ways.

F. Explosives: Explosives are not permitted at the site.

G. Flame Cutting: Do not use cutting torches for removal until flammable materials are removed. At concealed spaces, verify conditions prior to flame cutting operations. Maintain portable fire suppression devices during flame cutting operations.
H. Utility Services: Maintain utilities to off-site buildings designated to remain and protect against damage during demolition operations. Do not interrupt utilities serving buildings to remain, except when such utilities have been relocated and when authorized in writing by authorities having jurisdiction. All utilities to be relocated or removed by others should be notified at least 48 hours before demolition begins.

I. Fire Protection: Maintain fire protection services during demolition operations. Coordinate work to ensure fire sprinklers, fire alarms, smoke detectors, emergency lighting, exit signs and other life safety systems remain in full operation in occupied areas. Provide Fire Watch services as required by the project specifications.

J. Environmental Controls:
1. The Contractor shall furnish all labor, equipment, and means required and shall carry out effective measures wherever and as often as necessary to prevent its operations from causing visible dust emissions from leaving the work areas. These measures shall include, but are not limited to, providing additional watering equipment, reducing vehicle speed on haul roads, restricting traffic on haul roads, and covering haul vehicles. The Contractor shall be responsible for any damage resulting from any dust originating from operations. The dust abatement measures shall be continued for the duration of the contract.

2. The Contractor shall hose down any vehicle or equipment leaving the project area with water prior to entering the public right-of-way if the vehicles appear to be transporting excessive amounts of dust. When any material or debris is tracked out from the project area, the Contractor shall clean all paved public roads near the site entrances as often as required to prevent spreading of dust by vehicles.

3. The Contractor shall comply with the regulations issued by the Clark County Department of Air Quality Management including, but not limited to the following:
   a. Dust palliative application is required in bare soil areas that are left unattended for more than 30 days. Upon completion of the demolition work, the site may lay unattended for up to 10 weeks and portions of the site contain bare soil. Therefore, at the completion of demolition work, a dust palliative shall be applied to bare soil areas without Type II gravel. The Contractor shall be responsible for application of dust palliative as specified in the regulations.

4. Comply with governing regulations pertaining to environmental protection.
5. Do not use water when it may create hazardous or objectionable conditions.
6. Upon completion of demolition, provide appropriate erosion control.

K. Contractor is responsible for conforming to the demolition phasing plans as shown on Drawings. Any conflicts that require deviation from the approved phasing must be submitted and approved by the Owner and Architect.

L. It is the Contractor's responsibility to coordinate and perform all demolition work in areas to accommodate new construction. Areas are to be cleaned and properly prepped to receive new work.

M. Items indicated on the Drawings to be removed and reinstalled shall be carefully removed and temporarily stored in a climatized, weatherproof area as determined by the Owner. Any items that are damaged during the removal process shall be replaced or repaired to existing condition at no expense to the Owner. If items indicated to be removed and reinstalled are deemed unable to be removed without damage, inform the Owner and Architect for an approved direction.
N. Access to/from the garden area, playgrounds, portables, and parking are to be maintained throughout demolition.

O. If unforeseen conditions are discovered during demolition, report to Owner and Architect immediately for an approved scope of work.

P. The Contractor is responsible for repairing or replacing any damage that exceeds the demolition scope indicated on the Drawings, at no additional cost to the Owner.

PART 2 PRODUCTS

As noted in applicable Sections.

PART 3 EXECUTION

3.01 EXISTING BUILDING DOCUMENTATION

A. Document condition of adjacent site items, structure, and buildings that are to remain.

B. Make arrangements with building owners and occupants to survey interior and exterior of existing buildings.

C. Employ land surveyor to provide following documentation:
   1. Survey building exterior for position and elevation of principal elements before and after completion of demolition.

D. Provide following graphic documentation:
   1. Photographically document existing building exterior before beginning demolition and after completing demolition.
   2. Identify photographs with date, time, orientation, and project identification.
   3. Deliver photographs to Owner with project record documents.

3.02 EXAMINATION

A. Examine existing buildings indicated to be demolished before demolition.

B. Determine where removals may result in structural deficiency or unplanned building collapse during demolition. Coordinate demolition sequence and procedures to prevent structures from becoming unstable.

C. Determine where demolition may affect structural integrity or weather resistance of adjacent buildings indicated to remain.
   1. Identify measures required to protect buildings from damage.
   2. Identify remedial work including patching, repairing, bracing, and other work required to leave buildings indicated to remain in structurally sound and weathertight and watertight condition.

D. If applicable, verify hazardous material abatement is complete before beginning demolition.

3.03 PREPARATION

A. Where applicable, provide shoring, bracing, or support to prevent movement, settlement,
3.03  SELECTIVE DEMOLITION

B. Locate, identify, stub off, and disconnect utility services indicated to be removed. Provide continuous service during business hours to buildings designed to remain.

C. Protect existing landscape materials, trees, appurtenances, and structures indicated to remain.

D. Erect and maintain temporary barriers and security devices for protection of the public and existing items indicated to remain.

E. Notify affected utility companies before starting work and comply with utility’s requirements.

3.04  DEMOLITION REQUIREMENTS

A. Conduct demolition to minimize interference with adjacent structures, off-site buildings, utilities, and parking lot designated to remain.

B. Provide services for effective air and water pollution controls required by local authorities having jurisdiction.

C. Conduct demolition with minimum interference to public or private access to occupied adjacent structures. Maintain egress and access at all times during school operating hours. Conform to phasing plans as indicated on Drawings.

3.05  DEMOLITION

A. Perform demolition activities in a systematic manner.

B. Demolish and remove foundation walls including footings. Break up and remove below grade concrete slabs and/or any associated structural elements for items shown to be removed on Drawings.

C. Demolish and remove all items indicated on Drawings.

D. If unanticipated mechanical, electrical, or structural elements conflicting with intended function or new construction are encountered, investigate and measure both the nature and extent of the conflict. Submit report to Owner in accurate written detail. Pending receipt of directive from Owner’s Representative, rearrange demolition schedule as necessary to continue overall job progress without undue delay.

E. Below Grade: Completely fill below grade areas and voids resulting from demolition work. Provide fill consisting of approved earth, gravel, or sand, free of trash and debris, stones over 3 inches in diameter, roots, or other organic matter.

F. Remove and dispose of natural and manmade landscape materials in landscaped areas designated to be demolished.

3.06  SALVAGED MATERIALS

A. Recycling of Materials: Wherever possible, salvage materials for recycling or post construction use.
3.07 DISPOSAL OF DEMOLISHED MATERIALS

A. Remove debris and rubbish resulting from operations from site. Transport and legally dispose off site.
   1. If hazardous materials are encountered during demolition operations, comply with applicable regulations, laws, and ordinances concerning removal, handling, and protection against exposure or environmental pollution.
   2. Burning of removed materials is not permitted on project site.
   3. Where possible, make use of recycling services and centers for demolished materials.

3.08 CLEANUP AND REPAIR

A. Upon completion of work, remove tools, equipment, and demolished materials from site.
   1. Repair demolition performed in excess of what is required, at no additional expense.
   2. Return construction and surfaces to remain to condition existing prior to start of operations.
   3. Repair adjacent construction or surfaces damaged by the work.

END OF SECTION
PART 1 GENERAL

1.1 SECTION INCLUDES

A. Formwork for cast-in-place concrete, with shoring, bracing and anchorage.
B. Openings for other work.
C. Form accessories.
D. Form stripping.

1.2 PRODUCTS INSTALLED BUT NOT FURNISHED UNDER THIS SECTION

A. Section 03 30 00 - Cast-In-Place Concrete: Supply of concrete accessories for placement by this Section.
B. Section 05 50 00 - Metal Fabrications: Supply of metal fabrications for placement by this Section.
C. Division 23: Supply of mechanical items for placement by this Section.
D. Section 26 05 10 - Basic Electrical Requirements: Supply of electrical items for placement by this Section.

1.3 RELATED SECTIONS

A. Section 03 20 00 - Concrete Reinforcing.
B. Section 03 30 00 - Cast-in-Place Concrete.

1.4 REFERENCES

A. ACI 301 - Structural Concrete for Buildings.
B. ACI 318 - Building Code Requirements for Reinforced Concrete.
C. ACI 347 - Recommended Practice for Concrete Formwork.
D. PS-1 - Construction and Industrial Plywood.

1.5 DESIGN REQUIREMENTS

A. Design, engineer and construct formwork, shoring and bracing to conform to design and code requirements; resultant concrete to conform to required shape, line and dimension.

1.6 QUALITY ASSURANCE

A. Perform Work in accordance with ACI 347, 301, 318.
B. Maintain one copy of each document on site.
1.7 REGULATORY REQUIREMENTS

A. Conform to IBC, latest edition, for design, fabrication, erection and removal of formwork.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect and handle products to site under provisions of Section 01 45 17.

1.9 COORDINATION

A. Coordinate work under provisions of Section 01 31 13.

B. Coordinate this Section with other Sections of work which require attachment of components to formwork.

C. If formwork is placed after reinforcement resulting in insufficient concrete cover over reinforcement, request instructions from Architect/Engineer before proceeding.

PART 2 PRODUCTS

2.1 WOOD FORM MATERIALS

A. Form Materials: At the discretion of the Contractor.

2.2 PREFABRICATED FORMS

A. Preformed Steel Forms: Minimum 16 gage matched, tight fitting, stiffened to support weight of concrete without deflection detrimental to tolerances and appearance of finished surfaces.

B. Glass Fiber Fabric Reinforced Plastic Forms: Matched, tight fitting, stiffened to support weight of concrete without deflection detrimental to tolerances and appearance of finished concrete surfaces.

C. Pan Type: Steel of size and profile required.

2.3 FORMWORK ACCESSORIES

A. Form Ties: Removable or Snap-off type, galvanized metal, fixed length, free of defects that could leave holes larger than one inch in concrete surface.

B. Form Release Agent: Noxcrete, Silco Seal 2000F, or approved equal. The form-release agent shall not bond with, or adversely affect concrete surfaces and impair subsequent treatments of concrete surfaces.

C. Dovetail Anchor Slot: Galvanized steel, 22 gage thick, foam filled, release tape sealed slots, anchors for securing to concrete formwork.

D. Nails, Spikes, Lag Bolts, Through Bolts, Anchorages: Sized as required, of sufficient strength and character to maintain formwork in place while placing concrete.

E. Waterstops: Rubber or Polyvinyl chloride, minimum 1,750 psi tensile strength, minimum 50 degrees F to plus 175 degrees F working temperature range, adequate width, maximum possible lengths, ribbed profile, preformed corner sections, heat welded jointing.
PART 3  EXECUTION

3.1  EXAMINATION

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

3.2  EARTH FORMS

A. Earth forming is not allowed on the exterior face of all footings and walls detailed to receive waterproofing under Section 07 13 26.

B. Hand trim sides and bottom of earth forms. Remove loose soil and moisten prior to placing concrete.

3.3  ERECTION - FORMWORK

A. Erect formwork, shoring and bracing to achieve design requirements, in accordance with requirements of ACI 301.

B. Provide bracing to ensure stability of formwork. Shore or strengthen formwork subject to overstressing by construction loads.

C. Arrange and assemble formwork to permit dismantling and stripping. Do not damage concrete during stripping. Permit removal of remaining principal shores.

D. Align joints and make watertight. Keep form joints to a minimum.

E. Obtain approval before framing openings in structural members which are not indicated on Drawings.

3.4  APPLICATION - FORM RELEASE AGENT

A. Apply form release agent on formwork in accordance with manufacturer's recommendations.

B. Apply prior to placement of reinforcing steel, anchoring devices, and embedded items.

C. Do not apply form release agent where concrete surfaces will receive special finishes or applied coverings which are affected by agent. Soak inside surfaces of untreated forms with clean water. Keep surfaces coated prior to placement of concrete.

3.5  INSERTS, EMBEDDED PARTS, AND OPENINGS

A. Provide formed openings where required for items to be embedded in or passing through concrete work.

B. Locate and set in place items which will be cast directly into concrete.

C. Coordinate work of other Sections in forming and placing openings, slots, reglets, recesses, chases, sleeves, bolts, anchors, and other inserts.

D. Install accessories in accordance with manufacturer's instructions, straight, level, and plumb. Ensure items are not disturbed during concrete placement.

E. Install waterstops continuous without displacing reinforcement.

F. Provide temporary ports or openings in formwork where required to facilitate cleaning and
inspection. Locate openings at bottom of forms to allow flushing water to drain.

G. Close temporary openings with tight fitting panels, flush with inside face of forms, and neatly fitted so joints will not be apparent in exposed concrete surfaces.

3.6 FORM CLEANING

A. Clean and remove foreign matter within forms as erection proceeds.

B. Clean formed cavities of debris prior to placing concrete.

C. Flush with water or use compressed air to remove remaining foreign matter. Ensure that water and debris drain to exterior through clean-out ports.

D. During cold weather, remove ice and snow from within forms. Do not use de-icing salts or water to clean out forms, unless formwork and concrete construction proceed within heat enclosure. Use compressed air or other means to remove foreign matter.

3.7 FORMWORK TOLERANCES

A. Construct formwork to maintain tolerances required by ACI 301.

3.8 FIELD QUALITY CONTROL

A. Inspect erected formwork, shoring, and bracing to ensure that work is in accordance with formwork design, and that supports, fastenings, wedges, ties, and items are secure.

3.9 FORM REMOVAL

A. Do not remove forms or bracing until concrete has gained sufficient strength to carry its own weight and imposed loads.

B. Loosen forms carefully. Do not wedge pry bars, hammers, or tools against finish concrete surfaces scheduled for exposure to view.

C. Store removed forms in manner that surfaces to be in contact with fresh concrete will not be damaged. Discard damaged forms.

END OF SECTION
SECTION 03 20 00
CONCRETE REINFORCING

PART 1    GENERAL

1.1    SECTION INCLUDES


1.2    RELATED SECTIONS

A.     Section 03 11 00 - Concrete Forming.

B.     Section 03 30 00 - Cast-in-Place Concrete.

C.     Section 03 35 00 - Concrete Finishing: Reinforcement for concrete floor toppings.

1.3    REFERENCES

A.     ACI 301 - Structural Concrete for Buildings.

B.     ACI 318 - Building Code Requirements For Reinforced Concrete.

C.     ACI SP-66 - American Concrete Institute - Detailing Manual.

D.     ANSI/ASTM A185 - Welded Steel Wire Fabric for Concrete Reinforcement.

E.     ANSI/AWS D1.4 - Structural Welding Code for Reinforcing Steel.


G.     AWS D12.1 - Welding Reinforcement Steel, Metal Inserts and Connections in Reinforced Concrete Construction.

H.     CRSI 63 - Recommended Practice For Placing Reinforcing Bars.

I.     CRSI 65 - Recommended Practice For Placing Bar Supports, Specifications and Nomenclature.

1.4    SUBMITTALS

A.     Submit under provisions of Section 01 33 00.

B.     Shop Drawings:

1.     Indicate bar sizes, spacings, locations, and quantities of reinforcing steel and wire fabric, bending and cutting schedules, and supporting and spacing devices.

2.     Submit rebar shop drawings for the cast-in-place concrete at the same time of those submittals.

C.     Submit welding certificates.

1.5    QUALITY ASSURANCE

A.     Perform Work in accordance with ACI 301, ACI SP-66, and ACI 318.

B.     Maintain one copy of each document on site.
C. Submit certified copies of mill test report of reinforcement materials analysis.

D. Submit welding qualifications.

E. Special inspection is required for this work.

1.6 COORDINATION

A. Coordinate work under provisions of Section 01 31 13.

B. Coordinate with placement of formwork, formed openings and other Work.

PART 2 PRODUCTS

2.1 REINFORCEMENT

A. Reinforcing Steel: ASTM A615, 60 ksi yield grade for all bars #5 and larger and all bars used for concrete walls, beams, elevated slabs, and column primary reinforcing; reinforcing may be grade 40 (FY = 40 ksi) deformed bars for all bars #4 and smaller unless noted otherwise on Drawings or Details; deformed billet steel bars, plain finish. All reinforcing to be welded shall be ASTM A706, grade 60 low alloy weldable steel.

B. Welded Steel Wire Fabric: ASTM A185 Plain Type in flat sheets or coiled rolls; plain finish.

2.2 ACCESSORY MATERIALS

A. Accessory materials shall be manufactured in accordance with CRSI “Manual of Standard Practice”.

B. Tie Wire: Minimum 16 gage annealed type.

C. Chairs, Bolsters, Bar Supports, Spacers: Sized and shaped for strength and support of reinforcement during concrete placement conditions including load bearing pad on bottom to prevent vapor barrier puncture.

D. Special Chairs, Bolsters, Bar Supports, Spacers Adjacent to Weather Exposed Concrete Surfaces: Type M; size and shape as required.

2.3 FABRICATION

A. Fabricate concrete reinforcing in accordance with CRSI Manual of Practice ACI 318.

B. Weld reinforcement in accordance with ANSI/AWS D1.4 and ANSI/AWS D12.1.

C. Locate reinforcing splices not indicated on Drawings, at point of minimum stress. Review location of splices with Architect/Engineer.

PART 3 EXECUTION

3.1 PLACEMENT

A. Place, support and secure reinforcement against displacement. Do not deviate from required position.
B. Do not displace or damage vapor barrier.
C. Accommodate placement of formed openings.
D. Conform to IBC, latest edition, for concrete cover over reinforcement.

3.2 FIELD QUALITY CONTROL
A. Field inspection will be performed under provisions of Section 01 40 00.

END OF SECTION
SECTION 03 30 00
CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Cast-in-place concrete floors, footings, foundations and walls.
B. Slabs on grade.
C. Vapor barrier.
D. Cold, control, expansion and contraction joint devices associated with concrete work of this Section, including joint sealants.
E. Equipment pads.

1.02 RELATED SECTIONS

A. Section 01 73 29 - Cutting and Patching.
B. Section 02 41 00 - Selective Demolition.
C. Section 03 20 00 - Concrete Reinforcing.
D. Section 03 35 00 - Concrete Finishing.
E. Section 03 39 00 - Concrete Curing.
F. Section 05 50 00 - Metal Fabrications.
G. Section 07 90 00 - Joint Protection.
H. Division 22 - Plumbing.
I. Division 23 - Heating, Ventilating and Air Conditioning (HVAC).
J. Division 26 - Electrical.
K. Structural Drawings and Notes.

1.03 REFERENCES

A. ACI 301 - Structural Concrete for Buildings.
B. ACI 302 - Guide for Concrete Floor and Slab Construction.
C. ACI 304 - Recommended Practice for Measuring, Mixing, Transporting and Placing Concrete.
D. ACI 305R - Hot Weather Concreting.
E. ACI 306R - Cold Weather Concreting.
F. ACI 308 - Standard Practice for Curing Concrete.
G. ACI 318 - Building Code Requirements for Reinforced Concrete.
H. ANSI/ASTM C618 - Coal Fly Ash and Raw or Calcinated Natural Pozzolan for Use as Mineral Admixture in Concrete.
I. ANSI/ASTM D994 - Preformed Expansion Joint Filler for Concrete (Bituminous Type).
J. ANSI/ASTM D1190 - Concrete Joint Sealer, Hot-Poured Elastic Type.
K. ANSI/ASTM D1751 - Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).
L. ANSI/ASTM D1752 - Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction.
M. ASTM E 1745 - Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill Under Concrete Slabs.
N. ASTM E 1643 - Installation of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs.
P. ASTM C33 - Concrete Aggregates.
Q. ASTM C94 - Ready-Mixed Concrete.
S. ASTM C494 - Chemicals Admixtures for Concrete.

1.04 SUBMITTALS
A. Submit under provisions of Section 01 33 00.
B. Provide data on concrete mix designs divided into, and defined as, structural building and site related including aggregates, products and admixtures.
C. Provide manufacturer's literature, installation, interfacing, coordination and instructions on vapor barrier.

1.05 PROJECT RECORD DOCUMENTS
A. Submit under provisions of Section 01 78 39.
B. Accurately record actual locations of embedded utilities and components which are concealed from view. Dimension and annotate accordingly, including items that have been field placed at variance with the Drawings.
C. Accurately record actual locations of found or existing utilities and components discovered and not identified on the Drawings.
1.06 QUALITY ASSURANCE

A. Perform Work in accordance with ACI 301.

B. Maintain one copy of each document on site.

C. Acquire cement and aggregate from same source for all work.

D. Conform to ACI 305R when concreting during hot weather.

E. Conform to ACI 306R when concreting during cold weather.

F. Special inspection is required for this work.

1.07 LAYOUT

A. Red pigment chalk is prohibited from use on or around all concrete surfaces.

B. Use of this pigment color on concrete will result in defective concrete and will be required to be replaced.

PART 2 PRODUCTS

2.01 CONCRETE MATERIALS

A. Use one brand of cement throughout project unless otherwise acceptable to Architect.

1. Cement: ASTM C150, Type V - Sulphate Resistant Portland type, unless otherwise noted.


3. Water: Clean and potable not detrimental to concrete.

B. Normal Weight Aggregates: ASTM C 33, and as herein specified. Provide aggregates from a single source for exposed concrete.

2.02 ADMIXTURES


2.03 ACCESSORIES

A. Bonding Agent: Two component modified epoxy resin.

B. Vapor Barrier:
   1. Vapor Barrier membrane must have the following properties:
      a. Minimum 10-mil thick polyolefin or polyethylene resin-based geomembrane.
      b. Manufactured from ISO certified virgin resins.
      c. Water Vapor Barrier ASTM E-1745 Meets or exceeds Class A
      d. Water Vapor Transmission Rate ASTM E-96 0.006 gr./ft²/hr. or lower
      e. Permeance Rating ASTM E-96 0.01 gr./ft²/hr. or lower
2. Vapor Barrier Accessories:
   a. Seam Tape:
      (1) High Density Polyethylene Tape with pressure sensitive adhesive, non-water soluable. Minimum width 4 inches.
   b. Fluid Sealant:
      (1) Seal penetrations using pressure tape and complete seal using manufacturer’s mastic.

3. Manufacturers:
   a. Stego Industries: Product - Stegowrap, 15 mil, Class A.
   b. Reef Industries: Product - VaporGuard.
   c. Substitutions: None.

4. Protection:
   a. Repair all damage to the vapor barrier per manufacturers recommendations

C. Non-Shrink Grout: Premixed compound consisting of nonmetallic aggregate, cement, water reducing and plasticizing agents; capable of developing minimum compressive strength of 2,400 psi in 48 hours and 5,000 psi in 28 days.

2.04 JOINT DEVICES AND FILLER MATERIALS

A. Joint Filler: ASTM D1752; Closed cell polyvinyl chloride foam, resiliency recovery of 95 percent if not compressed more than 50 percent of original thickness.

B. Construction Joint Devices: Integral galvanized steel, formed to tongue and groove profile, with removable top strip exposing sealant trough, knockout holes spaced at 6 inches, ribbed steel spikes with tongue to fit top screed edge.

C. Expansion and Contraction Joint Devices: ASTM B221 alloy, extruded aluminum; resilient neoprene filler strip with a Shore A hardness of 35 to permit plus or minus 25 percent joint movement with full recovery; extruded aluminum cover plate, of longest manufactured length at each location, flush mounted; color as selected.

D. Membrane Curing Compound: Section 03 39 00.

E. Sealant: Cold applied.

2.05 CONCRETE MIX

A. Mix and deliver concrete in accordance with ASTM C94, Alternative No. 3.

B. Provide concrete to the following mix design:

<table>
<thead>
<tr>
<th>Concrete Use</th>
<th>Min. 28 Day Strength</th>
<th>Max. Aggregate Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conventional slabs-on-grade</td>
<td>4500 psi</td>
<td>3/4&quot;</td>
</tr>
<tr>
<td>Walls</td>
<td>4500 psi</td>
<td>3/4&quot;</td>
</tr>
<tr>
<td>Footings</td>
<td>4500 psi</td>
<td>1-1/2&quot;</td>
</tr>
<tr>
<td>Courtyard slabs</td>
<td>4500 psi</td>
<td>3/4&quot;</td>
</tr>
</tbody>
</table>

Water/Cement Ratio (maximum):
0.45 by weight (mass) for 4500 psi concrete
Slump (plus or minus 1 inch):
4 inches (3 to 5 inches)

C. Use accelerating admixtures in cold weather only when approved by Architect/Engineer. Use of admixtures will not relax cold weather placement requirements.

D. Use set retarding admixtures during hot weather only when approved by Architect/Engineer.

E. Adjustment to Concrete Mixes: Mix design adjustments may be requested by Contractor when characteristics of materials, job conditions, weather, test results, or other circumstances warrant; at no additional cost to Owner and as accepted by Architect. Laboratory test data for revised mix design and strength results must be submitted to and accepted by Architect before using in work.

PART 3  EXECUTION

3.01  EXAMINATION

A. Verify requirements for concrete cover over reinforcement.

B. Verify that anchors, seats, plates, reinforcement and other items to be cast into concrete are accurately placed, positioned securely, and will not cause hardship in placing concrete.

C. Contractor to verify vapor barrier is not damaged or broken prior to concrete placement.

3.02  PREPARATION

A. Prepare previously placed concrete by cleaning with steel brush and applying bonding agent in accordance with manufacturer's instructions.

B. In locations where new concrete is dowelled to existing work, drill holes in existing concrete, insert steel dowels and pack solid with non-shrink grout.

3.03  PLACING CONCRETE

A. Place concrete in accordance with ACI 301, ACI 305, ACI 306, ACI 318, ACI 614, IBC 1905, and ASTM C94.

B. Notify the Architect and inspector a minimum of 48 hours prior to commencement of operations.

C. Ensure reinforcement, inserts, embedded parts, formed joint fillers, joint devices and are not disturbed during concrete placement.

D. Install vapor barrier under interior slabs, beneath and around building footings on grade per ASTME-1643 and manufacturer's instructions. Lap joints minimum 6 inches and seal watertight with seam tape. Seal to foundation walls to provide continuous barrier.

E. Repair vapor barrier damaged during placement of concrete reinforcing. Repair with vapor barrier material; seal tape manufacturer's fluid sealant; lap over damaged areas minimum 6 inches and seal watertight.
F. Seal all penetrations and pipes with manufacturer’s fluid sealant.

G. Install joint fillers, primer and sealant in accordance with manufacturer's instructions.

H. Separate slabs on grade from vertical surfaces and finishes with 1/4 inch thick joint filler and seal.

I. Extend joint filler from bottom of slab to within 1/8 inch of finished slab surface.

J. Install joint devices in accordance with manufacturer's instructions.

K. Install joint device anchors. Maintain correct position to allow joint cover flush with floor and wall finish.

L. Install joint covers in longest practical length, when adjacent construction activity is complete.

M. Apply sealants in joint devices in accordance with Section 07 92 00.

N. Maintain records of concrete placement. Record date, location, quantity, air temperature, test samples taken, and slump results.

O. Place concrete continuously between predetermined expansion, control, and construction joints.

P. Do not interrupt successive placement; do not permit cold joints to occur.

Q. Saw cut joints are not permitted.

R. Screed floors and slabs on grade level, maintaining surface flatness of maximum 1/8 inch in 10 ft.

S. Concrete Age: No more than 90 minutes shall elapse between concrete batching and concrete placement unless approved by the engineer or authorized testing agency.

T. Concrete Placement and Quality: Shall be per IBC Section 1905 and recommendations in ACI 614, ACI 301, ACI 309 and ACI 318. Mechanically vibrate all concrete when placed, except that slabs on grade need be vibrated only around floor tendon anchors, floor ducts etc. Cast closure pour, where shown on plans around columns after column dead load is applied. Remove all debris from forms before pouring. Do not vibrate forms or reinforcing steel.

U. Segregation of Aggregates: Concrete shall not be dropped through reinforcing steel (as in walls, columns, and drop capitals) so as to cause segregation of aggregates. Unconfined fall of concrete shall not exceed 5 feet.

V. Inserts: All items to be cast in concrete such as reinforcing, dowels, bolts, anchors, pipes, sleeves, etc., shall be securely positioned in the forms and existing conditions before placing the concrete.

W. Control Joints: Unless approved otherwise, all concrete slabs on grade shall be bounded by keyed control joints such that the enclosed area does not exceed 260 sq. ft. Concrete slab on grade shall be bounded by keyed control joints as shown on Drawings. Ratio of boundary dimensions shall not exceed 1-1/2:1.

X. Place all required reinforcement on chairs and supports.
Y. Pipes: Pipes other than electrical conduits shall not be embedded in structural concrete except where specifically approved by the engineer. Maximum pipe size shall be 1/3 of the slab thickness and located at the mid depth. Minimum spacing shall be 3 times the pipe diameter. Pipes shall not impair the strength of the member.

Z. Cold Weather Placing: Protect concrete work from physical damage or reduced strength which could be caused by frost, freezing actions, or low temperatures, in compliance with ACI 306.1 and as herein specified.
1. When air temperature has fallen to or is expected to fall below 40 deg F (4 deg C), uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F (10 deg C), and not more than 80 deg F (27 deg C) at point of placement.
2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
3. Do not use calcium chloride, salt, and other materials containing antifreeze agents or chemical accelerators, unless otherwise accepted in mix designs.

AA. Hot Weather Placing: When hot weather conditions exist that would seriously impair quality and strength of concrete, place concrete in compliance with ACI 305 and as herein specified.
1. Cool ingredients before mixing to maintain concrete temperature at time of placement below 90 deg F (32 deg C). Mixing water may be chilled, or chopped ice may be used to control temperature provided water equivalent of ice is calculated to total amount of mixing water. Use of liquid nitrogen to cool concrete is Contractor's option.
2. Cover reinforcing steel with water-soaked burlap if it becomes too hot, so that steel temperature will not exceed the ambient air temperature immediately before embedment in concrete.
3. Fog spray forms, reinforcing steel, and subgrade just before concrete is placed.
4. Use water-reducing retarding admixture (Type D) when required by high temperatures, low humidity, or other adverse placing conditions.

3.04 CONCRETE JOINTS

A. Construction Joints: Locate and install construction joints as indicated or, if not indicated, locate so as not to impair strength and appearance of the structure, as acceptable to Architect.

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

C. Place construction joints perpendicular to main reinforcement. Continue reinforcement across construction joints, except as otherwise indicated.

D. Waterstops: Provide waterstops in construction joints as indicated. Install waterstops to form continuous diaphragm in each joint. Make provisions to support and protect exposed waterstops during progress of work. Fabricate field joints in waterstops in accordance with manufacturer's printed instructions.

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

F. Contraction (Control) Joints in Slabs-on-Ground: Construct contraction joints in slabs-on-ground to form panels of patterns as shown.
3.05 CONCRETE FINISHING
   A. Refer to Section 03 35 00.

3.06 CURING AND PROTECTION
   A. Refer to Section 03 39 00.

3.07 FIELD QUALITY CONTROL
   A. Field inspection and testing will be performed in accordance with ACI 301 and under provisions of Section 01 40 00 and Section 01 43 26.
   B. Provide free access to Work and cooperate with appointed special inspection agency.
   C. Submit proposed mix design (separated as required) to Architect for review prior to commencement of Work, per Section 01 33 00.
   D. Tests of cement and aggregates may be performed to ensure conformance with specified requirements.
   E. Three concrete test cylinders will be taken for every 75 or less cu yds of concrete placed.
   F. One additional test cylinder will be taken during cold weather concreting, cured on job site under same conditions as concrete it represents.
   G. One slump test will be taken for each set of test cylinders taken.

3.08 PATCHING
   A. Notify and allow Architect/Engineer to inspect concrete surfaces immediately upon removal of forms.
   B. Honeycomb or embedded debris in concrete is not acceptable. Entire concrete panel, control joint to control joint, corner to corner, will be removed and replaced. Notify Architect/Engineer upon discovery. Architect will determine acceptability.
   C. Epoxy adhesive for patching concrete imperfections is not acceptable.

3.09 DEFECTIVE CONCRETE
   A. Defective Concrete: Concrete not conforming to required lines, details, dimensions, tolerances, specified requirements, poor finish, or stained is required to be replaced corner to corner, joint to joint, as directed by Architect.
   B. Repair or replacement of defective concrete will be determined and at the discretion of the Architect/Engineer.
   C. Do not patch, fill, touch-up, repair, or replace exposed concrete except upon express direction of Architect/Engineer for each individual area.

END OF SECTION
PART 1  GENERAL

1.1  SECTION INCLUDES

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

B. Section includes cast-in-place concrete, formwork, reinforcement, and accessories.

C. Refer to Part 3.3.C of this Section for specified concrete finishes. No grout cleaned or plastered finishes shall be permitted or accepted.

1.2  RELATED SECTIONS

A. Section 03 20 00 – Concrete Reinforcing.

B. Section 03 30 00 – Cast-In-Place Concrete.

C. Section 03 39 00 – Concrete Curing.

1.3  SUBMITTALS

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

B. Shop Drawings: Comply with ACI 315 "Manual of Standard Practice for Detailing Reinforced Concrete Structures" showing bar schedules, stirrup spacing, diagrams of bent bars, arrangement of concrete reinforcement. Include special reinforcement required for openings through concrete structures.

C. Architect's review is for general architectural applications and features only. Design of formwork for structural stability and efficiency is Contractor's responsibility.

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

E. Laboratory Test Reports: Submit laboratory test reports for concrete materials and mix design test.

F. Materials Certificates: Provide materials certificates in lieu of materials laboratory test reports when permitted by Architect. Materials certificates shall be signed by manufacturer and Contractor, certifying that each material item complies with, or exceeds, specified requirements. Provide certification from admixture manufacturers that chloride content complies with specification requirements.

G. Applied, Cured Color Samples: Provide (3) pieces of each color to be installed for review and approval by the Architect before installation begins.

H. Test Slab: Apply each color on site in a mechanical, or electrical room for review and approval by Architect before installation of scheduled areas begins.
1.4 QUALITY ASSURANCE

A. Codes and Standards: Comply with provisions of following codes, specifications, and standards, except where more stringent requirements are shown or specified:
1. ACI 301 "Specifications for Structural Concrete for Buildings".
2. ACI 318 "Building Code Requirements for Reinforced Concrete".
3. Concrete Reinforcing Steel Institute (CRSI), "Manual of Standard Practice".

B. Testing Agency: Owner will employ and pay a qualified independent testing agency to perform field quality-control testing services specified in Part 3 of this section. Retesting of materials failing to meet specified requirements shall be done at Contractor's expense.

1.5 PROJECT CONDITIONS

A. Protection of Footings Against Freezing: Cover completed work at footing level with sufficient temporary or permanent cover as required to protect footings and adjacent subgrade against possibility of freezing; maintain cover for time period as necessary.

B. Surface Protection: Protect adjacent finish materials against spatter during concrete placement.

C. Environmental Conditions for Concrete to Receive Staining: Maintain an ambient temperature of between 50 and 90-deg F during application and at least 48 hours after application.
1. Protection: Precautions shall be taken to avoid damage or contamination of any surfaces near the work zone. Protect completed stain work from moisture or contamination.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Floor Hardener:
1. Day Chem Hardener; Dayton Superior.
2. Surfhard; Euclid Chemical Co.
3. Lapidolith; Sonneborn Building Products.
4. Tamms Industries.

B. Floor Sealer:
1. Eucopoxy I; Euclid Chemical Co.
2. Sonomar; Sonneborn Building Products.
3. Colma Protective Coat; Sika Chemical.
4. Tamms Industries.

C. Floor Finishing:
1. Spartan-Cote Cure-Seal Hardener.
2. Burke.
4. Sonneborn.
5. Tamms Industries.

D. Self-Leveling Cement:
1. Ardex K15; Ardex.
2. Level Magic; Tamms Industries.
3. Thoro Underlayment Self-Leveling; Thoro.
4. System Products.

E. Concrete Patching Cement:
1. Recrete 20 Minute Repair; Dayton Superior.
2.2 MATERIALS

A. Forms:
1. Forms for Exposed Finish Concrete: Plywood, metal, metal-framed plywood faced, or other acceptable panel-type materials, to provide continuous, straight, smooth, exposed surfaces. Furnish in largest practicable sizes to minimize number of joints and to conform to joint system shown on drawings.
   a. Overlaid plywood complying with U.S. Product Standard PS-1 "A-C or B-B High Density Overlaid Concrete Form", Class I.
   b. Plywood complying with U.S. Product Standard PS-1 "B-B (Concrete Form) Plywood", Class I, Exterior Grade or better, mill-oiled and edgesealed, with each piece bearing legible inspection trademark.
   c. Forms for Unexposed Finish Concrete: Plywood, lumber, metal, or other acceptable material. Provide lumber dressed on at least 2 edges and one side for tight fit.
   d. Form Coatings: Provide commercial formulation form-coating compounds that will not bond with, stain, nor adversely affect concrete surfaces, and will not impair subsequent treatments of concrete surfaces.
   e. Form Ties: Factory-fabricated, adjustable-length, removable or snapoff metal form ties, designed to prevent form deflection and to prevent spalling concrete upon removal. Provide units which will leave no metal closer than 1-1/2" to surface.
      1) Provide ties which, when removed, will leave holes not larger than 1" diameter in concrete surface.

B. Reinforcing Materials:
1. Reinforcing Bars: ASTM A 615, Grade 60, deformed; or Grade 40 where specified.
2. Steel Wire: ASTM A 82, plain, cold-drawn steel.
   a. Flat.
   b. Supports for Reinforcement: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire fabric in place. Use wire bar type supports complying with CRSI specifications.
      1) For slabs-on-grade, use supports with sand plates or horizontal runners where base material will not support chair legs.
      2) For exposed-to-view concrete surfaces, where legs of supports are in contact with forms, provide supports with legs which are plastic protected (CRSI, Class 1) or stainless steel protected (CRSI, Class 2).

C. Concrete:
1. Portland Cement: ASTM C 150, Type I, typical unless noted otherwise.
   a. Use one brand of cement throughout project, unless otherwise acceptable to Architect.
   b. Fly Ash: ASTM C 618, Class F.
      1) For exterior exposed surfaces, do not use fine or coarse aggregates containing spalling-causing deleterious substances.
      2) Fine Aggregates shall comply with the following gradations:
         
         | Sieve | Percent passing |
         |-------|-----------------|
         | 3/8"  | 100             |
         | No. 4 | 95 to 100       |

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3) Course Aggregates shall comply with the following gradations:

<table>
<thead>
<tr>
<th>Sieve</th>
<th>Percent passing</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-1/2&quot;</td>
<td>100</td>
</tr>
<tr>
<td>3/4&quot;</td>
<td>90 to 100</td>
</tr>
<tr>
<td>3/8&quot;</td>
<td>25 to 55</td>
</tr>
<tr>
<td>No. 4</td>
<td>0 to 10</td>
</tr>
<tr>
<td>No. 8</td>
<td>0 to 5</td>
</tr>
</tbody>
</table>
| No. 200 Not to exceed 1.75 percent by weight in the combined course and fine aggregate.

4) Gradation limits: Maximum aggregate size shall not exceed the following requirements.

(a) 1/5 narrowest dimension between forms.
(b) 1/3 of depth of slabs.
(c) 3/4 of minimum clear spacing between reinforcing bars.

e. Water: Drinkable.

D. Admixtures:
1. Air-Entraining Admixture: ASTM C 260, certified by manufacturer to be compatible with other required admixtures.
2. Water-Reducing Admixture: ASTM C 494, Type A, and containing not more than 0.1 percent chloride ions.
3. Super Plasticizer: ASTM C 494, Type F or Type G and containing not more than 0.1 percent chloride ions.
4. Water-Reducing, Non-Chloride Accelerator Admixture: ASTM C 494, Type E, and containing not more than 0.1 percent chloride ions.
5. Water-Reducing, Retarding Admixture: ASTM C 494, Type D, and containing not more than 0.1 percent chloride ions.
6. Prohibited Admixtures: Calcium chloride thyocyanates or admixtures containing more than 0.1 percent chloride ions are not permitted.

E. Accessories:
1. Reglets: Where resilient or elastomeric sheet flashing or bituminous membranes are terminated in reglets, provide reglets of not less than 26 gage galvanized sheet steel. Fill reglet or cover face opening to prevent intrusion of concrete or debris.
2. Waterstops: Provide flat, dumbbell type or centerbulb type waterstops at construction joints and other joints as indicated. Size to suit joints.
   a. Rubber Waterstops: Corps of Engineers CRD-C 513.
   b. Polyvinyl Chloride Waterstops: Corps of Engineers CRD-C 572.
   c. Non-Shrink Grout: Grout shall be prepackaged, non-metallic, non-gaseous. It shall conform to ASTM C 1107 Grade B or C at a fluid, flow cone, consistency. Fluid grout shall attain 6500 psi compressive strength in 28 days.
   d. Absorptive Cover: Burlap cloth made from jute or kenaf, weighing approximately 9 oz. per sq. yd., complying with AASHTO M 182, Class 2.
   e. Moisture-Retaining Cover: One of the following, complying with ASTM C 171.
      1) Waterproof paper.
      2) Polyethylene film.
      3) Polyethylene-coated burlap.
   f. Liquid Membrane-Forming Curing Compound: Liquid type membrane-forming curing compound complying with ASTM C 309, Type 1 or 1D Class B for interior and ASTM C 309 Type 2 Class A for exterior.
   g. Bonding Compound: Polyvinyl Acetate (interior only) shall conform to ASTM C 1059 Type 1. Acrylic or styrene butadiene shall conform to ASTM C 1059 Type II.
h. Epoxy Adhesive: ASTM C 881, two component material suitable for use on dry or damp surfaces. Provide material "Type", "Grade", and "Class" to suit project requirements.

i. Evaporation Control: Monomolecular film designed to reduce rapid moisture loss during placement, float and finish operation.

2.3 MIXES

A. Proportioning And Design of Mixes:
1. Prepare design mixes for each type and strength of concrete by either laboratory trial batch or field experience methods as specified in ACI 301. If trial batch method used, use an independent testing facility acceptable to Architect for preparing and reporting proposed mix designs. The testing facility shall not be the same as used for field quality control testing.

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

B. Design mixes to provide normal weight concrete with the following properties, as indicated on drawings and schedules:
1. 4500 psi 28-day compressive strength; W/C ratio, 0.45.
2. 3000 psi 28-day compressive strength.

C. Suspended Slabs: Proportion structural concrete mixture as follows:
1. Minimum Compressive Strength: As indicated at 28 days.
2. Calculated Equilibrium Unit Weight: As indicated, plus or minus 3 lb/cu. ft. (48.1 kg/cu. m) as determined by ASTM C 567.
3. Slump Limit: As indicated on Structural Drawings.
4. Air Content: Do not allow air content of troweled finished floors to exceed 3 percent and as indicated on structural drawings.

D. Adjustment to Concrete Mixes: Mix design adjustments may be requested by Contractor when characteristics of materials, job conditions, weather, test results, or other circumstances warrant; at no additional cost to Owner and as accepted by Architect. Laboratory test data for revised mix design and strength results must be submitted to and accepted by Architect before using in work.

E. Admixtures:
1. Use water-reducing admixture or high range water-reducing admixture (super plasticizer) in concrete as required for placement and workability.

2. Use non-chloride accelerating admixture in concrete slabs placed at ambient temperatures below 50 deg F (10 deg C).
3. Use high-range water-reducing admixture in pumped concrete, concrete for industrial slabs, architectural concrete, parking structure slabs, concrete required to be watertight, and concrete with water/cement ratios below 0.50.
4. Use air-entraining admixture in exterior exposed concrete, unless otherwise indicated. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having total air content with a tolerance of plus-or-minus 1.5 percent as indicated.
5. Use admixtures for water-reducing and set-control in strict compliance with manufacturer's directions.
6. Water-Cement Ratio: Provide concrete for following conditions with maximum water-cement (W/C) ratios as follows:
   a. Subjected to freezing and thawing; W/C 0.50.
   b. Subjected to deicers/watertight; W/C 0.45.
   c. Subjected to brackish water, salt spray, or deicers; W/C 0.40.
   d. Slump Limits: Proportion and design mixes to result in concrete slump at point of placement as indicated.
F. Concrete Mixing:
   1. Job-Site Mixing: Mix materials for concrete in appropriate drum type batch machine mixer. For mixers of one cu. yd., or smaller capacity, continue mixing at least 1-1/2 minutes, but not more than 5 minutes after ingredients are in mixer, before any part of batch is released. For mixers of capacity larger than one cu. yd., increase minimum 1-1/2 minutes of mixing time by 15 seconds for each additional cu. yd., or fraction thereof.
      a. Provide batch ticket for each batch discharged and used in work, indicating project identification name and number, date, mix type, mix time, quantity, and amount of water introduced.
      b. Ready-Mix Concrete: Comply with requirements of ASTM C 94, and as herein specified.
      c. During hot weather, or under conditions contributing to rapid setting of concrete, a shorter mixing time than specified in ASTM C 94 may be required.

PART 3 EXECUTION

3.1 GENERAL

A. Coordinate the installation of joint materials and vapor retarders with placement of forms and reinforcing steel.

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

C. Installation Tolerances:
   2. Walls: Comply with ACI requirements for horizontal, vertical, and story to story tolerances.

D. Preparation for Slabs to Receive Concrete Stain:
   1. Newly placed concrete shall be sufficiently cured to allow concrete to become reactive, minimum 14 days. (The 14 days curing time would also apply from the time concrete topping is applied at suspended composite floors.)
   2. If any of the following colors are used, the minimum cure time of the concrete shall be 30 to 60 days to meet water vapor transmission requirements.
      a. Copper Patina.
      b. Fern Green.
      c. Weathered Bronze.
      d. Do not use liquid curing materials. Cure concrete flatwork with new, unwrinkled, non-staining, high quality curing paper. Do not overlap curing paper.
      e. Timing: Surfaces shall be cured using the same method and different sections (pours) chemically stained when the concrete is the same age.
      f. Cleaning: Immediately prior to chemically staining, thoroughly clean the concrete. Sweep surfaces, then pressure wash or scrub using a rotary floor machine. Use suitable, high quality commercial detergents to facilitate cleaning. Rinse surfaces after cleaning until rinse water is completely clean. Allow floor to dry completely prior to application of floor stain.

3.2 ERECTION

A. Forms: Design, erect, support, brace, and maintain formwork to support vertical and lateral, static, and dynamic loads that might be applied until such loads can be supported
by concrete structure. Construct formwork so concrete members and structures are of correct size, shape, alignment, elevation, and position. Maintain formwork construction tolerances complying with ACI 347.

1. Design formwork to be readily removable without impact, shock, or damage to cast-in-place concrete surfaces and adjacent materials.
2. Construct forms to sizes, shapes, lines, and dimensions shown, and to obtain accurate alignment, location, grades, level and plumb work in finished structures. Provide for openings, offsets, sinkages, keyways, recesses, moldings, rustications, reglets, chamfers, blocking, screeds, bulkheads, anchorages and inserts, and other features required in work. Use selected materials to obtain required finishes. Solidly butt joints and provide back-up at joints to prevent leakage of cement paste.
3. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush plates or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces where slope is too steep to place concrete with bottom forms only. Kerf wood inserts for forming keyways, reglets, recesses, and the like, to prevent swelling and for easy removal.
4. Provide temporary openings where interior area of formwork is inaccessible for cleanout, for inspection before concrete placement, and for placement of concrete. Securely brace temporary openings and set tightly to forms to prevent loss of concrete mortar. Locate temporary openings on forms at inconspicuous locations.
5. Chamfer exposed corners and edges as indicated, using wood, metal, PVC, or rubber chamfer strips fabricated to produce uniform smooth lines and tight edge joints.
6. Provisions for Other Trades: Provide openings in concrete formwork to accommodate work of other trades. Determine size and location of openings, recesses, and chases from trades providing such items. Accurately place and securely support items built into forms.
7. Cleaning and Tightening: Thoroughly clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, or other debris just before concrete is placed. Retightening forms and bracing after concrete placement is required to eliminate mortar leaks and maintain proper alignment.
8. Preparation of Form Surfaces:
   a. Clean re-used forms of concrete matrix residue, repair and patch as required to return forms to acceptable surface condition.
   b. Coat contact surfaces of forms with a form-coating compound before reinforcement is placed.
   c. Thin form-coating compounds only with thinning agent of type, amount, and under conditions of form-coating compound manufacturer's directions. Do not allow excess form-coating material to accumulate in forms or to come into contact with in-place concrete surfaces against which fresh concrete will be placed. Apply in compliance with manufacturer's instructions.
   d. Coat steel forms with a non-staining, rust-preventative form oil or otherwise protect against rusting. Rust-stained steel formwork is not acceptable.

3.3 INSTALLATION

A. Reinforcement: Comply with Concrete Reinforcing Steel Institute's recommended practice for "Placing Reinforcing Bars", for details and methods of reinforcement placement and supports, and as herein specified.
   1. Avoiding cutting or puncturing vapor retarder during reinforcement placement and concreting operations.
   2. Clean reinforcement of loose rust and mill scale, earth, ice, and other materials which reduce or destroy bond with concrete.
   3. Accurately position, support, and secure reinforcement against displacement by...
formwork, construction, or concrete placement operations. Locate and support reinforcing by metal chairs, runners, bolsters, spacers, and hangers, as required.

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

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

B. Concrete Placement:

1. Apply temporary protective covering to lower 2’ of finished walls adjacent to poured floor slabs and similar conditions, and guard against spattering during placement.

2. General: Comply with ACI 304 "Recommended Practice for Measuring, Mixing, Transporting, and Placing Concrete", and as herein specified.

3. Deposit concrete continuously or in layers of such thickness that no concrete will be placed on concrete which has hardened sufficiently to cause the formation of seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as herein specified. Deposit concrete as nearly as practicable to its final location to avoid segregation.

4. Placing Concrete in Forms: Deposit concrete in forms in horizontal layers not deeper than 24” and in a manner to avoid inclined construction joints. Where placement consists of several layers, place each layer while preceding layer is still plastic to avoid cold joints.

5. Consolidate placed concrete by mechanical vibrating equipment supplemented by hand-spading, rodding, or tamping. Use equipment and procedures for consolidation of concrete in accordance with ACI 309.

a. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations not farther than visible effectiveness of machine. Place vibrators to rapidly penetrate placed layer and at least 6” into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to set. At each insertion limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing segregation of mix.

b. Do not vibrate forms or reinforcing steel.

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

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

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

3) Maintain reinforcing in proper position during concrete placement operations.

d. Cold Weather Placing: Protect concrete work from physical damage or reduced strength which could be caused by frost, freezing actions, or low temperatures, in compliance with ACI 306.1 and as herein specified.

1) When air temperature has fallen to or is expected to fall below 40 deg F (4 deg C), uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F (10 deg C), and not more than 80 deg F (27 deg C) at point of placement.

2) Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade.
containing frozen materials.
3) Do not use calcium chloride, salt, and other materials containing antifreeze agents or chemical accelerators, unless otherwise accepted in mix designs.

e. Hot Weather Placing: When hot weather conditions exist that would seriously impair quality and strength of concrete, place concrete in compliance with ACI 305 and as herein specified.
1) Cool ingredients before mixing to maintain concrete temperature at time of placement below 90 deg F (32 deg C). Mixing water may be chilled, or chopped ice may be used to control temperature provided water equivalent of ice is calculated to total amount of mixing water. Use of liquid nitrogen to cool concrete is Contractor's option.
2) Cover reinforcing steel with water-soaked burlap if it becomes too hot, so that steel temperature will not exceed the ambient air temperature immediately before embedment in concrete.
3) Fog spray forms, reinforcing steel, and subgrade just before concrete is placed.
4) Use water-reducing retarding admixture (Type D) when required by high temperatures, low humidity, or other adverse placing conditions.

C. Finish:
1. Rough Form Finish: Formed concrete surfaces not exposed-to-view in the finish work or by other construction, unless otherwise indicated. This is the concrete surface having texture imparted by form facing material used, with tie holes and defective areas repaired and patched and fins and other projections exceeding 1/4" in height rubbed down or chipped off.
2. Smooth Form Finish: For formed concrete surfaces exposed-to-view, or that are to be covered with a coating material applied directly to concrete, or a covering material applied directly to concrete, such as waterproofing, damproofing, veneer plaster, painting, or other similar system. This is as-cast concrete surface obtained with selected form facing material, arranged orderly and symmetrically with a minimum of seams. Repair and patch defective areas.
3. Smooth Rubbed Finish: Provide smooth rubbed finish to concrete surfaces, which have received smooth form finish treatment, not later than one day after form removal.
   a. Moisten concrete surfaces and rub with carborundum brick or other abrasive until a uniform color and texture is produced. Do not apply cement grout other than that created by the rubbing process.
4. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces occurring adjacent to formed surfaces, strike-off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces, unless otherwise indicated.

D. Slab Finishes:
1. Scratch Finish: Apply scratch finish to monolithic slab surfaces that are to receive concrete floor topping or mortar setting beds for tile, portland cement terrazzo, and other bonded applied cementitious finish flooring material, and as otherwise indicated.
   a. After placing slabs, plane surface to tolerances for floor flatness (F ) of 15 and floor levelness (F ) of 13. Slope surfaces uniformly to drains where required. After leveling, roughen surface before final set, with stiff brushes, brooms, or rakes.
2. Float Finish: Apply float finish to monolithic slab surfaces to receive trowel finish and other finishes as hereinafter specified, and slab surfaces which are to be covered with membrane or elastic waterproofing, membrane or elastic roofing, or...
sand-bed terrazzo, and as otherwise indicated.

a. After screeding, consolidating, and leveling concrete slabs, do not work surface until ready for floating. Begin floating when surface water has disappeared or when concrete has stiffened sufficiently to permit operation of power-driven floats, or both. Consolidate surface with power-driven floats, or by hand-floating if area is small or inaccessible to power units. Check and level surface plane to tolerances of F 18 - F 15. Cut down high spots and fill low spots. Uniformly slope surfaces to drains. Immediately after leveling, refloat surface to a uniform, smooth, granular texture.

3. Trowel Finish: Apply trowel finish to monolithic slab surfaces to be exposed-to-view, and slab surfaces to be covered with resilient flooring, carpet, ceramic or quarry tile, paint, or other thin film finish coating system.

a. After floating, begin first trowel finish operation using a power-driven trowel. Begin final troweling when surface produces a ringing sound as trowel is moved over surface. Consolidate concrete surface by final hand-troweling operation, free of trowel marks, uniform in texture and appearance, and with surface leveled to tolerances of F 20 - F 17. Grind smooth surface defects which would telegraph through applied floor covering system.

4. Trowel and Fine Broom Finish: Where ceramic or quarry tile is to be installed with thin-set mortar, apply trowel finish as specified, then immediately follow with slightly scarifying surface by fine brooming.

5. Non-Slip Broom Finish: Apply non-slip broom finish to exterior concrete platforms, steps, and ramps, and elsewhere as indicated.

a. Immediately after float finishing, slightly roughen concrete surface by brooming with fiber bristle broom perpendicular to main traffic route. Coordinate required final finish with Architect before application.

E. Joints:

1. Construction Joints: Locate and install construction joints as indicated or, if not indicated, locate so as not to impair strength and appearance of the structure, as acceptable to Architect.

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

3. Place construction joints perpendicular to main reinforcement. Continue reinforcement across construction joints, except as otherwise indicated.

4. Waterstops: Provide waterstops in construction joints as indicated. Install waterstops to form continuous diaphragm in each joint. Make provisions to support and protect exposed waterstops during progress of work. Fabricate field joints in waterstops in accordance with manufacturer's printed instructions.

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

6. Contraction (Control) Joints in Slabs-on-Ground: Construct contraction joints in slabs-on-ground to form panels of patterns as shown. Use saw cuts 1/8" x 1/4 slab depth or inserts 1/4" wide x 1/4 of slab depth, unless otherwise indicated.

a. Form contraction joints by inserting premolded plastic, hardboard or fiberboard strip into fresh concrete until top surface of strip is flush with slab surface. Tool slab edges round on each side of insert. After concrete has cured, remove inserts and clean groove of loose debris.

b. Contraction joints in unexposed floor slabs may be formed by saw cuts as soon as possible after slab finishing as may be safely done without dislodging aggregate.

c. If joint pattern not shown, provide joints not exceeding 15' in either direction and located to conform to bay spacing wherever possible (at column centerlines, half bays, third-bays).
d. Embedded Items:
1) Set and build into work anchorage devices and other embedded items required for other work that is attached to, or supported by, cast-in-place concrete. Use setting drawings, diagrams, instructions, and directions provided by suppliers of items to be attached thereto.
2) Install reglets to receive top edge of foundation sheet waterproofing, and to receive thru-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, relieving angles, and other conditions.
3) Edge Forms and Screed Strips for Slabs: Set edge forms or bulkheads and intermediate screed strips for slabs to obtain required elevations and contours in finished slab surface. Provide and secure units sufficiently strong to support types of screed strips by use of strike-off templates or accepted compacting type screeds.

F. Special Control Joints.
1. Provide special control joint cuts as indicated on drawings: Control joint pattern to be as indicated on the drawings.
2. Control Joint Profile: The control joint to be equal to joint made by ‘Soff Cut International’, 1112 Olympic Drive, Corona CA 92881, 1-800-776-3328.
3. The control joint to be XL-V21. The width to be 0.100” to 0.120” wide with a beveled profile that is 3/8” wide at the surface and slopes at a 45 degree angle for a depth of an 1/8”.

G. Miscellaneous Concrete:
1. Filling-In: Fill-in holes and openings left in concrete structures for passage of work by other trades, unless otherwise shown or directed, after work of other trades is in place. Mix, place, and cure concrete as herein specified, to blend with in-place construction. Provide other miscellaneous concrete filling shown or required to complete work.
2. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.
3. Equipment Bases and Foundations: Provide machine and equipment bases and foundations, as shown on drawings. Set anchor bolts for machines and equipment to template at correct elevations, complying with certified diagrams or templates of manufacturer furnishing machines and equipment.
4. Steel Pan Stairs: Provide concrete fill for steel pan stair treads and landings and associated items. Cast-in safety inserts and accessories as shown on drawings. Screed, tamp, and finish concrete surfaces as scheduled.

1.4 CURING AND PROTECTION

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

B. Curing Methods: Perform curing of concrete by curing and sealing compound, by moist curing, by moisture-retaining cover curing, and by combinations thereof, as herein specified.
1. Provide moisture curing by following methods.
   a. Keep concrete surface continuously wet by covering with water.
   b. Continuous water-fog spray.
   c. Covering concrete surface with specified absorptive cover, thoroughly saturating cover with water and keeping continuously wet. Place absorptive cover to provide coverage of concrete surfaces and edges, with 4" lap over adjacent absorptive covers.
   d. Provide moisture-cover curing as follows:
      1) Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width with sides and ends lapped at least 3" and sealed by waterproof tape or adhesive. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
   e. Provide curing and sealing compound to exposed interior slabs and to exterior slabs, walls, and curbs, as follows:
      1) Apply specified curing and sealing compound to concrete slabs as soon as final finishing operations are complete (within 2 hours). Apply uniformly in continuous operation by power-spray or roller in accordance with manufacturer's directions. Reccoat areas subjected to heavy rainfall within 3 hours after initial application. Maintain continuity of coating and repair damage during curing period.
      2) Do not use membrane curing compounds on surfaces which are to be covered with coating material applied directly to concrete, liquid floor hardener, waterproofing, damp proofing, membrane roofing, flooring (such as ceramic or quarry tile, glue-down carpet), painting, and other coatings and finish materials, unless otherwise acceptable to Architect.

2. Curing Formed Surfaces: Cure formed concrete surfaces, including undersides of beams, supported slabs, and other similar surfaces by moist curing with forms in place for full curing period or until forms are removed. If forms are removed, continue curing by methods specified above, as applicable.

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

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

5. Sealer and Dustproofer: Apply a second coat of specified curing and sealing compound only to surfaces given a first coat.

3.5 REMOVAL OF FORMS

A. Formwork not supporting weight of concrete, such as sides of beams, walls, columns, and similar parts of the work, may be removed after cumulatively curing at not less than 50 deg F (10 deg C) for 24 hours after placing concrete, provided concrete is sufficiently hard to not be damaged by form removal operations, and provided curing and protection operations are maintained.

B. Formwork supporting weight of concrete, such as beam soffits, joists, slabs, and other structural elements, may not be removed in less than 14 days and until concrete has attained design minimum compressive strength at 28 days. Determine potential compressive strength of in-place concrete by testing field-cured specimens representative of concrete location or members.

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

D. Re-Used of Forms:
1. Clean and repair surfaces of forms to be re-used in work. Split, frayed, delaminated, or otherwise damaged form facing material will not be acceptable for exposed surfaces. Apply new form coating compound as specified for new formwork.

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

3.6 CONCRETE SURFACE REPAIRS

A. Patching Defective Areas: Repair and patch defective areas with cement mortar immediately after removal of forms, when acceptable to Architect.

1. Cut out honeycomb, rock pockets, voids over 1/4" in any dimension, and holes left by tie rods and bolts, down to solid concrete but, in no case to a depth of less than 1". Make edges of cuts perpendicular to the concrete surface. Thoroughly clean, dampen with water, and brush-coat the area to be patched with specified bonding agent. Place patching mortar after bonding compound has dried.

2. For exposed-to-view surfaces, blend white portland cement and standard portland cement so that, when dry, patching mortar will match color surrounding. Provide test areas at inconspicuous location to verify mixture and color match before proceeding with patching. Compact mortar in place and strike-off slightly higher than surrounding surface.

3. Repair of Formed Surfaces: Remove and replace concrete having defective surfaces if defects cannot be repaired to satisfaction of Architect. Surface defects, as such, include color and texture irregularities, cracks, spalls, air bubbles, honeycomb, rock pockets; fins and other projections on surface; and stains and other discolorations that cannot be removed by cleaning. Flush out form tie holes, fill with dry pack mortar, or precast cement cone plugs secured in place with bonding agent.

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

5. Repair of Unformed Surfaces: Test unformed surfaces, such as monolithic slabs, for smoothness and verify surface plane to tolerances specified for each surface and finish. Correct low and high areas as herein specified. Test unformed surfaces sloped to drain for trueness of slope, in addition to smoothness using a template having required slope.

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

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

8. Correct low areas in unformed surfaces during or immediately after completion of surface finishing operations by cutting out low areas and replacing with fresh concrete. Finish repaired areas to blend into adjacent concrete. Proprietary patching compounds may be used when acceptable to Architect.

B. Repair defective areas, except random cracks and single holes not exceeding 1" diameter, by cutting out and replacing with fresh concrete. Remove defective areas to sound concrete with clean, square cuts and expose reinforcing steel with at least 3/4" clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding compound. Mix patching concrete of same materials to provide concrete of same type or class as original concrete. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.

1. Repair isolated random cracks and single holes not over 1" in diameter by dry-
pack method. Groove top of cracks and cut-out holes to sound concrete and clean of dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding compound. Mix dry-pack, consisting of one part portland cement to 2-1/2 parts fine aggregate passing a No. 16 mesh sieve, using only enough water as required for handling and placing. Place dry pack after bonding compound has dried. Compact dry-pack mixture in place and finish to match adjacent concrete. Keep patched area continuously moist for not less than 72 hours.

C. Perform structural repairs with prior approval of Architect or Structural Engineer for method and procedure, using specified epoxy adhesive and mortar.

3.7 FIELD QUALITY CONTROL

A. Sampling and testing for quality control during placement of concrete may include the following, as directed by Architect.

1. Sampling Fresh Concrete: ASTM C 172, except modified for slump to comply with ASTM C 94.
   a. Slump: ASTM C 143; one test at point of discharge for each day’s pour of each type of concrete; additional tests when concrete consistency seems to have changed.
   b. Air Content: ASTM C 173, volumetric method for lightweight or normal weight concrete; ASTM C 231 pressure method for normal weight concrete; one for each day's pour of each type of air-entrained concrete.
   c. Concrete Temperature: Test hourly when air temperature is 40 deg F (4 deg C) and below, and when 80 deg F (27 deg C) and above; and each time a set of compression test specimens made.
   d. Compression Test Specimen: ASTM C 31; one set of 5 standard cylinders for each compressive strength test, unless otherwise directed. Mold and store cylinders for laboratory cured test specimens except when field-cure test specimens are required.
   e. Compressive Strength Tests: ASTM C 39; one set for each day’s pour exceeding 5 cu. yds. plus additional sets for each 50 cu. yds. over and above the first 25 cu. yds. of each concrete class placed in any one day; one specimen tested at 7 days, two specimens tested at 28 days, and two specimens retained in reserve for later testing if required.
      1) When frequency of testing will provide less than 5 strength tests for a given class of concrete, conduct testing from at least 5 randomly selected batches or from each batch if fewer than 5 are used.
      2) When total quantity of a given class of concrete is less than 50 cu. yds., strength test may be waived by Architect if, in his judgment, adequate evidence of satisfactory strength is provided.
      3) When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, evaluate current operations and provide corrective procedures for protecting and curing the in-place concrete.
      4) Strength level of concrete will be considered satisfactory if averages of sets of three consecutive strength test results equal or exceed specified compressive strength, and no individual strength test result falls below specified compressive strength by more than 500 psi.

B. Test results will be reported in writing to Architect, Structural Engineer and Contractor within 24 hours after tests. Reports of compressive strength tests shall contain the project
identification name and number, date of concrete placement, name of concrete testing service, concrete type and class, location of concrete batch in structure, design compressive strength at 28 days, concrete mix proportions and materials; compressive breaking strength and type of break for both 7-day tests and 28-day tests.

C. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted but shall not be used as the sole basis for acceptance or rejection.

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

END OF SECTION
SECTION 03 39 00
CONCRETE CURING

PART 1  GENERAL

1.1  SECTION INCLUDES

A. Initial and final curing of horizontal and vertical concrete surfaces.

1.2  RELATED SECTIONS

A. Section 03 30 00 - Cast-In-Place Concrete.
B. Section 03 35 00 - Concrete Finishing.

1.3  REFERENCES

A. ACI 301 - Structural Concrete for Buildings.
B. ACI 302 - Recommended Practice for Concrete Floor and Slab Construction.
C. ACI 308 - Standard Practice for Curing Concrete.
D. ASTM C171 - Sheet Materials for Curing Concrete.

1.4  SUBMITTALS

A. Submit under provisions of Section 01 33 00.
B. Product Data:  Provide data on curing compounds, product characteristics, compatibility and limitations.
C. Manufacturer's Installation Instructions:  Indicate criteria for preparation and application.

1.5  DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect and handle products under provisions of Section 01 45 17.
B. Deliver curing materials in manufacturer's packaging including application instructions.

PART 2  PRODUCTS

2.1  MATERIALS

A. Membrane Curing Compound:  ASTM C309 Type Class A and B, Acrylic dissipating resin type, clear without fugitive dye; Aqua Resin Cure as manufactured by Burke, Kure-n-Seal as manufactured by Sonneborn, or Master Seal by Master Builders.  Not for use where sealers or ceramic tile are scheduled.
B. Water:  Potable and not detrimental to concrete.
PART 3  EXECUTION

3.1  EXAMINATION

A. Verify that substrate surfaces are ready to be cured.

3.2  EXECUTION - HORIZONTAL SURFACES

A. Cure floor surfaces in accordance with ACI 308.

B. Spray water over floor slab areas and maintain wet for 7 days or apply membrane curing compound in accordance with manufacturer's instructions in 2 coats with second coat at right angles to first.

3.3  EXECUTION - VERTICAL SURFACES

A. Cure surfaces in accordance with ACI 308.

B. Spray water over surfaces and maintain wet for seven (7) days or apply membrane curing compound in accordance with manufacturer's instructions in two (2) coats with second coat at right angles to first.

3.4  PROTECTION OF FINISHED WORK

A. Protect finished Work under provisions of Section 01 45 17.

B. Do not permit traffic over unprotected floor surface.

END OF SECTION
PART 1  GENERAL

1.1  SECTION INCLUDES

A. Mortar and grout for masonry.

1.2  RELATED SECTIONS

A. Section 09 24 00 - Portland Cement Plaster (Stucco).

1.3  REFERENCES

A. ASTM C91 - Masonry Cement.
B. ASTM C94 - Ready-Mixed Concrete.
C. ASTM C144 - Aggregate for Masonry Mortar.
D. ASTM C150 - Portland Cement.
F. ASTM C270 - Mortar for Unit Masonry.
G. ASTM C404 - Aggregates for Masonry Grout.
H. ASTM C476 - Grout for Masonry.
I. ASTM C780 - Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry.

1.4  SUBMITTALS

A. Submit under provisions of Section 01 33 00.
B. Include design mix, indicate whether the Proportion or Property specification of ASTM C270 is to be used, required environmental conditions, and admixture limitations.
C. Samples: Submit two samples of mortar, illustrating mortar color and color range to match each color of CMU. May be submitted in conjunction with the CMU mock-up.
D. Submit reports on mortar indicating conformance of mortar to property requirements of ASTM C270 and test and evaluation reports to ASTM C780.
E. Submit reports on grout indicating conformance of component grout materials to requirements of ASTM C476 and test and evaluation reports to ASTM C1019.
F. Submit manufacturer's certificate under provisions of Section 01450 that products meet or exceed specified requirements.
1.5 DELIVERY, STORAGE, AND HANDLING
A. Deliver products to site under provisions of Section 01655.
B. Store and protect products under provisions of Section 01655.
C. Maintain packaged materials clean, dry, and protected against dampness, freezing, and foreign matter.

1.6 ENVIRONMENTAL REQUIREMENTS

1.7 MIX TESTS
A. Test mortar and grout in accordance with Section 01 43 26.
B. Testing of Mortar Mix: In accordance with ASTM C780.
C. Test mortar mix for compressive strength, mortar aggregate ratio, water content and air content.
D. Testing of Grout Mix: In accordance with ASTM C1019.
E. Test mortar mix for compressive strength and slump.
F. Test mortar and grout along with masonry units per ASTM C1314 to confirm specified f’m is provided.

PART 2 PRODUCTS
2.1 MATERIALS
A. Portland Cement: ASTM C150, Type V; colors for reinforced unit masonry mortar to match CMU colors.
B. Masonry Cement: ASTM C91, Type M or S, Type M shall be used where masonry is in contact with soil.
C. Grout Aggregate: ASTM C404.
D. Water: Clean and potable.

2.2 MORTAR MIXES
A. Mortar for Reinforced Unit Masonry: ASTM C270, Type M or S using the Property Method. Color: Grey. 1800 psi (min) at 28 days.

2.3 MORTAR MIXING
A. Thoroughly mix mortar ingredients in quantities needed for immediate use in accordance with ASTM C270.
B. Maintain sand uniformly damp immediately before the mixing process.
C. Do not use "anti-freeze" compounds or any compound containing chlorides to lower the
freezing point of mortar.

D. If water is lost by evaporation, retemper only within two hours of mixing.

E. Use mortar within two hours after mixing at temperatures of 80 degrees F, or two-and-one-half hours at temperatures between 40 degrees F and 50 degrees F. Do not mix mortar when temperatures at time of application are less than 40 degrees F.

2.4 GROUT MIXES

A. Bond Beams: 2000 psi strength at 28 days (unless noted otherwise in the drawings); 7-8 inches slump; mixed in accordance with ASTM C476 Course Grout.

B. Engineered Masonry: 2000 psi strength at 28 days (unless noted otherwise in the drawings); 7-8 inches slump; mixed in accordance with ASTM C476 Course Grout.

C. Grout strength shall be sufficient to achieve specified f'm in prism tests.

D. Epoxy grout shall be used to install all cap block.

2.5 GROUT MIXING

A. Thoroughly mix mortar ingredients in quantities needed for immediate use in accordance with ASTM C476 Course grout.

B. Add admixtures in accordance with manufacturer's instructions. Provide uniformity of mix.

C. Do not use "anti-freeze" compounds or any compound containing chlorides to lower the freezing point of grout.

PART 3 EXECUTION

3.1 EXAMINATION

A. Request inspection of spaces to be grouted.

3.2 PREPARATION

A. Plug cleanout holes with block masonry units to prevent leakage of grout materials. Brace masonry for wet grout pressure.

3.3 INSTALLATION

A. Install mortar and grout to requirements of the specific masonry Sections.

B. Work grout into masonry cores and cavities to eliminate voids.

C. Do not install grout in lifts greater than 16 inches without consolidating grout by vibration.

D. Do not displace reinforcement while placing grout.

E. Remove grout spaces of excess mortar.

3.4 MORTAR JOINTS

A. Above Grade - Light mortar wash finish.

B. Below Grade - Flush joints.
END OF SECTION
PART 1 GENERAL

1.1 SECTION INCLUDES

A. Interior wall framing where indicated on drawings.
B. Fascia and soffit framing.
C. All headers in stud walls which are part of the work of this section.

1.2 PRODUCTS FURNISHED BUT NOT INSTALLED UNDER THIS SECTION

A. Section 03 11 00 - Concrete Forming: Placement of anchors for securing the work of this Section.

1.3 PRODUCTS INSTALLED BUT NOT FURNISHED UNDER THIS SECTION

A. Section 08 41 13 - Aluminum Entrances and Storefronts: Anchors for support of framing.

1.4 RELATED SECTIONS

A. Section 07 21 16 - Blanket Insulation: Insulation within framing members.
B. Section 07 90 00 - Joint Protection.
C. Section 09 21 16 - Gypsum Board Assemblies: Light weight, non-load bearing metal stud framing.
D. Section 09 51 13 - Acoustical Panel Ceilings.
E. Section 09 90 00 - Painting and Coating: Painting of exposed members.

1.5 REFERENCES

A. AISI - American Iron and Steel Institute - Cold-Formed Steel Design Manual.
C. ASTM A446 - Steel Sheet, Zinc-Coated (Galvanized) by Hot-Dip Process, Physical (Structural) Quality.
D. ASTM A525 - Steel Sheet, Zinc Coated (Galvanized) by the Hot Dip Process.
E. AWCI (Association of Wall and Ceiling Industries) - Specifications Guide for Cold-Formed Steel Structural Members.
F. AWS D1.3 - Light Steel Welding Code.
G. SSPC (Steel Structures Painting Council) - Steel Structures Painting Manual.
H. MFMA (Metal Framing Manufacturers Association) - Guidelines for the Use of Metal Framing.
1.6 SYSTEM DESIGN
   A. Non-bearing stud wall framing may be designed and submitted as a deferred submittal to the Architect for approval prior to acceptance.

1.7 SUBMITTALS
   A. Submit under provisions of Section 01 33 00.
   B. Shop Drawings: Indicate component details, framed openings, bearing, anchorage, welds, type and location of fasteners, and accessories or items required of related work.
   C. Indicate stud, ceiling and roof joist layouts.
   D. Describe method for securing studs to tracks and for bolted and welded framing connections.
   E. Provide product data on standard framing members; describe materials and finish, product criteria and limitation.
   F. Submit manufacturer's installation instructions under provisions of Section 01 33 23.
   G. Drawings and calculations for non-load bearing stud wall framing system design, if applicable.

1.8 QUALITY ASSURANCE
   A. Calculate structural properties of framing members in accordance with AWCI, MFMA, and AWS D1.3 requirements.
   B. Special inspection is required for all welding.
   C. Prepare shop drawings under the direct supervision of a Professional Structural Engineer licensed in the state of Nevada.

1.9 QUALIFICATIONS
   A. Installer: Company specializing in performing the work of this section with minimum 5 years documented experience.

1.10 COORDINATION
   A. Coordinate work under provisions of Section 01 31 13.

PART 2 PRODUCTS

2.1 MANUFACTURERS
   A. Allied Studco.
   B. Knoor Steel Framing System.
   C. Consolidated Fabricators.
   D. National Gypsum.
   E. Dietrich.
F. Substitutions: Under provisions of Section 01 25 00.

2.2 FRAMING MATERIALS

A. Studs: ASTM C955, galvanized structural quality sheet steel, formed to channel shape, punched web; 16 gage or as scheduled on Drawings, 6 inch or 3-5/8 inch face and 1-5/8 inch depth.

B. Joists and Purlins: ASTM C955, galvanized structural quality sheet steel, formed to channel shape, solid web; 16 gage thick or as scheduled on Drawings, face and depth dimensions as detailed on Structural Drawings.

C. Track: Formed steel; channel shaped; same thickness and width as studs and double deflection tracks.

2.3 ACCESSORIES

A. Bracing and Bridging: Formed sheet steel, of same thickness as joists or studs.

B. Plates, Gussets, Clips: Formed sheet steel, 3/16 inch thickness.

C. Touch-Up Primer for Galvanized Surfaces: SSPC 20, Type 1, zinc rich.

2.4 FASTENERS

A. Self-drilling, Self-tapping Screws, Bolts, Nuts and Washers: ASTM A123, hot-dip galvanized to .60 oz/sq ft.

B. Anchorage Devices: Power actuated.

C. Welding: In conformance with AWS D1.3.

2.5 FINISHES

A. Studs: Galvanize to G60 coating class, conforming to ASTM A525.

B. Tracks and Headers: Galvanize to G60 coating class, conforming to ASTM A525.

C. Channels (Joists): Galvanize to G60 coating class, conforming to ASTM A525.

D. Bracing, Furring, Bridging: Same finish as framing members.

E. Plates, Gussets, Clips: Same finish as framing members.

F. Finish Painting of Exposed Members: See Schedule in Paragraph 3.5.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that surface conditions are prepared properly to receive work.

3.2 ERECTION OF STUDDLING

A. Install components in accordance with manufacturer's instructions.
B. Align top and bottom tracks; locate to wall layout. Secure in place at 24 inches oc. Coordinate installation of sealant with bottom track.

C. Place studs at 16 inches oc; not more than 2 inches from abutting walls and at each side of openings. Connect studs to tracks using clip and tie or fastener method.

D. Construct corners using minimum three studs. Double stud wall openings, door and window jambs.

E. Erect load bearing studs, one-piece full length. Splicing of studs is not permitted.

F. Erect load bearing studs, brace, and reinforce to develop full strength, to achieve design requirements.

G. Install intermediate studs above and below openings to align with wall stud spacing.

H. Attach cross studs to studs for attachment of fixtures anchored to walls.

I. Install framing between studs for attachment of mechanical and electrical items, and to prevent stud rotation.

J. Touch-up field welds and damaged galvanized surfaces with primer for galvanized surfaces.

K. Complete framing ready to receive interior gypsum board, backerboard.

3.3 ERECTION TOLERANCES

A. Maximum Variation from True Position: 1/8 inch in 10 feet.

B. Maximum Variation of any Member from Plane: 1/8 inch in 10 feet.

3.4 SCHEDULE OF FINISHING

A. Interior Exposed Framing Members:

1. Paint as scheduled in Section 09 90 00 – Painting and Coating.
2. Color: As scheduled on Drawings.

END OF SECTION
PART 1    GENERAL

1.1    SECTION INCLUDES
   A. Shop fabricated ferrous metal items, galvanized and prime painted.
   B. Shop fabricated trench covers and framing.
   C. Shelf angles.
   D. Miscellaneous steel trim.
   E. Metal bollards.

1.2    RELATED SECTIONS
   A. Section 03 11 00 - Concrete Forming.
   B. Section 03 30 00 - Cast-In-Place Concrete.
   C. Section 05 40 00 - Cold Formed Metal Framing.
   D. Section 05 52 00 - Metal Railings.
   E. Section 09 90 00 - Painting and Coating: Paint finish.
   F. Section 12 36 61 - Countertops.

1.3    REFERENCES
   A. ASTM A36 - Structural Steel.
   B. ASTM A123 - Zinc Coatings on Iron and Steel Products.
   C. ASTM A153 - Zinc Coating (Hot Dip) on Iron and Steel Hardware.
   D. ASTM A269 - Seamless and Welded Austenitic Stainless Steel Tubing for General Service.
   F. ASTM A325 - High Strength Bolts for Structural Steel Joints.
   G. ASTM A500 - Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Round and Shapes.
   H. ASTM A501 - Hot-Formed Welded and Seamless Carbon Steel Structural Pipe.
   I. AWS A2.0 - Standard Welding Symbols.
   J. AWS D1.1 - Structural Welding Code.
   K. SSPC - Steel Structures Painting Council.
1.4 SUBMITTALS

A. Submit under provisions of Section 01 33 00.

B. Shop Drawings: Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories. Include erection drawings, elevations, and details where applicable. As a minimum, present the following shop drawings:
   1. Steel framing and support for mechanical and electrical equipment.
   2. Railings for mechanical equipment.
   3. Railings for special equipment.
   4. Brackets and supports for counters.

C. Indicate welded connections using standard AWS A2.0 welding symbols. Indicate net weld lengths.

1.5 QUALIFICATIONS

A. Welders' Certificates: Submit under provisions of Section 01 33 00, certifying welders employed on the Work, verifying AWS qualification within the previous 12 months.

1.6 FIELD MEASUREMENTS

A. Verify that field measurements are as indicated on Drawings.

B. Special inspection is required for all welding.

1.7 COORDINATION

A. Coordinate shop primers with topcoats to be applied to products. Comply with paint and coating manufacturer’s written recommendations to ensure that shop primers and topcoats are comparable with one another.

B. Coordinate installation of metal fabrications that are anchored and/or receive other work. Furnish drawings, templates, and directions for all this work. Ensure on-time delivery of these items.

PART 2 PRODUCTS

2.1 MATERIALS

A. Steel Sections: ASTM A36.

B. Steel Tubing: ASTM A500, Grade B and ASTM A501.

C. Angles and Plates: ASTM A36.


E. Bolts, Nuts, and Washers: ASTM A325 or A307 as specified galvanized to ASTM A153 for galvanized components.

F. Welding Materials: AWS D1.1; type required for materials being welded.
G. Touch-Up Primer for Galvanized Surfaces: SSPC 20, Type 1, zinc rich.
J. Stainless Steel Sheet and Tubing - Austenitic 18-8, Type 304.

2.2 FABRICATION

A. Fit and shop assemble in largest practical sections, for delivery to site.
B. Fabricate items with joints tightly fitted and secured.
C. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.
D. Exposed Mechanical Fastenings: Flush countersunk screws or bolts; unobtrusively located; consistent with design of component, except where specifically noted otherwise.
E. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.
F. Trench covers and frames are as manufactured by Architectural Art Manufacturing.

2.3 FINISHES

A. Prepare all steel surfaces in accordance with SSPC SP-2.
B. Shop prime steel items. Do not prime surfaces in direct contact with concrete or where field welding is required.
C. Galvanized items to minimum 1.25 oz/sq ft zinc coating in accordance with ASTM A123.
D. Aluminum items - smooth plate mill finish aluminum.
E. Stainless steel items - #4 commercial finish.
F. Finish Paint: See Schedule, Paragraph 3.5.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that field conditions are acceptable and are ready to receive work.
B. Beginning of installation means erector accepts existing conditions.

3.2 PREPARATION

A. Clean and strip primed steel items to bare metal where site welding is required.
B. Supply items required to be cast into concrete or embedded in masonry with setting templates, to appropriate sections.
3.3 INSTALLATION

A. Install items plumb and level, accurately fitted, free from distortion or defects.

B. Allow for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.

C. Field weld components indicated on Drawings.

D. Perform field welding in accordance with AWS D1.1.

E. Obtain Architect/Engineer approval prior to site cutting or making adjustments not scheduled.

F. After erection, prime welds, abrasions, and surfaces not shop primed or galvanized, except surfaces to be in contact with concrete.

3.4 ERECTION TOLERANCES

A. Maximum Variation From Plumb: 1/4 inch per story, non-cumulative.

B. Maximum Offset From True Alignment: 1/4 inch.

3.5 SCHEDULE

A. The Schedule is a list of principal items only. Refer to Drawing details for items not specifically scheduled.

B. Support Brackets for mechanical and electrical equipment as required.

C. Bollards: Steel pipe, concrete filled, crowned cap; paint as scheduled in Section 09 90 00.

D. Ledge and Shelf Angles, Channels and Plates Not Attached to Structural Framing.

E. Ledge and Shelf Angles, Channels and Plates attached to Structural Walls.

F. Stainless Steel Counter Support Framing: 2" x 2", 16 ga. steel channel.

G. Counter Support Brackets: Steel, 5/16-inch thick x 2 inch bar stock or approved equal, formed into triangular closed bracket. Prime and paint as scheduled in Section 09 90 00 - Painting and Coating.

H. Steel Tube Fence, Gate, and Screening Panel Frame Construction: Structural steel tubes as detailed. Paint as scheduled in Section 09 90 00. Color per Drawings.

I. Trench Covers and Framing for Mechanical French Drains. Minimum: Steel Angle, 1" x 1" x 1/4" trench framing. Trench covers framing with 3/4" x 3/4" x 1/4" and 5/8" x 3/16" plates welded vertically to expose the thickness of the plate and/or as standard fabricated by Architectural Art Manufacturing or architect approved equal. Prime and paint as scheduled in Section 09 90 00 – Painting and Coating.

END OF SECTION
SECTION 05 52 00
METAL RAILINGS

PART 1  GENERAL

1.1  SECTION INCLUDES
   A. Steel tube and pipe handrails, and fittings.
   B. Steel bar guardrails and supports.
   C. Wire mesh panel guardrail infill panels.

1.2  PRODUCTS FURNISHED BUT NOT INSTALLED UNDER THIS SECTION
   A. Section 03 30 00 - Cast-In-Place Concrete: Placement of anchors in concrete.

1.3  RELATED SECTIONS
   A. Section 09 90 00 - Painting: Paint finish.

1.4  REFERENCES
   A. ASTM A36 - Structural Steel.
   B. ASTM A53 - Hot-Dipped, Zinc-coated Welded and Seamless Steel Pipe.
   C. ASTM A500 - Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Round and Shapes.
   E. SSPC - Steel Structures Painting Council.

1.5  DESIGN REQUIREMENTS
   A. Railing assembly, wall rails, and attachments to resist lateral force of 200 lbs at any point without damage or permanent set.
   B. Handrails to comply with size and wall clearance requirements of ADAAG.

1.6  SUBMITTALS
   A. Railing assembly, wall rails, and attachments to resist the required design loads per the standards and codes in Section 05 51 00, paragraphs 1.5 B and C, without damage or permanent set.
   B. Handrails to comply with size and wall clearance requirements of ADAAG.
1.7 FIELD MEASUREMENTS

A. Verify that field measurements are as indicated on Drawings and shop drawings.

PART 2 PRODUCTS

2.1 STEEL RAILING SYSTEM

A. Steel Tubing: ASTM A500, Grade B.
B. Pipe: ASTM A53, Grade B.
C. Bars and Plates: ASTM A36.
D. Guardrails and Posts: 1-1/2 inch diameter Schedule 40 steel pipe; welded joints.
E. Fittings: Elbows, T-shapes, wall brackets, escutcheons; cast steel.
F. Splice Connectors: Steel welding collars.
G. Shop and Touch-Up Primer: SSPC 15, Type 1, red oxide for plain steel; SSPC 20, Type 1, zinc rich type for galvanized steel.

2.2 FABRICATION

A. Fit and shop assemble components in largest practical sizes, for delivery to site.
B. Fabricate components with joints tightly fitted and secured.
C. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.
D. Continuously seal joined pieces by continuous welds.
E. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.
F. Accurately form components to each other and to building structure.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that field conditions are acceptable and are ready to receive work.
B. Beginning of installation means erector accepts existing conditions.

3.2 PREPARATION

A. Clean and strip primed steel items to bare metal where site welding is required.
B. Supply items required to be cast into concrete, placed in partitions with setting templates, to
appropriate Sections.

3.3 INSTALLATION

A. Install components plumb and level, accurately fitted, free from distortion or defects.

B. Field weld anchors as indicated on shop drawings. Grind welds smooth. Immediately after erection, prime welds, abrasions, and surfaces not shop primed or galvanized, except surfaces to be in contact with concrete.

3.4 ERECTION TOLERANCES

A. Maximum Variation From Plumb: 1/8 inch per vertical member.

B. Maximum Offset From True Alignment: 1/8 inch in 10 feet.

3.5 FINISH SCHEDULE

A. Pipe, tube, bar and wire mesh components, galvanized and plain; shop primed.

B. Finish Painting: Paint as scheduled in Section 09 90 00.

END OF SECTION
PART 1  GENERAL

1.1  SECTION INCLUDES

A. Batt insulation in exterior furred chase wall, soffit and ceiling construction.
B. Batt insulation in exterior metal stud wall construction.
C. Batt insulation at interior sound partitions.

1.2  RELATED SECTIONS

A. Section 05 40 00 - Cold Formed Metal Framing.
B. Section 07 21 13 - Board Insulation.
C. Section 07 84 00 - Firestopping.
D. Section 09 21 16 - Gypsum Board Assemblies: Installation of acoustical insulation.

1.3  REFERENCES


1.4  SYSTEM DESCRIPTION

A. Materials of this Section shall provide continuity of thermal barrier at building enclosure elements.

1.5  SUBMITTALS

A. Submit under provisions of Section 01 33 00.
B. Product Data: Provide data on product characteristics, performance criteria, and limitations.

1.6  COORDINATION

A. Coordinate Work under provisions of Section 01 31 13.

PART 2  PRODUCTS

2.1  MANUFACTURERS - INSULATION MATERIALS

C. Certainteed.
D. Knauf Fiberglass Insulation.
E. Substitutions: Under provisions of Section 01 25 00.

2.2 MATERIALS

A. Batt Insulation: ASTM C-665 Type II; glass fiber batts; preformed, friction-fit type; faced on one side; Thickness as shown per drawings.
   1. Thermal Resistance: R of R19 or R15 as shown on drawings.
   2. Roll Size: 15-3/4" width or as required for fit between framing members.
   3. Facing: Faced on one side with polypropylene reinforced scrim.
   4. Flame/Smoke Properties: 25/50 per ASTM E84.

B. Acoustical Insulation: ASTM C-665 Type I; glass fiber batts; preformed, friction-fit type; no-membrane surface; 3-1/2 inch thick, minimum.

C. Tape: Polyethylene self-adhering type, 2 inch wide.

D. Insulation Fasteners: Steel impale spindle and clip on flat metal base, self adhering backing, length to suit insulation thickness, capable of securely and rigidly fastening insulation in place.

E. Wire Mesh: Galvanized steel, hexagonal wire mesh.

F. Wire-up Restraining: 16 ga. galvanized steel wire.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that substrate, adjacent materials, and insulation are dry and ready to receive insulation.

3.2 INSTALLATION

A. Install insulation in accordance with insulation manufacturer's instructions.

B. Install in wall spaces without gaps or voids.

C. Trim insulation neatly to fit spaces.

D. Fit insulation tight in spaces and tight to exterior side of mechanical and electrical services within the plane of insulation. Leave no gaps or voids.

E. Install facing of insulation facing any above ceiling plenum space. In no case shall fiberglass fibers be exposed to the atmosphere within plenums.

F. Install vapor barrier facing warm side of building spaces. Lap ends of membrane between framing members.

G. Tape ends and tears or cuts in membrane.

H. Install wire-up restraints per insulation manufacturer's instructions; diagonally every 18 to 24 inches.

END OF SECTION
SECTION 07 21 19

FOAMED-IN-PLACE INSULATION

PART 1  GENERAL

1.1  SECTION INCLUDES

A. Closed cell spray polyurethane foam.

1.2  RELATED SECTIONS

A. Section 07 90 00 - Joint Protection.

1.3  REFERENCES


1.4  PERFORMANCE REQUIREMENTS

A. Material Performance: Provide materials which have an air permeance not to exceed 0.004 cubic feet per minute per square foot under a pressure differential of 0.3 in. water (1.57 psf) (0.02 L/m² @ 75 Pa.) when tested according to ASTM E2178.

B. System Performance: Substantiate that air barrier material used as/in a system, will have an air permeance not to exceed 0.2 L/m² @ 75 Pa. when tested according to ASTM E2357.

C. Connections to Adjacent Materials: Provide connections to prevent air leakage migration at the following locations:

1. Foundation and walls, including penetrations, ties and anchors.
2. Walls, windows, curtain walls, storefronts, louvers or doors.
3. Different wall assemblies, and fixed openings within those assemblies.
4. Wall and roof connections.
5. Floors over unconditioned space.
6. Walls, floor and roof across construction, control and expansion joints.
7. Walls, floors and roof to utility, pipe and duct penetrations.
8. All other leakage pathways in the building envelope.

1.5 QUALITY ASSURANCE
A. All work is to be performed by applicators skilled in the application of polyurethane foam systems. Applicators shall have completed 5 similar projects over the last five (5) years and shall provide a list of these projects to the Owner or Owner’s representative upon request.

1.6 SUBMITTALS
A. Submit under provisions of Section 01 33 00.
B. Quality Assurance Program: Submit evidence of current Contractor accreditation and Installer certification under the Air Barrier Association of America’s (ABAA) Quality Assurance Program (QAP). Submit accreditation number of the Contractor and certification number(s) of the ABAA Certified Installer(s).
C. Product Data: Submit material manufacturer’s product data and material manufacturer’s instructions for evaluating preparing, and treating substrate, temperature and other limitations of installation conditions, technical data, and tested physical and performance properties.
1. Submit letter from primary air barrier material manufacturer indicating approval of materials that are proposed to be used that are not currently listed in the accessories section of this specification for that manufacturer’s material.
2. Include statement from the primary air barrier material manufacturer that the materials used in their air barrier assembly which will be used to adhere to the underlying substrate are chemically compatible to the substrate material.
3. Samples: Submit clearly labeled samples, 3 inch by 4 inch minimum size, of material specified.
D. Compatibility: Submit letter from primary material manufacturer stating that materials proposed for use are permanently chemically compatible and adhesively compatible with adjacent materials proposed for use. Submit letter from material manufacturer stating that cleaning materials used during installation are chemically compatible with adjacent materials proposed for use.
E. Air Barrier Subcontractor Qualifications: Air barrier subcontractor(s) shall be accredited at the time of bidding and during the complete installation period by the Air Barrier Association of America (ABAA) whose installer(s) are certified in accordance with the site Quality Assurance Program used by ABAA.
1. Closed cell, medium density sprayed polyurethane foam air barrier installer(s) shall be certified by BPQI (Building Performance Quality Institute) for the ABAA Quality Assurance Program in accordance with the requirements outlined in the QAP program used by ABAA. Installers shall have their photo-identification air barrier certification cards in their possession and available on the project site, for inspection upon request.

1.7 MATERIALS, DELIVERY AND STORAGE
A. Materials shall be delivered in the manufacturer’s original, tightly sealed containers or unopened packages clearly labeled with the manufacturer’s name, product identification, safety information, approvals, and lot numbers where applicable.
B. Containers shall be stored out of the weather and away from direct sunlight in a cool dry place at temperatures between 50 and 70 degrees F within the limits specified by the
materials manufacturer.

C. All materials shall be stored in compliance with local fire and safety codes.

1.8 ENVIRONMENTAL CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer’s absolute limits. Do not install spray polyurethane foam before the roof assembly has been sufficiently installed to prevent an accumulation of water in the interior of the building.

B. Do not apply the polyurethane foam when substrate or ambient air temperatures are below 40 degrees F.

C. Or above 120 degrees F and relative humidity is greater than 85 percent unless advance means and methods are recommended by the manufacturer.

D. Do not apply polyurethane foam when wind velocity exceeds 15 miles per hour unless advance means and methods are recommended by the manufacturer. Use precautions to prevent damage to adjacent areas from fugitive overspray.

PART 2 PRODUCTS

2.1 MANUFACTURERS – SPRAY POLYURETHANE

A. Certainteed.

B. Gaco Western LLC.

C. Demilec Inc.

D. Substitutions: Under provisions of Section 01 25 00.

2.2 POLYURETHANE FOAM

A. Material Properties:
   1. Material Air Permeance at 1 inch Thickness: 0.013
   2. Water Vapor Permeance (ASTM E96):
      a. Water Method @ 2 inches: 1.1 US perms
   3. Core Density – Sprayed-in-Place (ASTM D1622): 2.0± pcf
   5. Closed Cell Content (ASTM D2856): 90% minimum
   6. Aged R Value (ASTM C518), tested at 75 deg F:
      R at 1 Inch: 6.4
      R at 3.5 Inches: 23.3

2.3 ACCESSORY MATERIALS

A. Transition Membrane, Counter-Flashing, Primers, Substrate Joint Treatment, and Intumescent Coating: As recommended by manufacturer.

PART 3 EXECUTION

3.1 APPLICATION OF PRODUCTS

A. The products intended for use in the building envelope insulation system and adjacent walls must be applied within the manufacturer’s guidelines for temperature, humidity and
other atmospheric conditions. In addition, they must be sequenced so as to take into consideration substrate preparation, proper cure times and inter-pass adhesion.

3.2 EXAMINATION

A. The spray foam contractor shall examine substrates, areas, and conditions under which the air barrier assembly will be installed, with General Contractor, for compliance with the following requirements:
   1. Confirm site access logistics and scheduling requirements, including but not limited to use of scaffolding, lifts and staging.
   2. At the end of each working day, the General Contractor shall provide weather protection at the top of parapet walls and non-finished roofs to prevent moisture migration into walls and damage to installed air barrier systems.
   3. Verify that surfaces and conditions are suitable prior to commencing work of this Section. Do not proceed with installation until unsatisfactory conditions have been corrected.
   4. Ensure that the following conditions are met:
      a. Surfaces are sound, dry, even, and free of excess mortar or other contaminants.
      b. Inspect substrates to be smooth without large voids or sharp protrusions. Inform General Contractor if substrates are not acceptable and need to be repaired by the concrete sub-trade.
      c. Inspect masonry joints to be reasonably flush and completely filled, and ensure all excess mortar sitting on masonry ties has been removed. Inform General Contractor if masonry joints are not acceptable and need to be repaired by the mason sub-trade. Verify substrate is visibly dry and free of moisture. Test for capillary moisture by plastic sheet method according to ASTM D4263 and take suitable measures until substrate passes moisture test.
   5. Verify sealants are compatible with the proposed for use. Perform field peel-adhesion test on materials to which sealants are adhered.

3.3 SURFACE PREPARATION

A. The spray foam contractor shall ensure the substrate is clean, dust-free, dry and prepared in accordance with the air barrier material manufacturer’s written instructions. The General Contractor shall be notified if this is not the case.
   1. Ensure that penetrating work by other trades is in place and complete.
   2. Prepare surfaces by brushing, scrubbing, scraping, grinding or compressed air to remove loose mortar, dust, oil, grease, oxidation, mill scale, rust and other contaminants which will affect adhesion of the closed cell, medium density spray polyurethane foam.
   3. Wipe down metal surfaces to remove release agents or other non-compatible coatings using clean sponges.
   4. Prime substrate for installation of sheet membrane transition strips if required by material manufacturer and as follows:
      b. Prepare, treat, and seal vertical and horizontal surfaces at terminations and penetrations through air barrier and protrusions.
   5. Protection from Spray Polyurethane Foam:
      a. Mask and cover adjacent areas and materials that aren’t being sprayed to protect from overspray.
      b. Ensure any required foam stop or backup material is in place and complete to prevent overspray and achieve complete seal.
c. Seal off existing ventilation equipment. Install temporary ducting and fans to ensure exhaust fumes are removed from the spray location to exterior of the building. Provide for make-up air.

d. Erect barriers, isolate area and post warning signs to advise non-protected personnel to avoid the spray area.

B. Substrate Preparation for Spray Polyurethane Foam:

1. Steel:
   a. Primed: If the primed metal surface is free of scale, rust or oils it normally does not require priming. Remove loose dirt or contaminants by power washing prior to application of polyurethane foam. Stainless steel requires primer.
   b. Previously Painted: Clean the painted metal surface using hand or power tools to remove loose scale and rust. Grease, oil and other surface contaminants can be cleaned using a power washer.
   c. Galvanized: Galvanized metals shall be clean and free of oils. Galvanized metal does not typically require primer.

2. Concrete:
   a. Must be cured, dry, and loose dirt and any other contaminants, including asphaltic materials, removed.

3. Gypsum and Other Sheathing:
   a. Most sheathing does not require priming; where required, primers shall be as recommended by the manufacturer.

3.4 STORAGE OF MATERIALS

A. Materials shall be protected from freezing and should be stored in a controlled environment at a temperature of 50 – 70 degrees F.

B. A and B chemical drum temperatures must be 60 – 80 degrees F before and during spraying for the drum to be serviceable (ready to spray). Material temperatures below 60 degrees F can result in proportioning errors and/or insufficient heat at the spray gun.

3.5 INSTALLATION

A. Transition Strip Installation: Install air barrier accessories and spray polyurethane foam to provide continuity throughout the building envelope. Install materials in accordance with manufacturer’s instructions.

1. Apply primer for transition membrane at rate recommended by material manufacturer. Allow primer to dry completely before membrane application. Apply as many coats as necessary for proper adhesion.

2. Position subsequent sheets of membrane applied above so that it overlaps the membrane sheet below by a minimum of 2.0 inches, unless greater overlap is recommended by material manufacturer. Roll into place with roller ensuring all transition membranes are free of fish-mouths, wrinkles, delaminations, bubbles and voids.

3. Overlap horizontally adjacent pieces of membrane a minimum of 2.0 inches, unless greater overlap is recommended by material manufacturer. Roll all areas of membrane including seams with roller.

4. Seal around all penetrations with termination mastic, extruded silicone sealant, membrane counter-flashing or other procedure in accordance with material manufacturer’s recommendations.
3.6 PROTECTING AND CLEANING

A. Protect air barrier materials from damage during installation and the remainder of the construction period, according to material manufacturer’s written instructions.
   1. Coordinate with installation of materials which cover the air barrier assemblies, to ensure exposure period does not exceed that recommended by the air barrier material manufacturer.

B. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction and acceptable to the primary material manufacturer.

END OF SECTION
SECTION 07 84 00
FIRESTOPPING

PART 1  GENERAL

1.1  SECTION INCLUDES

A. Through penetration smoke protection for all smoke partitions.

B. Construction joint firestopping occurring within smoke partitions, floors, the intersection of smoke partitions to exterior walls, and the intersection of top of smoke partitions to roof deck.

1.2  RELATED SECTIONS

A. Section 03 30 00 - Cast-in-Place Concrete.

B. Section 07 90 00 - Joint Protection.

C. Section 09 21 16 - Gypsum Board Assemblies: Gypsum wallboard construction.

D. Divisions 21, 22 and 23 - Mechanical.

E. Division 26 - Electrical.

1.3  REFERENCES


D. UL 1479 - Standard for Fire Tests of Through-Penetration Firestops.


F. UL - Fire Resistance Directory:
   1. Through Penetration Firestop Systems (XHEZ).
   2. Through Penetration Firestop Devices (XHJI).
   3. Fill, Void, or Cavity Material (XHHW).

G. 2012 IBC with amendments.

1.4  DEFINITIONS

A. Firestopping: A material or combination of materials placed in openings in a fire-rated assembly (wall, floor, etc.) or smoke partition to maintain the integrity of the fire-rating of that wall, floor, or other assembly, by arresting the movement of smoke or gasses through openings in that assembly.

B. Firesafing: Stuffing material used as part of a firestop assembly to provide structural
support to the fluid-applied firestopping material.

C. System: A specific firestop material or combination of materials in conjunction with a specific wall or floor construction type and a specific penetrant(s), as defined by a recognized testing laboratory.

D. Barrier: Any wall, partition, enclosure, or floor that has an hourly fire and smoke rating.

E. Through-penetration: Any penetration of a fire-rated wall, floor, or smoke partition that completely breaches the barrier.

1.5 SUBMITTALS

A. Submit under provisions of Section 01 33 00.

B. UL Tested Systems: Submit details from the UL Fire Resistance Directory (most recent edition) indicating the method of installation for each and every field condition.

C. Product Data: Submit manufacturer's product data for each type of firestop material to be installed. Literature shall indicate preparation and installation instructions, product characteristics, performance and test data from the UL Fire Resistance Directory, where a tested system exists.

D. Material Safety Data Sheets (MSDS): Submit MSDS for each firestop product.

E. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

F. Shop Drawings: Submit job specific shop drawings showing each condition requiring firestopping of a penetration or gap. Drawings must be in strict accordance with the tested firestopping system. Provide information on materials used, attachment, method of installation and relationship to all adjacent construction. Also submit shop drawings for any other areas where tested system data is unavailable, showing proposed materials, attachment and adjacent construction in accordance with manufacturer's data.

G. Installers may submit firestopping data and shop drawing along with those of their primary trades.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the products specified in this section with minimum 5 years documented experience.

B. Installers: Contractors approved by the firestop manufacturer with minimum 5 years documented experience. All installers shall install firestopping compatible with that of other trades. General Contractor to coordinate these installations as to compatibility and Code compliance.

1.7 QUALITY ASSURANCE

A. When project is ready for installation of through-penetration smoke protection, coordinate with the Architect to select an area to be used to demonstrate the installation methods and procedures for each type of condition. This mock-up area can be incorporated into the Work. Inspect smoke partitions.

B. An inspection by third party Inspection and/or county having jurisdiction will be required for the annular space and backing material at penetrations prior to the installation of sealants.

1.8 REGULATORY REQUIREMENTS
A. For penetrations and head-of-wall joint conditions in smoke resistive partitions required at incidental areas by 2012 IBC Section 302.1.1.1, firestop systems specified in this Section shall be installed or the Contractor may provide other penetration sealers along with project-specific engineering data proving compliance with the requirements of 2012 IBC 302.1.1.1 and acceptable to the governing building authorities.

B. For unique firestop conditions not specifically conforming to previously tested and listed systems, the manufacturer must provide project-specific engineering data acceptable to the governing building authorities.

1.9 DELIVERY, STORAGE AND HANDLING

A. Deliver materials to project site in manufacturer's original unopened containers, with intact product labels showing product name and number, batch number, date of manufacturer and handling precaution statements.

B. Store products in weather protected environment, clear of ground and moisture.

1.10 ENVIRONMENTAL CONDITIONS

A. Do not install materials when temperature or moisture conditions are outside the range of acceptable conditions as required by materials manufacturers.

B. Assure that required conditions are maintained during material curing times.

1.11 PRE-INSTALLATION CONFERENCE

A. Convene two weeks prior to commencing work of this Section.

B. Provide two weeks written notice of time and date of meeting to Owner and Architect.

C. Review installation procedures and coordination required with related work.

D. Contractor to provide all UL (Underwriters Laboratories, Inc.) / WH (Warnock Hersey) approved application details for all intended installations.

E. The following personnel are required to be in attendance:
   1. General Contractor’s Superintendent.
   2. Prime Subcontractors involved.
   3. Third Party Inspections and/or County.

PART 2 PRODUCTS

2.1 GENERAL

A. Firestopping sealants must be flexible, allowing for cyclical movement of building elements and for normal inertial pipe movement.

B. Firestopping materials shall not shrink upon drying as evidence by cracking or pulling back from contact surfaces.

C. All firestopping materials shall be moisture resistant and may not dissolve in water after curing.

D. All firestopping materials shall be non-toxic, non-hazardous and lead or asbestos-free.
E. Material used shall be in accordance with the manufacturer's written installation instructions.

2.2 ACCEPTABLE MANUFACTURERS - FOR USE IN UL LISTED FIRE RESISTIVE SYSTEMS

A. Specified Technologies, Inc. (SpecSeal).
B. Hevi-Duty/Nelson.
C. Hilti.
D. Tremco.
E. 3M.
F. Metaline/Metacaulk.
G. Nuco Inc.
H. Substitutions under provisions of 01 60 00. Request to install systems using products not listed below must be accompanied by UL Assembly drawings indicating that the equivalent fire-resistant performance can be achieved with substituted products in walls or other areas requiring firestopping as shown on Drawings in order to be approved as an equivalent system.

2.3 SEALANT MATERIALS - FOR USE IN UL LISTED FIRESTOP OR HEAD-OF-WALL JOINT SYSTEMS

A. Latex Intumescent Sealant:
   1. SpecSeal 100
   2. Nelson CLK.
   3. Hilti FS-ONE
   4. 3M Fire Barrier CP25WB+
   5. Tremstop - IA
   6. Or other latex intumescent sealants by above listed manufacturers.

B. Latex Non-Intumescent Sealant:
   1. SpecSeal LC-150
   2. Nelson LBC
   3. 3M Fire Dam 150
   4. A/D Fire Barrier Seal N/S
   5. Or other latex non-intumescent sealants by above listed manufacturers.

C. Firestop Putty:
   1. SpecSeal Firestop Putty
   2. Nelson FSP
   3. Metacaulk Fire Rated Putty
   4. 3M Fire Barrier Moldable Putty+
   5. Tremstop - FP
   6. Or other firestop putty by above listed manufacturers.

D. Wrap Strip:
   1. SpecSeal SSWRED
   2. Nelson WRS
   3. Metacaulk Wrap Strip
   4. 3M Fire Barrier FS-195+
   5. Tremstop - WS
   6. Or other wrap strip by above listed manufacturers.
E. Mortar:
1. SpecSeal Firestop Mortar
2. Nelson CMP
3. Hilti Firestop Mortar
4. Metacaulk Fire Rated Mortar
5. 3M Fire Barrier Mortar
6. Tremstop - WBM
7. Or other mortar by above listed manufacturers.

F. Silicone Elastomeric Sealant:
1. Pensil 300
2. 3M Fire Barrier 2000+
3. Metacaulk 835+
4. A/D Fire Barrier Silicone N/S
5. Or other silicone elastomeric sealants by above listed manufacturers.

2.4 SEALANT MATERIALS FOR USE IN WALL JOINTS

A. Silicone Elastomeric Sealant:
1. Hilti CP601S
2. 3M Fire Barrier 2000+
3. Metacaulk 835+
4. Or other silicone elastomeric sealants by above listed manufacturers.

2.5 FIRESAFING MATERIALS

A. Mineral Fiber Insulation: Density 3.5 lb/cu. ft. (min); compressible to 50% (min):
1. Owens Corning Thermafiber.
2. Rockwool.

2.6 ACCESSORIES

A. Primer: Type recommended by sealant manufacturer for specific substrate surfaces.

B. Installation Accessories: Metal clips, collars, fasteners, temporary stops or dams, and other devices required to position and retain materials in place. Schedule 40 pipe sleeve required at all openings larger than 8 inches in diameter.

PART 3 EXECUTION

3.1 INSPECTION

A. Verify that environmental conditions are safe and suitable for installation of firestop products.

B. Verify that all pipe, conduit, cable and other items which penetrate smoke partitions have been permanently installed prior to installation of firestops.

C. Examine surfaces for conditions which would adversely affect execution, permanence and quality of work.

D. If unsatisfactory conditions for installation exist, notify the Construction Manager.

3.2 INSTALLATION

A. Surface Preparation: Remove all dust, dirt, oil and other foreign materials and contaminates from the application surfaces.
B. Coordinate with third party Inspection and/or County having jurisdiction for the annular space inspection required by paragraph 1.7 B.

C. Apply firestops in accordance with the fire test reports, fire resistance requirements and manufacturer's recommendations.

D. Schedule and sequence the work to assure that partitions, ceilings, and other construction which would conceal penetrations are not erected prior to the installation of firestops.

E. Unless specified and approved, all insulation used in conjunction with through-penetrants shall remain intact and undamaged and may not be removed.

F. Damming Construction: When required to properly contain firestopping materials within openings, damming or parking materials may be utilized. Remove all damming material after material has cured unless damming is a component of the listed system.

G. Inspect areas to assure that all openings have been completely sealed. Perform all remedial sealing necessary to assure complete closure of all openings, per the UL listed assemblies.

H. Finish visible surfaces flush and smooth as per details from the UL Fire Resistance Directory.

3.3 CLEANING

A. Clean Work under provisions of Section 01 74 23.

B. Clean adjacent surfaces of firestopping materials.

3.4 PROTECTION OF FINISHED WORK

A. Protect finished Work under provisions of Section 01 45 17.

B. Protect adjacent surfaces from damage by material installation.

END OF SECTION
SECTION 07 90 00
JOINT PROTECTION

PART 1  GENERAL

1.1  SECTION INCLUDES
A. Preparing substrate surfaces.
B. Sealant and joint backing.
C. Sealant at all dissimilar materials.

1.2  RELATED SECTIONS
A. Sections 03 30 00 - Cast-in-Place Concrete and 03 47 13 – Tilt-Up Precast Concrete: Sealants required in conjunction with concrete.
B. Section 07 84 00 - Firestopping - thru penetration firestopping at fire-rated and smoke partitions.
C. Sections 08 11 13 – Hollow Metal Doors and Frames: Sealants required in conjunction with hollow metal doors and frames.
D. Section 08 41 13 – Aluminum Framed Entrances and Storefronts: Sealants required in conjunction with aluminum entrances and storefronts.
E. Section 08 80 00 - Glazing: Sealants required in conjunction with glazing methods.

1.3  REFERENCES
H. SWRI (Sealant, Waterproofing and Restoration Institute) - Sealant and Caulking Guide Specification.

1.4  SUBMITTALS
A. Submit product data under provisions of Section 01 33 00.
B. Product Data: Provide data indicating sealant chemical characteristics, performance criteria, substrate preparation, limitations, and color availability.

C. Manufacturer's Installation Instructions: Indicate special procedures, surface preparation, precautions for protection of adjacent materials, perimeter conditions requiring special attention, and environmental conditions required for installation.

D. Certification: Submit manufacturer's certification of compliance indicating that each product being furnished complies with these specifications, is recommended for the application indicated, and is compatible with the other materials in the joint system.

1.5 QUALITY ASSURANCE

A. Perform work in accordance with SWRI requirements for materials and installation.

B. Field Samples and Mockups:
1. Provide samples of sealants and caulking compounds at locations coordinated with the Architect.
2. Samples will be visually and manually examined by the Architect/Owner for joining, dirt pick up, shrinkage, color, work quality, and appearance.
3. Schedule applications with allowance of sufficient curing time. Samples may need to be examined at least two (2) weeks prior of date scheduled for commencing the work.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum five years documented experience.

B. Applicator: Company specializing in performing the work of this section with minimum three years documented experience.

1.7 COORDINATION

A. Coordinate work under provisions of Section 01 31 13.

B. Coordinate the work with the sections referencing this section.

1.8 SITE CONDITIONS

A. Do not start installation of sealants and caulking during inclement weather, unless the installation complies with the manufacturer's instructions.

B. Do not start installation of sealants under extreme temperature conditions that may cause joint openings to be near either maximum or minimum widths.

C. Schedule installation of sealants and cure of them within reasonable temperatures and within manufacturer's recommended range of temperatures.
PART 2 PRODUCTS

2.1 SEALANTS

A. Acrylic Emulsion Latex: ASTM C834, single component; non-sag; color to match adjacent surfaces.

B. Butyl Sealant: ASTM C920, Class A, single component, solvent release, non-skinning, non-sagging, black color.
   1. Elongation Capability: 7 to 10 percent
   2. Service Temperature Range: -13 to 180 degrees F
   3. Shore A Hardness Range: 10 to 30

C. Polysulfide Sealant: ASTM C920, Class A, two component, chemical curing, non-staining, non-bleeding, capable of continuous water immersion, non-sagging, self-leveling type; grey color; paintable.
   1. Elongation Capability: 25 percent
   2. Service Temperature Range: -40 to 180 degrees F
   3. Shore A Hardness Range: 20 to 35

D. Polyurethane Sealant: ASTM C920, Class A, single component, chemical curing, non-staining, non-bleeding, capable of continuous water immersion, non-sagging type; color to match adjacent surfaces.
   1. Elongation Capability: 25 percent
   2. Service Temperature Range: -40 to 180 degrees F
   3. Shore A Hardness Range: 20 to 35

E. Silicone Sealant: ASTM C920, low modulus type, Class A, single component, solvent curing, non-sagging, non-staining, fungus resistant, non-bleeding; color to match adjacent surfaces.
   1. Elongation Capability: 25 percent
   2. Service Temperature Range: -65 to 180 degrees F
   3. Shore A Hardness Range: 15 to 35

2.2 ACCESSORIES

A. Primer: Non-staining type, recommended by sealant manufacturer to suite application.

B. Joint Cleaner: Non-corrosive and non-staining type, recommended by sealant manufacturer; compatible with joint forming materials.

C. Joint Backing: ANSI/ASTM D1056; round, closed cell polyethylene foam rod; 30 to 50 percent larger than joint width.

D. Bond Breaker: Pressure sensitive tape recommended by sealant manufacturer to suite application.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that substrate surfaces and joint openings are ready to receive work.

B. Verify that joint backing and release tapes are compatible with sealant.
3.2 PREPARATION
A. Remove loose materials and foreign matter which might impair adhesion of sealant.
B. Clean and prime joints in accordance with manufacturer's instructions.
C. Perform preparation in accordance with ASTM C804 for solvent release and ASTM C790 for latex base sealants.
D. Protect elements surrounding the work of this Section from damage or disfiguration.

3.3 INSTALLATION
A. Perform installation in accordance with ASTM C804 for solvent release and ASTM C790 for latex base sealants.
B. Install other sealants in accordance with manufacturer's instructions.
C. Measure joint dimensions and size materials to achieve required width/depth ratios.
D. Install joint backing to achieve a neck dimension no greater than 1/3 the joint width.
E. Install bond breaker where joint backing is not used.
F. Install sealant free of air pockets, foreign embedded matter, ridges, and sags.
G. Apply sealant within recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.
H. Tool joints concave.

3.4 CLEANING AND REPAIRING
A. Clean work under provisions of Section 01 74 23.
B. Clean adjacent soiled surfaces.
C. Repair or replace finishes defaced by Work of this Section.

3.5 PROTECTION OF FINISHED WORK
A. Protect finished installation under provisions of Section 01 45 17.
B. Protect sealants until cured.

3.6 SCHEDULE

<table>
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<th>Location</th>
<th>Type</th>
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<tr>
<td>Door Frame/Walls</td>
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<td></td>
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<td>Sealant</td>
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<tr>
<td>Under Thresholds</td>
<td>Butyl</td>
</tr>
</tbody>
</table>

UNLV MSL Building Renovation
October 30, 2017
100% Construction Documents
D. Ceramic Tile, Marble Thresholds
   Silicone, Fungus Resistant

E. Exposed Vertical Concrete Joints in Tilt-Up
   Panels and Cast-in-Place Walls
   Polyurethane

F. Exterior Windows and Doors, Perimeter
   Polyurethane

G. Glazing
   Silicone

H. Aluminum Storefront Perimeter
   Silicone

END OF SECTION
PART 1 GENERAL

1.1 SECTION INCLUDES

A. Standard hollow metal doors and frames.

1.2 RELATED SECTIONS

A. Section 08 71 00 – Finish Hardware.
B. Section 08 80 00 – Glazing.
C. Section 09 90 00 – Painting and Coating: Field painting hollow metal doors and frames.
D. Division 26 – Electrical: Electrical connections including conduit and wiring for door controls and operators.

1.3 DEFINITIONS

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

1.4 SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, core descriptions, fire-resistance rating, temperature-rise ratings, and finishes.
B. Shop Drawings: Include the following:
   1. Elevations of each door design.
   2. Details of doors, including vertical and horizontal edge details and metal thicknesses.
   3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
   4. Locations of reinforcement and preparations for hardware.
   5. Details of each different wall opening condition.
   6. Details of anchorages, joints, field splices, and connections.
   7. Details of accessories.
   8. Details of moldings, removable stops, and glazing.
   9. Details of conduit and preparations for power, signal, and control systems.

C. Samples for Initial Selection: For units with factory-applied color finishes.

D. Samples for Verification:
   1. For each type of exposed finish required, prepared on Samples of not less than 3 by 5 inches.
   2. For the following items, prepared on Samples about 12 by 12 inches to demonstrate compliance with requirements for quality of materials and construction:
a. Doors: Show vertical-edge, top, and bottom construction; core construction; and hinge and other applied hardware reinforcement. Include separate section showing glazing if applicable.

b. Frames: Show profile, corner joint, floor and wall anchors, and silencers. Include separate section showing fixed hollow metal panels and glazing if applicable.

E. Other Action Submittals:
   1. Schedule: Provide a schedule of hollow metal work prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with door hardware schedule.

F. Oversize Construction Certification: For assemblies required to be fire rated and exceeding limitations of labeled assemblies.

G. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each type of hollow metal door and frame assembly.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain hollow metal work from single source from single manufacturer.

B. Doors and frames shall conform to NAAMM.

C. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to UL 10C.
   1. Where required by agencies having jurisdiction, provide label on door and label on frame.
   2. Oversize Fire-Rated Door Assemblies: For units exceeding sizes of tested assemblies provide certification by a qualified testing agency that doors comply with standard construction requirements for tested and labeled fire-rated door assemblies except for size.
   3. Temperature-Rise Limit: At vertical exit enclosures and exit passageways, provide doors that have a maximum transmitted temperature end point of not more than 250 deg F above ambient after 30 minutes of standard fire-test exposure.

D. Pre-installation Conference: Conduct conference at Project site.

E. Pre-installation: Mock-up doors inspected and approved by UNLV Lock Shop before commencing door and hardware work. Install one of each type of door and hardware.

F. Pre-installation; Destructive testing of doors and frames, Owner, UNLV Lock Shop will pick a random door and frame to inspect and verify door and frame are of approved specification.

1.6 DELIVERY STORAGE, AND HANDLING

A. Deliver hollow metal work palletized, 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 units.

B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.

C. Store hollow metal work under cover at Project site. Place in stacks of five units maximum in a vertical position with heads up, spaced by blocking, on minimum 4-inch high wood blocking. Do not store in a manner that traps excess humidity.
1. Provide minimum 1/4-inch space between each stacked door to permit air circulation.

1.7 PROJECT CONDITIONS
A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

1.8 COORDINATION
A. Coordinate installation of anchorages for hollow metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.

1.9 WARRANTY
A. Provide manufacturer's one (1) year warranty under provisions of Section 01 78 36.

PART 2 PRODUCTS

2.1 MANUFACTURERS
A. 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.
3. Steelcraft Manufacturing; an Ingersoll Rand company.

2.2 MATERIALS
A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M-16, Commercial Steel (CS), Type B; suitable for exposed applications.
B. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M-15, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.
C. Metallic-Coated Steel Sheet: ASTM A 653/A 653M-15, Commercial Steel (CS), Type B; with minimum A60 metallic coating.
D. Frame Anchors: ASTM A 591/A 591M-89, Commercial Steel (CS), 40Z coating designation; mill phosphatized.
   1. For anchors built into exterior walls, steel sheet complying with ASTM A 1008/A 1008M or ASTM A 1011/A 1011M, hot-dip galvanized according to ASTM A 153/A 153M, Class B.
E. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A 153/A 153M.
F. Powder-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hollow metal frames of type indicated.
G. Grout: ASTM C 476, except with a maximum slump of 4 inches, as measured according to ASTM C 143/C 143M.
H. Mineral-Fiber Insulation: ASTM C 665-12, Type I Class (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool with 6- to 12-lb/cu. ft. density; with maximum flame-spread and smoke-development indexes of 25 and 50, respectively; passing ASTM E 136 for combustion characteristics.
I. Glazing: Comply with requirements in Section 08 80 00.

2.3 STANDARD HOLLOW METAL DOORS

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

1. Design: As indicated.
2. Clearly mark doors to match Architectural opening numbers.
   a. Fire Door Core: As required to provide fire-protection and temperature-rise ratings indicated.
   b. Core shall consist of 22 gauge vertical steel stiffeners spaced 6 inches apart and securely attached to face sheets by spot welds. Spaces between stiffeners shall be sound deadened and insulated the full height of the door with an inorganic noncombustible batt type material.
   c. Thermal-Rated (Insulated) Doors: Where indicated, provide doors fabricated with thermal-resistance value (R-value) of not less than 4.0 deg F x h x sq. ft./Btu when tested according to ASTM C 1363.

6. Top and Bottom Edges: Closed with flush or inverted 0.042-inch thick, end closures or channels of same material as face sheets.

B. Exterior Doors: 16 gauge. Face sheets fabricated from metallic-coated steel sheet. Provide doors complying with requirements indicated below by referencing ANSI/SDI A250.8 for level and model and ANSI/SDI A250.4 for physical performance level:

1. Level 3 and Physical Performance Level A (Maximum Duty), Model 2 (Seamless).

C. Interior Doors: 18 gauge. Face sheets fabricated from cold-rolled steel sheet. Provide doors complying with requirements indicated below by referencing ANSI/SDI A250.8 for level and model and ANSI/SDI A250.4 for physical performance level:

1. Level 2 and Physical Performance Level B (Heavy Duty), Model 1 (Full Flush).

D. Hardware Reinforcement: Fabricate according to ANSI/SDI A250.6 with reinforcing plates from same material as door face sheets. Doors without proper reinforcement will not be accepted.

1. Hinges 7 gauge
2. Locks 12 gauge
3. Closers 12 gauge
4. Surface hardware 16 gauge
5. Use Riv-Nuts on existing frames without reinforcement.

E. Fabricate concealed stiffeners and hardware reinforcement from either cold- or hot-rolled steel sheet.

2.4 STANDARD HOLLOW METAL FRAMES

A. General: Comply with ANSI/SDI A250.8 and with details indicated for type and profile. Knock down frames are not allowed.
B. Clearly mark frames to match architectural opening numbers.

   1. Fabricate frames with mitered or coped corners.
   2. Fabricate frames as full profile welded unless otherwise indicated.
   3. Frames for Level 4 Steel Doors: 0.067-inch thick steel sheet.

D. Interior Frames: 16 gauge to 3’11” over 14gauge. Fabricated from cold-rolled steel sheet.
   1. Fabricate frames with mitered or coped corners.
   2. Fabricate frames as full profile welded unless otherwise indicated.
   3. Frames for Level 2 Steel Doors: 0.053-inch thick steel sheet.

E. Hardware Reinforcement: Fabricate according to ANSI/SDI A250.6 with reinforcement plates from same material as frames.
   1. Hinges 7 gauge
   2. Locks 12 gauge
   3. Closers 12 gauge
   4. Surface Hardware 14 gauge
   5. Continuous hinges shall have 14 gauge full height of frame face for full surface hinges.
   6. Continuous hinges on existing frames without reinforcement will require the use of Riv-Nuts.
   7. Use Riv-Nuts on existing openings without reinforcement.
   8. Without proper hardware reinforcements doors and frames will not be accepted.

F. All mullions at side lights, borrowed lights and transoms shall be continually welded including the face, rabbets, stops and soffits, ground, dressed and finished. Plug weld mullion seams every 6” and finish. Continuous weld top, bottom, and faces.
   1. Acceptable Manufacturers:
      a. Ceco Door Products - Series SQ
      b. Curries Company - Series M
      c. Steelcraft Manufacturing.
      d. Alternate manufacturer's may be considered upon approval of samples submitted to UNLV. No other manufacturers may be submitted without prior approval of submitted sample.

2.5 FRAME ANCHORS

A. Jamb Anchors:
   1. Masonry Type: Adjustable strap-and-stirrup or T-shaped anchors to suit frame size, not less than 0.042 inch thick, with corrugated or perforated straps not less than 2 inches wide by 10 inches long; or wire anchors not less than 0.177 inch thick.
   2. Stud-Wall Type: Designed to engage stud, welded to back of frames; not less than 0.042 inch thick.
   3. Compression Type for Drywall Slip-on Frames: Adjustable compression anchors.
   4. Postinstalled Expansion Type for In-Place Concrete or Masonry: Minimum 3/8-inch diameter bolts with expansion shields or inserts. Provide pipe spacer from frame to wall, with throat reinforcement plate, welded to frame at each anchor location.

B. Floor Anchors: Formed from same material as frames, not less than 0.042 inch thick, and as follows:
   1. Monolithic Concrete Slabs: Clip-type anchors, with two holes to receive fasteners.
   2. Separate Topping Concrete Slabs: Adjustable-type anchors with extension clips, allowing not less than 2-inch height adjustment. Terminate bottom of frames at finish floor surface.
2.6 HOLLOW METAL PANELS

A. Provide hollow metal panels of same materials, construction, and finish as specified for adjoining hollow metal work.

2.7 STOPS AND MOLDINGS

A. Moldings for Glazed Lites in Doors: Minimum 0.032 inch thick, fabricated from same material as door face sheet in which they are installed.

B. Fixed Frame Moldings: Formed integral with hollow metal frames, a minimum of 5/8 inch high unless otherwise indicated.

C. Loose Stops for Glazed Lites in Frames: Minimum 0.032 inch thick, fabricated from same material as frames in which they are installed.

D. Terminated Stops: Where indicated on interior door frames, terminate stops 6 inches above finish floor with a 45-degree angle cut, and close open end of stop with steel sheet closure. Cover opening in extension of frame with welded-steel filler plate, with welds ground smooth and flush with frame.
   1. Provide terminated stops where indicated.

2.8 ACCESSORIES

A. Mullions and Transom Bars: Join to adjacent members by welding.

B. Ceiling Struts: Minimum 1/4-inch-thick by 1-inch wide steel.

C. Grout Guards: Formed from same material as frames, not less than 0.016 inch thick.

2.9 FABRICATION

A. Fabricate hollow metal work 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. Tolerances: Fabricate hollow metal work to tolerances indicated in SDI 117.

C. Hollow Metal Doors:
   1. Exterior Doors: Provide weep-hole openings in bottom of exterior doors to permit moisture to escape. Seal joints in top edges of doors against water penetration.
   2. Glazed Lites: Factory cut openings in doors.
   3. Astragals: Provide overlapping astragal on one leaf of pairs of doors where required by NFPA 80 for fire-performance rating or where indicated. Extend minimum 3/4 inch beyond edge of door on which astragal is mounted.

D. Hollow Metal Frames: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.
   1. Welded Frames: Weld flush face joints continuously; grind, fill, dress, and make smooth, flush, and invisible.
   2. Frames shall be clearly labeled to correspond with architect's door schedule opening numbers.
   3. Sidelight and Transom Bar Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by butt welding.
4. Mullions and open back headers: Plug welded mullion seams every 6" and finish, continuous weld joint at all seams, top and bottom. Including faces, rabbets, soffits and faces. Fill and finish as required.

5. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.

6. Grout Guards: Weld guards to frame at back of hardware mortises in frames to be grouted.

7. Floor Anchors: Weld anchors to bottom of jambs and mullions with at least four spot welds per anchor.

8. Jamb Anchors: Provide number and spacing of anchors as follows:
   a. Masonry Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:
      1) Two anchors per jamb up to 60 inches high.
      2) Three anchors per jamb from 60 to 90 inches high.
      3) Four anchors per jamb from 90 to 120 inches high.
      4) Four anchors per jamb plus 1 additional anchor per jamb for each 24 inches or fraction thereof above 120 inches high.
   b. Stud-Wall Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:
      1) Three anchors per jamb up to 60 inches high.
      2) Four anchors per jamb from 60 to 90 inches high.
      3) Five anchors per jamb from 90 to 96 inches high.
      4) Five anchors per jamb plus 1 additional anchor per jamb for each 24 inches or fraction thereof above 96 inches high.
      5) Two anchors per head for frames above 42 inches wide and mounted in metal-stud partitions.
   c. Compression Type: Not less than two anchors in each jamb.
   d. Post installed Expansion Type: Locate anchors not more than 6 inches from top and bottom of frame. Space anchors not more than 26 inches o.c.

9. Door Silencers: Except on weather-stripped doors, drill stops to receive door silencers as follows. Keep holes clear during construction.
   a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
   b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.

E. Fabricate concealed stiffeners, edge channels, and hardware reinforcement from either cold- or hot-rolled steel sheet.

F. Hardware Preparation: Factory prepare hollow metal work to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to the Door Hardware Schedule and templates furnished as specified in Section 08 71 00.
   1. Locate hardware as indicated, or if not indicated, according to ANSI/SDI A250.8.
   2. Reinforce doors and frames to receive nontemplated, mortised and surface-mounted door hardware.
   3. Comply with applicable requirements in ANSI/SDI A250.6 and ANSI/DHI A115 Series specifications for preparation of hollow metal work for hardware.
   4. Coordinate locations of conduit and wiring boxes for electrical connections with Division 26 Sections.

G. Stops and Moldings: Provide stops and moldings around glazed lites where indicated. Form corners of stops and moldings with butted or mitered hairline joints.
   1. Single Glazed Lites: Provide fixed stops and moldings welded on secure side of hollow metal work.
   2. Multiple Glazed Lites: Provide fixed and removable stops and moldings so that each glazed lite is capable of being removed independently.
3. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames.
4. Provide loose stops and moldings on inside of hollow metal work.
5. Coordinate rabbet width between fixed and removable stops with type of glazing and type of installation indicated.

2.10 STEEL FINISHES

A. Prime Finish: Apply manufacturer's standard primer immediately after cleaning and pretreating.

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


2.11 COLOR AND GLOSS

A. As selected by Architect from manufacturer's full range.

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 the Work.

B. Examine roughing-in for embedded and built-in anchors to verify actual locations before frame installation.

C. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

D. 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 welded hollow metal frames for squarness, alignment, twist, and plumbness to the following tolerances:
   1. Squarness: 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 doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.
3.3 INSTALLATION

A. General: Install hollow metal work plumb, rigid, properly aligned, and securely fastened in place; comply with Drawings and manufacturer's written instructions.

B. Hollow Metal Frames: Install hollow metal frames of size and profile indicated. Comply with ANSI/SDI A250.11.
   1. Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.
      a. At fire-protection-rated openings, install frames according to NFPA 80.
      b. Where frames are fabricated in sections because of shipping or handling limitations, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces.
      c. Install frames with removable glazing stops located on secure side of opening.
      d. Install door silencers in frames before grouting.
      e. Remove temporary braces necessary for installation only after frames have been properly set and secured.
      f. Check plumbness, squareness, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
      g. Field apply bituminous coating to backs of frames that are filled with grout containing antifreezing agents.
   2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with postinstalled expansion anchors.
      a. Floor anchors may be set with powder-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.
   4. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with grout.
   5. Concrete Walls: Solidly fill space between frames and concrete with grout. Take precautions, including bracing frames, to ensure that frames are not deformed or damaged by grout forces.
   6. In-Place Concrete or Masonry Construction: Secure frames in place with postinstalled expansion anchors. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
   7. In-Place Gypsum Board Partitions: Secure frames in place with postinstalled expansion anchors through floor anchors at each jamb. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
   8. Ceiling Struts: Extend struts vertically from top of frame at each jamb to overhead structural supports or substrates above frame unless frame is anchored to masonry or to other structural support at each jamb. Bend top of struts to provide flush contact for securing to supporting construction. Provide adjustable wedged or bolted anchorage to frame jamb members.
   9. Installation Tolerances: Adjust hollow metal 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. Hollow Metal Doors: Fit hollow metal doors accurately in frames, within clearances specified below. Shim as necessary.
   1. Non-Fire-Rated Standard Steel Doors:
      a. Jams and Head: 1/8 inch plus or minus 1/16 inch.
      b. Between Edges of Pairs of Doors: 1/8 inch plus or minus 1/16 inch.
      c. Between Bottom of Door and Top of Threshold: Maximum 3/8 inch.
   2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.
   3. Smoke-Control Doors: Install doors according to NFPA 105.

D. Glazing: Comply with installation requirements in Division 08 Section "Glazing" and with hollow metal manufacturer's written instructions.
   1. Secure stops with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches o.c. and not more than 2 inches o.c. from each corner.

3.4 ADJUSTING AND CLEANING

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 hollow metal work that is warped, bowed, or otherwise unacceptable.

B. Remove grout and other bonding material from hollow metal work immediately after installation.

C. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.

D. Metallic-Coated Surfaces: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.

END OF SECTION
PART 1  GENERAL

1.1  SECTION INCLUDES

A. Access door and frame units.
B. Wall and ceiling locations.

1.2  RELATED SECTIONS

A. Section 07 90 00 – Joint Protection: Perimeter sealant.
B. Section 09 21 16 - Gypsum Board Assemblies: Openings in partitions.
C. Section 09 90 00 – Painting and Coating: Field paint finish.
D. Divisions 22 and 23: Plumbing components requiring access.
E. Section 26 05 35 - Boxes: Electrical components requiring access.

1.3  SUBMITTALS

A. Submit under provisions of Section 01 33 00.
B. Product Data: Provide sizes, types, finishes, scheduled locations, and details of adjoining work.

1.4  PROJECT RECORD DOCUMENTS

A. Submit under provisions of Section 01 78 39.
B. Record actual locations of all access units.

1.5  COORDINATION

A. Coordinate work under provisions of Section 01 31 13.
B. Coordinate the work with mechanical, electrical, and plumbing work requiring access units.

PART 2  PRODUCTS

2.1  MANUFACTURERS - WALL AND CEILING UNITS

A. BAR-CO, Division of Alfab.
B. Bilco Company.
C. JL Industries.
H. Substitutions: Under provisions of Section 01 25 00.

2.2 FLUSH FRAMED ACCESS DOORS
A. Frames and nominal 1 inch wide exposed flanges of 16 gage steel and door panels of 14 gage steel.

2.3 FABRICATION - WALL AND CEILING UNITS
A. Fabricate frames and doors of continuous welded construction; phosphate dipped, prime coated.
B. Weld, fill, and grind joints to assure flush and square unit.
C. Hardware:
   1. Hinge: Concealed continuous hinge with spring-type constant force closer.
   2. Lock: Cylinder lock with latch, two keys for each unit.

2.4 FINISHES
A. Base Metal Protection: Phosphate dipped with rust inhibitive baked on primer.
B. Finish: Paint to match adjacent surfaces.

2.5 SPARE MATERIALS
A. Provide two keys for each door installed.

PART 3 EXECUTION

3.1 EXAMINATION
A. Verify substrate conditions are ready to receive Work of this Section.
B. Verify that rough openings for door and frame are correctly sized and located.

3.2 INSTALLATION
A. Install units in accordance with manufacturer's instructions.
B. Install frames plumb and level in opening. Secure rigidly in place.
C. Position unit to provide convenient access to concealed work requiring access.
D. Caulk around perimeter flange at gypsum board surfaces.

3.3 SCHEDULE

A. Walls to access plumbing values or other controls: 12 inch x 12 inch. See also plumbing, mechanical, and electrical.

B. Access doors providing access to fire dampers shall be marked as such.

END OF SECTION
SECTION 087100 – DOOR HARDWARE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes:

1. Mechanical and electrified door hardware for:
   a. Swinging doors.
   b. Sliding doors.
   c. Gates.

2. Electronic access control system components, including:
   a. Electronic access control locksets and electric strikes.

3. Field verification, preparation and modification of existing doors and frames to receive new door hardware.
4. Lead-lining door hardware items required for radiation protection at door openings.

B. Exclusions: Unless specifically listed in hardware sets, hardware is not specified in this section for:

1. Windows
2. Cabinets (casework), including locks in cabinets
3. Signage
4. Toilet accessories
5. Overhead doors

C. Related Sections:

1. Division 01 Section “Alternates” for alternates affecting this section.
2. Division 07 Section “Joint Sealants” for sealant requirements applicable to threshold installation specified in this section.
3. Division 09 sections for touchup finishing or refinishing of existing openings modified by this section.
4. Division 13 Section “Radiation Protection” for requirements for lead-lining for door hardware at openings indicated to receive radiation protection.
5. Division 26 sections for connections to electrical power system and for low-voltage wiring.
6. Division 28 sections for coordination with other components of electronic access control system.
1.3 REFERENCES

A. Fire/Life Safety

1. NFPA - National Fire Protection Association
   a. NFPA 70 – National Electric Code
   b. NFPA 80 - Standard for Fire Doors and Fire Windows
   d. NFPA 105 - Smoke and Draft Control Door Assemblies


B. UL - Underwriters Laboratories

1. UL 10B - Fire Test of Door Assemblies
2. UL 10C - Positive Pressure Test of Fire Door Assemblies
3. UL 1784 - Air Leakage Tests of Door Assemblies
4. UL 305 - Panic Hardware

C. Accessibility

1. ADA - Americans with Disabilities Act.

D. DHI - Door and Hardware Institute

1. Sequence and Format for the Hardware Schedule
2. Recommended Locations for Builders Hardware
3. Key Systems and Nomenclature

E. ANSI - American National Standards Institute

1. ANSI/BHMA A156.1 - A156.29, and ANSI A156.31 - Standards for Hardware and Specialties

1.4 SUBMITTALS

A. General:

1. Submit in accordance with Conditions of Contract and Division 01 requirements.
2. Highlight, encircle, or otherwise specifically identify on submittals deviations from Contract Documents, issues of incompatibility or other issues which may detrimentally affect the Work.
3. Prior to forwarding submittal, comply with procedures for verifying existing door and frame compatibility for new hardware, as specified in PART 3, “EXAMINATION” article, herein.

B. Action Submittals:

1. Product Data: Product data including manufacturers’ technical product data for each item of door hardware, installation instructions, maintenance of operating parts and finish, and other information necessary to show compliance with requirements.
2. Riser and Wiring Diagrams: After final approval of hardware schedule, submit details of electrified door hardware, indicating:
a. **Wiring Diagrams:** For power, signal, and control wiring and including:
   1) Details of interface of electrified door hardware and building safety and security systems.
   2) Schematic diagram of systems that interface with electrified door hardware.
   3) Point-to-point wiring.
   4) Risers.

3. **Samples for Verification:** If requested by Architect, submit production sample or sample installations of each type of exposed hardware unit in finish indicated, and tagged with full description for coordination with schedule.
   a. Samples will be returned to supplier in like-new condition. Units that are acceptable to Architect may, after final check of operations, be incorporated into Work, within limitations of key coordination requirements.

4. **Door Hardware Schedule:** Submit schedule with hardware sets in vertical format as illustrated by Sequence of Format for the Hardware Schedule as published by the Door and Hardware Institute. Indicate complete designations of each item required for each door or opening, include:
   a. Door Index; include door number, heading number, and Architects hardware set number.
   b. Opening Lock Function Spreadsheet: List locking device and function for each opening.
   c. Type, style, function, size, and finish of each hardware item.
   d. Name and manufacturer of each item.
   e. Fastenings and other pertinent information.
   f. Location of each hardware set cross-referenced to indications on Drawings.
   g. Explanation of all abbreviations, symbols, and codes contained in schedule.
   h. Mounting locations for hardware.
   i. Door and frame sizes and materials.
   j. Name and phone number for local manufacturer's representative for each product.
   k. Operational Description of openings with any electrified hardware (locks, exits, electromagnetic locks, electric strikes, automatic operators, door position switches, magnetic holders or closer/holder units, and access control components). Operational description should include how door will operate on egress, ingress, and fire and smoke alarm connection.
      1) Submittal Sequence: Submit door hardware schedule concurrent with submissions of Product Data, Samples, and Shop Drawings. Coordinate submission of door hardware schedule with scheduling requirements of other work to facilitate fabrication of other work that is critical in Project construction schedule.

5. **Key Schedule:**
   a. Key Schedule and keying to be done by UNLV Facilities Lock Shop

6. **Templates:** After final approval of hardware schedule, provide templates for doors, frames and other work specified to be factory prepared for door hardware installation.

C. **Informational Submittals:**

1. **Qualification Data:** For Supplier, Installer and Architectural Hardware Consultant.
2. **Product Certificates for electrified door hardware, signed by manufacturer:**
a. Certify that door hardware approved for use on types and sizes of labeled fire-rated doors complies with listed fire-rated door assemblies.

3. Certificates of Compliance:
   a. Certificates of compliance for fire-rated hardware and installation instructions if requested by Architect or Authority Having Jurisdiction.
   b. Installer Training Meeting Certification: Letter of compliance, signed by Contractor, attesting to completion of installer training meeting specified in “QUALITY ASSURANCE” article, herein.
   c. Electrified Hardware Coordination Conference Certification: Letter of compliance, signed by Contractor, attesting to completion of electrified hardware coordination conference, specified in “QUALITY ASSURANCE” article, herein.

4. Product Test Reports: For compliance with accessibility requirements, based on evaluation of comprehensive tests performed by manufacturer and witnessed by qualified testing agency, for door hardware on doors located in accessible routes.

5. Warranty: Special warranty specified in this Section.

D. Closeout Submittals:
   1. Operations and Maintenance Data: Provide in accordance with Division 01 and include:
      a. Complete information on care, maintenance, and adjustment; data on repair and replacement parts, and information on preservation of finishes.
      b. Catalog pages for each product.
      c. Name, address, and phone number of local representative for each manufacturer.
      d. Parts list for each product.
      e. Final approved hardware schedule, edited to reflect conditions as-installed.
      f. Final keying schedule
      g. Copies of floor plans with keying nomenclature
      h. As-installed wiring diagrams for each opening connected to power, both low voltage and 110 volts.
      i. Copy of warranties including appropriate reference numbers for manufacturers to identify project.

1.5 QUALITY ASSURANCE

A. Product Substitutions: Comply with product requirements stated in Division 01 and as specified herein.

   1. Where specific manufacturer’s product is named and accompanied by “No Substitute,” including make or model number or other designation, provide product specified. (Note: Certain products have been selected for their unique characteristics and particular project suitability.)
      a. Where no additional products or manufacturers are listed in product category, requirements for “No Substitute” govern product selection.

   2. Where products indicate “acceptable substitute” or “acceptable manufacturer”, provide product from specified manufacturers, subject to compliance with specified requirements and “Single Source Responsibility” requirements stated herein.

B. Supplier Qualifications and Responsibilities: Recognized architectural hardware supplier with record of successful in-service performance for supplying door hardware similar in quantity, type, and quality to that indicated for this Project and that provides certified Architectural
Hardware Consultant (AHC) available to Owner, Architect, and Contractor, at reasonable times during the Work for consultation.

1. Warehousing Facilities: In Project's vicinity.
2. Scheduling Responsibility: Preparation of door hardware and keying schedules.
3. Engineering Responsibility: Preparation of data for electrified door hardware, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.
4. Coordination Responsibility: Coordinate installation of electronic security hardware with Architect and electrical engineers and provide installation and technical data to Architect and other related subcontractors.
   a. Upon completion of electronic security hardware installation, inspect and verify that all components are working properly.

C. Installer Qualifications: Qualified tradesmen, skilled in application of commercial grade hardware with record of successful in-service performance for installing door hardware similar in quantity, type, and quality to that indicated for this Project.

D. Architectural Hardware Consultant Qualifications: Person who is experienced in providing consulting services for door hardware installations that are comparable in material, design, and extent to that indicated for this Project and meets these requirements:
   1. For door hardware, DHI-certified, Architectural Hardware Consultant (AHC).
   2. Can provide installation and technical data to Architect and other related subcontractors.
   3. Can inspect and verify components are in working order upon completion of installation.
   5. Capable of coordinating installation of electrified hardware with Architect and electrical engineers.

E. Single Source Responsibility: Obtain each type of door hardware from single manufacturer.
   1. Provide electrified door hardware from same manufacturer as mechanical door hardware, unless otherwise indicated.
   2. Manufacturers that perform electrical modifications and that are listed by testing and inspecting agency acceptable to authorities having jurisdiction are acceptable.

F. Fire-Rated Door Openings: Provide door hardware for fire-rated openings that complies with NFPA 80 and requirements of authorities having jurisdiction. Provide only items of door hardware that are listed and are identical to products tested by Underwriters Laboratories, Intertek Testing Services, or other testing and inspecting organizations acceptable to authorities having jurisdiction for use on types and sizes of doors indicated, based on testing at positive pressure and according to NFPA 252 or UL 10C and in compliance with requirements of fire-rated door and door frame labels.

G. Smoke- and Draft-Control Door Assemblies: Where smoke- and draft-control door assemblies are required, provide door hardware that meets requirements of assemblies tested according to UL 1784 and installed in compliance with NFPA 105.
   1. Air Leakage Rate: Maximum air leakage of 0.3 cfm/sq. ft. (3 cu. m per minute/sq. m) at tested pressure differential of 0.3-inch wg (75 Pa) of water.

H. Electrified Door Hardware: Listed and labeled as defined in NFPA 70, Article 100, by testing agency acceptable to authorities having jurisdiction.
I. Means of Egress Doors: Latches do not require more than 15 lbf (67 N) to release latch. Locks do not require use of key, tool, or special knowledge for operation.

J. Accessibility Requirements: For door hardware on doors in an accessible route, comply with governing accessibility regulations cited in “REFERENCES” article, herein.

1. Provide operating devices that do not require tight grasping, pinching, or twisting of wrist and that operate with force of not more than 5 lbf (22.2 N).
2. Maximum opening-force requirements:
   a. Interior, Non-Fire-Rated Hinged Doors: 5 lbf (22.2 N) applied perpendicular to door.
   b. Sliding or Folding Doors: 5 lbf (22.2 N) applied parallel to door at latch.
   c. Fire Doors: Minimum opening force allowable by authorities having jurisdiction.

3. Bevel raised thresholds with slope of not more than 1:2. Provide thresholds not more than 1/2 inch (13 mm) high.
4. Adjust door closer sweep periods so that, from open position of 70 degrees, door will take at least 3 seconds to move to 3 inches (75 mm) from latch, measured to leading edge of door.

K. Keying Conference: Conduct conference at Project site to comply with requirements in Division 01.

2. Incorporate keying conference decisions into final keying schedule after reviewing door hardware keying system including:
   a. Function of building, flow of traffic, purpose of each area, degree of security required, and plans for future expansion.
   b. Preliminary key system schematic diagram.
   c. Requirements for key control system.
   d. Requirements for access control.
   e. Address for delivery of keys.

L. Pre-installation Conference: Conduct conference at Project site

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. Inspect and discuss preparatory work performed by other trades.
3. Inspect and discuss electrical roughing-in for electrified door hardware.
4. Review sequence of operation for each type of electrified door hardware.
5. Review required testing, inspecting, and certifying procedures.

M. Coordination Conferences:

1. Installation Coordination Conference: Prior to hardware installation, schedule and hold meeting to review questions or concerns related to proper installation and adjustment of door hardware.
   a. Attendees: Door hardware supplier, door hardware installer, Contractor.
   b. After meeting, provide letter of compliance to Architect, indicating when meeting was held and who was in attendance.

2. Electrified Hardware Coordination Conference: Prior to ordering electrified hardware, schedule and hold meeting to coordinate door hardware with security, electrical, doors and frames, and other related suppliers.
a. Attendees: Owner’s access control company – Vegas Valley Locking Systems, electrified door hardware supplier, doors and frames supplier, electrified door hardware installer, electrical subcontractor, Owner, Architect and Contractor.
b. After meeting, provide letter of compliance to Architect, indicating when coordination conference was held and who was in attendance.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Inventory door hardware on receipt and provide secure lock-up for hardware delivered to Project site.

B. Tag each item or package separately with identification coordinated with final door hardware schedule, and include installation instructions, templates, and necessary fasteners with each item or package.
   1. Deliver each article of hardware in manufacturer’s original packaging.

C. Project Conditions:
   1. Maintain manufacturer-recommended environmental conditions throughout storage and installation periods.
   2. Provide secure lock-up for door hardware delivered to Project, but not yet installed. Control handling and installation of hardware items so that completion of Work will not be delayed by hardware losses both before and after installation.

D. Protection and Damage:
   1. Promptly replace products damaged during shipping.
   2. Handle hardware in manner to avoid damage, marring, or scratching. Correct, replace or repair products damaged during Work.
   3. Protect products against malfunction due to paint, solvent, cleanser, or any chemical agent.

E. Deliver keys to manufacturer of key control system for subsequent delivery to Owner.

F. Deliver keys and permanent cores to: JJ Hall, Lead Locksmith, UNLV Lock Shop by registered mail or overnight package service.

1.7 COORDINATION

A. Coordinate layout and installation of floor-recessed door hardware with floor construction. Cast anchoring inserts into concrete. Concrete, reinforcement, and formwork requirements are specified in Division 03.

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

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

D. Electrical System Roughing-In: Coordinate layout and installation of electrified door hardware with connections to power supplies and building safety and security systems.
E. Existing Openings: Where hardware components are scheduled for application to existing construction or where modifications to existing door hardware are required, field verify existing conditions and coordinate installation of door hardware to suit opening conditions and to provide proper door operation.

F. Direct shipments not permitted, unless approved by Contractor.

1.8 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Years from date of Substantial Completion, for durations indicated.
   a. Closers:
      1) Mechanical: 30 years for LCN 4000
      2) Electrified: 2 years.
   b. Automatic Operators: 1 year
   c. Exit Devices:
      1) Mechanical: 3 years.
      2) Electrified: 1 year.
   d. Locksets:
      1) Mechanical: 7 years.
      2) Electrified: 1 year.
   e. Continuous Hinges: Lifetime warranty
   f. Key Blanks: Lifetime

2. Warranty does not cover damage or faulty operation due to improper installation, improper use or abuse.

1.9 MAINTENANCE

A. Extra Materials:

1. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   a. Door Hardware: Coordinate with UNLV Lock Shop
   b. Electrical Parts: Coordinate with UNLV Lock Shop

B. Maintenance Tools:

1. Furnish complete set of special tools required for maintenance and adjustment of hardware, including changing of cylinders.
2.1 MANUFACTURERS

A. The Owner requires use of certain products for their unique characteristics and particular project suitability to insure continuity of existing and future performance and maintenance standards. After investigating available product offerings Awarding Authority has elected to prepare proprietary specifications. These products are specified with the notation: “No Substitute.”

1. Where “No Substitute” is noted, submittals and substitution requests for other products will not be considered.

B. Approval of manufacturers other than those listed shall be in accordance with QUALITY ASSURANCE article, herein.

C. Approval of products from manufacturers indicated as “Acceptable Manufacturer” is contingent upon those products providing all functions and features and meeting all requirements of scheduled manufacturer’s product.

<table>
<thead>
<tr>
<th>Item</th>
<th>Scheduled Manufacturer</th>
<th>Acceptable Manufacturer</th>
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<tr>
<td>Latch Protector</td>
<td>Ives (IVE)</td>
<td>Hager, Rockwood</td>
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doors are exposed to view: Finish to match adjacent door hardware material.

D. Cable and Connectors: Hardwired Electronic Access Control Lockset and Exit Device Trim:

1. Data: 24AWG, 4 conductor shielded, Belden 9843, 9841 or comparable.
2. DC Power: 18 AWG, 2 conductor, Belden 8760 or comparable.
3. Provide type of data and DC power cabling required by access control device manufacturer for this installation.

2.4 HINGES

A. Provide five-knuckle, ball bearing hinges.

1. Manufacturers and Products:

B. Requirements:

1. 1-3/4 inch (44 mm) thick doors, up to and including 36 inches (914 mm) wide:
   a. Exterior: Standard weight, bronze or stainless steel, 4-1/2 inches (114 mm) high
   b. Interior: Standard weight, steel, 4-1/2 inches (114 mm) high

2. 1-3/4 inch (44 mm) thick doors over 36 inches (914 mm) wide:
   a. Exterior: Heavy weight, bronze/stainless steel, 5 inches (127 mm) high
   b. Interior: Heavy weight, steel, 5 inches (127 mm) high

3. 2 inches or thicker doors:
   a. Exterior: Heavy weight, bronze or stainless steel, 5 inches (127 mm) high
   b. Interior: Heavy weight, steel, 5 inches (127 mm) high

4. Provide three hinges per door leaf for doors 90 inches (2286 mm) or less in height, and one additional hinge for each 30 inches (762 mm) of additional door height.

5. Where new hinges are specified for existing doors or existing frames, provide new hinges of identical size to hinge preparation present in existing door or existing frame.

6. Hinge Pins: Except as otherwise indicated, provide hinge pins as follows:
   a. Steel Hinges: Steel pins
   b. Non-Ferrous Hinges: Stainless steel pins
   c. Out-Swinging Exterior Doors: Non-removable pins
   d. Out-Swinging Interior Lockable Doors: Non-removable pins
   e. Interior Non-lockable Doors: Non-rising pins

7. Width of hinges: 4-1/2 inches (114 mm) at 1-3/4 inch (44 mm) thick doors, and 5 inches (127 mm) at 2 inches (51 mm) or thicker doors. Adjust hinge width as required for door, frame, and wall conditions to allow proper degree of opening.

8. Doors 36 inches (914 mm) wide or less furnish hinges 4-1/2 inches (114 mm) high; doors greater than 36 inches (914 mm) wide furnish hinges 5 inches (127 mm) high, heavy weight or standard weight as specified.

9. Provide hinges with electrified options as scheduled in the hardware sets. Provide with sufficient number and wire gage to accommodate electric function of specified hardware. Locate electric hinge at second hinge from bottom or nearest to electrified locking component.

10. Provide mortar guard for each electrified hinge specified, unless specified in hollow metal frame specification.
11. Provide spring hinges where specified. Provide two spring hinges and one bearing hinge per door leaf for doors 90 inches (2286 mm) or less in height. Provide one additional bearing hinge for each 30 inches (762 mm) of additional door height.

2.5 CONTINUOUS HINGES

A. Stainless Steel

1. Manufacturers:
   a. Scheduled Manufacturer: Ives
   b. Acceptable Manufacturers: Markar, Stanley

2. Requirements:
   a. Provide pin and barrel continuous hinges conforming to ANSI A156.26, Grade 2.
   b. Provide pin and barrel continuous hinges fabricated from 14 gauge, type 304 stainless steel.
   c. Provide twin self-lubricated nylon bearings at each hinge knuckle, with 0.25-inch (6 mm) diameter stainless steel pin.
   d. Provide hinges capable of supporting door weights up to 600 pounds, and successfully tested for 1,500,000 cycles.
   e. On fire-rated doors, provide pin and barrel continuous hinges that are classified for use on rated doors by testing agency acceptable to authority having jurisdiction.
   f. Provide pin and barrel continuous hinges with electrified options as scheduled in the hardware sets. Provide with sufficient number and wire gage to accommodate electric function of specified hardware.
   g. Install hinges with fasteners supplied by manufacturer.
   h. Provide hinges with symmetrical hole pattern.

B. Cold-Rolled Steel

1. Manufacturers:
   a. Scheduled Manufacturer: Ives
   b. Acceptable Manufacturers: Markar, Stanley

2. Requirements:
   a. Provide pin and barrel continuous hinges conforming to ANSI A156.26, Grade 2.
   b. Provide pin and barrel continuous hinges fabricated from type 1012 cold rolled steel.
   c. Provide twin self-lubricated nylon bearings at each hinge knuckle, with 0.25-inch (6 mm) diameter stainless steel pin.
   d. Provide hinges capable of supporting door weights up to 600 pounds, and successfully tested for 1,500,000 cycles.
   e. On fire-rated doors, provide pin and barrel continuous hinges that are classified for use on rated doors by testing agency acceptable to authority having jurisdiction.
   f. Provide pin and barrel continuous hinges with electrified options as scheduled in the hardware sets. Provide with sufficient number and wire gage to accommodate electric function of specified hardware.
   g. Install hinges with fasteners supplied by manufacturer.
   h. Provide hinges with symmetrical hole pattern.

C. Aluminum Geared

1. Manufacturers:
a. Scheduled Manufacturer: Ives.

2. Requirements:
   a. Provide aluminum geared continuous hinges conforming to ANSI A156.25, Grade 2.
   b. Provide aluminum geared continuous hinges, where specified in the hardware sets, fabricated from 6063-T6 aluminum, with 0.25-inch (6 mm) diameter Teflon coated stainless steel hinge pin.
   c. Provide split nylon bearings at each hinge knuckle for quiet, smooth, self-lubricating operation.
   d. Provide hinges capable of supporting door weights up to 450 pounds, and successfully tested for 1,500,000 cycles.
   e. On fire-rated doors, provide aluminum geared continuous hinges that are classified for use on rated doors by testing agency acceptable to authority having jurisdiction.
   f. Provide aluminum geared continuous hinges with electrified option scheduled in the hardware sets. Provide with sufficient number and wire gage to accommodate electric function of specified hardware.
   g. Install hinges with fasteners supplied by manufacturer.
   h. Provide hinges with symmetrical hole pattern.

2.6 ELECTRIC POWER TRANSFER

A. Manufacturers:
   a. Scheduled Manufacturer: Von Duprin
   b. Acceptable Manufacturers: ABH

B. Provide power transfer with electrified options as scheduled in the hardware sets. Provide with number and gage of wires sufficient to accommodate electric function of specified hardware.

C. Locate electric power transfer per manufacturer’s template and UL requirements, unless interference with operation of door or other hardware items.

2.7 FLUSH BOLTS

A. Manufacturers:
   1. Scheduled Manufacturer: Ives
   2. Acceptable Manufacturers: Hager, Rockwood

B. Requirements:
   1. Provide automatic, constant latching, and manual flush bolts with forged bronze or stainless steel face plates, extruded brass levers, and with wrought brass guides and strikes. Provide 12 inch (305 mm) steel or brass rods at doors up to 90 inches (2286 mm) in height. For doors over 90 inches (2286 mm) in height increase top rods by 6 inches (152 mm) for each additional 6 inches (152 mm) of door height. Provide dust-proof strikes at each bottom flush bolt.
2.8 SURFACE BOLTS

A. Manufacturers:
   1. Scheduled Manufacturer: Ives
   2. Acceptable Manufacturers: Hager, Rockwood

B. Requirements:
   1. Surface bolts to have 1” throw for maximum security with concealed mounting that prevents vandalism. Units to be constructed of heavy duty steel and cUL listed up to three (3) hours when used on the inactive door of a pair up to 8’ in height.

2.9 COORDINATORS

A. Manufacturers:
   1. Scheduled Manufacturer: Ives
   2. Acceptable Manufacturers: Hager, Rockwood

B. Requirements:
   1. Where pairs of doors are equipped with automatic flush bolts, an astragal, or other hardware that requires synchronized closing of the doors, provide bar-type coordinating device, surface applied to underside of stop at frame head.
   2. Provide filler bar of correct length for unit to span entire width of opening, and appropriate brackets for parallel arm door closers and surface vertical rod exit device strikes. Factory-prep coordinators for vertical rod devices if required.

2.10 ALUMINUM DOOR LOCKS – NARROW STYLE

A. Manufacturer and Product: Adams Rite 4900 series X 4568/9 Lever or 4590/1 Paddle

B. Requirements:
   1. Provide narrow style aluminum door locks as specified. Cylinders: Refer to “KEYING” article, herein.
   2. Provide locks with [1-1/8 inches (29 mm)][1-1/2 inches (38 mm)] backset as required for door detail with full 5/8 inch (16 mm) throw latchbolt.
   3. Provide manufacturer’s standard strikes unless extended lip strikes are necessary to protect trim.

2.11 CYLINDRICAL LOCKS – GRADE 1

A. Manufacturers and Products:
   1. Scheduled Manufacturer and Product: Schlage ND Series

B. Requirements:
   1. Provide cylindrical locks conforming to ANSI A156.2 Series 4000, Grade 1. Cylinders: Refer to “KEYING” article, herein.
2. If Required- Provide cylindrical locks with classroom security function with an inside indicator that provides clear direction for users to safely and quickly secure the room.

3. Provide locksets able to withstand 1500 inch pounds of torque applied to locked outside lever without gaining access per ANSI A156.2 Abusive Locked Lever Torque Test and cycle tested to 3 million cycles per ANSI A156.2 Cycle Test.

4. Provide solid steel rotational stops to control excessive rotation of lever.

5. Provide completely re-functionable lockset that allows lock function to be changed to over twenty other common functions by swapping easily accessible parts.

6. Provide locks with standard 2-3/4 inches (70 mm) backset, unless noted otherwise, with 1/2 inch latch throw. Provide proper latch throw for UL listing at pairs.

7. Provide locksets with separate anti-rotation thru-bolts, and no exposed screws.

8. Provide independently operating levers with two external return spring cassettes mounted under roses to prevent lever sag.

9. Provide standard ASA strikes unless extended lip strikes are necessary to protect trim.

10. Provide electrified options as scheduled in the hardware sets.

11. Lever Trim: Solid cast levers without plastic inserts, and wrought roses on both sides.
   b. Tactile Warning (Knurling): Where required by authority having jurisdiction. Provide on levers on exterior (secure side) of doors serving rooms considered to be hazardous.

2.12 EXIT DEVICES VON DUPRIN AND/OR THE CONCEALED CABLE DEVICE

A. Manufacturer and Product: Von Duprin 99/33 series OPTION 98/35 series, No Substitute

B. Requirements:

1. Provide exit devices tested to ANSI/BHMA A156.3 Grade 1, [OPTION for specific compliant products/applications: UL certified to meet maximum 5 pound requirements according to the California Building Code section 11B-309.4,) and UL listed for Panic Exit or Fire Exit Hardware. Cylinders: Refer to “KEYING” article, herein.

2. Provide touchpad type exit devices, fabricated of brass, bronze, stainless steel, or aluminum, plated to standard architectural finishes to match balance of door hardware.

3. Quiet Operation: Incorporate fluid damper or other device that eliminates noise of exit device operation.

4. Touchpad: Extend minimum of one half of door width, but not the full length of exit device rail. Provide end-cap with two-point attachment to door. Match exit device finish, stainless steel for US26, US26D, US28, US32, and US32D finishes; and for all other finishes, provide compatible finish to exit device. Provide compression springs in devices, latches, and outside trims or controls; tension springs prohibited.

5. Provide rim devices with a dual cylinder or inside thumb turn cylinder option with a visual security indicator that identifies the trims locked/unlocked status of the door from the inside of the room. Indicator in unlocked state presents a 1/2 inch x 1/2 inch white metal flag with black icon at top of device head. Indicator in locked state has no flag present. Provide rim devices without the dual cylinder or inside thumb turn cylinder option capable of being retrofitted with the visual security indicator.

6. Provide exit devices with deadlatching feature for security and for future addition of alarm kits and/or other electrical requirements.


8. OPTION XP 98/99 only: Latchbolt, Rim Exit Devices: Non-tapered smart latchbolt with 90° latchbolt to strike engagement under stress.

9. OPTION 98/9949 and/or 33/3549A only: Concealed Vertical Cable Exit Devices: Cable-actuated concealed vertical latch system in two-point and less bottom latch (LBL) configurations. Vertical rods not permitted.
a. Cable: Stainless steel core wire in stainless steel with polytetrafluoroethylene (Teflon®) liner color-coded to latches and center slides. Conduit and core wire ends snap into latch and center slides without use of tools.
b. Latchbolts and Blocking Cams: Manufactured from sintered metal low carbon copper-infiltrated steel, with molybdenum disulfide low friction coating.
c. Top Latchbolt: Minimum 0.382 inch (10 mm) and greater than 90 degree engagement with strike to prevent door and frame separation under high static load.
d. Bottom Latchbolt: Minimum of 0.44 inch (11 mm) engagement with strike.
e. Product Cycle Life: 1,000,000 cycles.
f. Latch Operation: Top and bottom latch operate independently of each other. Top latch fully engages top strike even when bottom latch is compromised. Separate trigger mechanisms not permitted.
g. Latch release does not require separate trigger mechanism.
h. Cable and latching system characteristics:
   1) Assembled prior to being installed in door.
   2) Installed in door as complete assembly.
   3) Installed independently of exit device installation, and capable of functioning on door prior to device and trim installation.
   4) Connected to exit device at single attachment point.
   5) Bottom latch height adjusted from single point, after system is installed and connected to exit device, while door is hanging
   6) Latch position altered up and down 2 inches (51 mm) without additional adjustment.
   7) System may be removed while door is hanging.
   8) Configure latchbolt mounting: double or single tab mount for steel doors, and wood doors, face mount for aluminum doors, eliminating requirement of tabs.
   9) Provide adjustable exit device to latch center line adjustment. Ensures double tab mounting option for top latch, regardless of exit device centerline.

10. Provide exit devices with manufacturer’s approved strikes.
11. Provide exit devices cut to door width and height. Locate exit devices at height recommended by exit device manufacturer, allowable by governing building codes, and approved by Architect.
12. Mount mechanism case flush on face of doors, or provide spacers to fill gaps behind devices. Where glass trim or molding projects off face of door, provide glass bead kits.
13. Provide cylinder[hex-key] dogging at non-fire-rated exit devices, unless specified less dogging.
14. Removable Mullions: 2 inches (51 mm) x 3 inches (76 mm) steel tube. Where scheduled as keyed removable mullion that is removed by use of a keyed cylinder, which is self-locking when re-installed.
15. Where lever handles are specified as outside trim for exit devices, provide heavy-duty lever trims with forged or cast escutcheon plates. Provide vandal-resistant levers that will travel to 90-degree down position when more than 35 pounds of torque are applied, and which can easily be re-set.

a. Lever Style: Match lever style of locksets.
b. Tactile Warning (Knurling): Where required by authority having jurisdiction. Provide on levers on exterior (secure side) of doors serving rooms considered to be hazardous.

16. Provide UL labeled fire exit hardware for fire rated openings.
17. Provide factory drilled weep holes for exit devices used in full exterior application, highly corrosive areas, and where noted in hardware sets.
18. Provide electrified options as scheduled in the hardware sets.
2.13 ACCESS CONTROL READER

A. Manufacturers and Products:


B. Requirements: Read Only Multi-technology Contactless reader

1. Access control card readers shall be as manufactured by a global company who is a recognized leader in the production of access control devices. Card reader manufactured for non-access control applications shall not be acceptable.
2. Multi-technology contactless reader shall read access control data from both 125 kHz and 13.56 MHz contactless smart cards and NFC-compatible. The multi-technology contactless reader shall be optimally designed for use in access control applications that require reading both 125 kHz Proximity and 13.56 MHz contactless smart cards by providing:
   a. Configuration allows reader to be enabled to read smart, proximity or both technologies at the same time.
   b. A migration platform to upgrade from the most popular 125 kHz proximity technologies to MIFARE or MIFARE DESFire EV1 by reading both 125 kHz proximity technology and 13.56 MHz contactless smart card technology.
   c. Guaranteed compatibility to read all standard data formats ensuring card-to-reader interoperability in multi-location installations and multi-card/reader populations.
   d. Secure access control data exchange between the smart card and the reader utilizing diversified keys and mutual authentication sequences.
   e. Universal compatibility with most access control systems.
   f. Ease of installation through industry standard wiring methods.
   g. Compatibility with legacy 125 KHz proximity access control formats (all standard formats up to 37 bits, including HID Corporate 1000 formats).
   h. Optimal read range and read speed for increased access control throughput.
   i. Global availability.
   j. Product construction suitable for both indoor and outdoor applications.
   k. Customizable behavior for indicator lights and beeper.

3. Multi-technology contactless reader shall comply with the following 13.56MHz-related standards to ensure product compatibility and predictability of performance:
   a. ISO 14443

4. Multi-technology contactless reader shall be configurable to read 13.56 MHz data simultaneously from the following cards (multiple credential support based on reader configuration):
   a. Secure support - Mifare DESFire EV1with PACSA, Mifare Classic, FIPS 201 PIV Credential.
   b. UID/CSN Support – DESFire Classic V0.06, HID iClass, ISOX (my-d).

5. Multi-technology contactless reader shall be configurable to read data from any compatible 125 kHz technology simultaneously with 13.56 MHz data. Compatible 125 kHz technologies include:
   a. XCEEDID/Schlage/HID Prox (format in the card – formats up to 37-bits supported).
   b. AWID PROX (SAME AS LENEL PROX - format in the card – formats up to 42-bits).
   c. GE PROX - two possible format options.
6. Multi-technology contactless reader shall provide the ability to read card access data stored in the secure access control sector/application area of the ISO 14443 XceedID MIFARE or MIFARE DESFire EV1 card.

7. The Multi-technology contactless reader shall be configurable to provide multiple hierarchical degrees of key compatibility for accessing the smart card access control data. Compatibility shall be provided for the following key structure options:
   a. Compatibility with the default manufacturer’s key structure to ensure convenient off the shelf compatibility with manufacturer’s cards and readers.
   b. Compatibility with custom keys managed by manufacturer which provide a site-specific, unique, protected key structure.
   c. Compatibility with high security customer managed custom keys.

8. The Multi-technology contactless reader shall be configurable to provide compatibility with all standard Prox formats up to 37 bits (including Corporate 1000®).

9. Multi-technology contactless reader shall allow the reader firmware to be upgraded in the field without the need to remove the reader from the wall through the use of factory-provided device.

10. Multi-technology contactless reader shall be suitable for global deployment by meeting worldwide radio and safety regulatory compliance including:
   a. FCC Certification (US)
   b. CE (EU)
   c. C-tick (Australia, New Zealand)
   d. R&TTE Directive (15EU)
   e. UL294 (US)
   f. ULC-S319
   g. IC (Canada)
   h. FIPS201 / PIV I
   i. IP65

11. Multi-technology contactless reader shall be fully compliant with Restriction of Hazardous Substances directive (RoHS) restricting the use of specific hazardous materials found in electrical and electronic products.

12. Multi-technology contactless reader shall provide universal compatibility with most access control systems by outputting card data in compliance with the SIA AC-01 Wiegand standard.

13. Multi-technology contactless reader shall allow for secure installation practices through mounting methods utilizing tamper resistant screws.

14. Multi-technology contactless reader shall provide the ability to transmit an alarm signal via and integrated optical tamper switch if an attempt is made to remove the reader from the wall. The tamper switch shall be programmable to provide a selectable action to provide a selectable action compatible with various tamper communication schemes provided by access control panel manufacturers. The selectable action shall include one of the following:
   a. The reader open collector line changes from a high state (5V) to a low state (Ground).
   b. If utilizing OSDP Protocol reader shall report a tamper condition via RS485.

15. Multi-technology contactless reader shall provide the ability for mounting to standard electrical boxes through the use of universal international mounting holes.

16. Multi-technology contactless reader shall be provided with a full potted assembly.

17. Multi-technology contactless reader shall be provided with a quick connect wire harness.

18. The Multi-technology contactless reader shall provide customizable reader behavior options either from the factory, or defined in the field through the use of pre-configured command cards. Reader behavior programming options shall include:
a. LED & Audio configurations.
b. Ability to disable reading of specific card technologies or frequencies.
c. ISO 14443/15693 CSN output configuration.
d. Wiegand output spacing and timing.

19. Multi-technology contactless reader shall provide the following programmable audio/visual indication:

a. An audio beeper shall provide tone sequence to signify: access granted, access denied, power up, and diagnostics.
b. A light bar shall provide clear visual status (red/green/amber).

20. Multi-technology contactless reader shall be designed for low current operation to enable migration from most legacy proximity applications without the need to replace existing access control panels and/or power supplies. Contactless smart card power requirements shall be:

a. Operating voltage: 5 – 16 VDC, reverse voltage protected. Linear power supply recommended.
b. Current requirements: 160 mA DC, 195 mA PEAK @ 12 VDC

21. Multi-technology contactless reader shall meet the following physical specifications:

a. Dimensions: 5.1" x 3.25" x 0.83" (12.9 cm x 8.3 cm x 2.1 cm)
b. Weight: 9.6 oz. (272.15 g)
c. Material: UL94 Polycarbonate
d. Plastics: Consist of three-piece design with mounting plate, potted case and aesthetic cover.
e. Color: Black, Gray, Brown or Cream as approved by the project architect.

22. Multi-technology contactless reader shall meet the following environmental specifications:

a. Operating temperature: -31 to 151 degrees F (-35 to 67 degrees C)
b. Operating humidity: 5% to 95% relative humidity non-condensing
c. Weatherized design suitable to withstand harsh environments
   1) Certified rating of IP65

23. Multi-technology contactless reader cabling requirements shall be:

a. Cable distance: (Wiegand): 500 feet (150m)
b. Cable type: 5-conductor #22 AWG
c. Standard reader termination: 18" (0.5m) wire harness

2.14 ELECTRIC STRIKES

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product: SCE, HES

B. Requirements:

1. Provide electric strikes designed for use with type of locks shown at each opening.
2. Provide electric strikes UL Listed as burglary-resistant.
3. Where required, provide electric strikes UL Listed for fire doors and frames.
4. Provide fail-secure type electric strikes, unless specified otherwise.
5. Coordinate voltage and provide transformers and rectifiers for each strike as required.

2.15 CYLINDERS

A. Manufacturers:
   1. Scheduled Manufacturer: Medeco KeyMark.
   2. Coordinate keying requirements with JJ Hall, Locksmith Lead, UNLV Lock Shop.

B. Small Format IC cylinders distributed throughout the Project as indicated.

2.16 CYLINDERS OPTION: FOR EXISTING KEY SYSTEM

A. Manufacturer: Medeco
   1. Scheduled Manufacturer: Keymark, No Substitute

B. Requirements: Provide cylinders/cores complying with the following requirements.
   1. Cylinders/cores compliant with ANSI/BHMA A156.5; latest revision, Section 12, Grade 1; permanent cylinders; cylinder face finished to match lockset, manufacturer’s series as indicated.

C. Manufacturer-keyed permanent cylinders/cores, configured into existing keying system per “KEYING” article herein. Must coordinate keying with JJ Hall, Locksmith Lead, UNLV Lock Shop.

2.17 DOOR CLOSERS

A. Manufacturer and Product: LCN 4040XP series. No Substitute

B. Requirements:
   1. Provide door closers conforming to ANSI/BHMA A156.4 Grade 1 requirements by BHMA certified independent testing laboratory. ISO 9000 certify closers. Stamp units with date of manufacture code.
   2. Provide door closers with fully hydraulic, full rack and pinion action with high strength cast iron cylinder, and full complement bearings at shaft.
   3. Cylinder Body: 1-1/2 inch (38 mm) diameter with 3/4 inch (19 mm) diameter double heat-treated pinion journal.
   4. Hydraulic Fluid: Fireproof, passing requirements of UL10C, and requiring no seasonal closer adjustment for temperatures ranging from 120 degrees F to -30 degrees F.
   5. Spring Power: Continuously adjustable over full range of closer sizes, and providing reduced opening force as required by accessibility codes and standards.
   6. Hydraulic Regulation: By tamper-proof, non-critical valves, with separate adjustment for latch speed, general speed, and backcheck.
   7. Provide closers with solid forged steel main arms and factory assembled heavy-duty forged forearms for parallel arm closers.
   8. Pressure Relief Valve (PRV) Technology: Not permitted.
9. Finish for Closer Cylinders, Arms, Adapter Plates, and Metal Covers: Powder coating finish which has been certified to exceed 100 hours salt spray testing as described in ANSI Standard A156.4 and ASTM B117, or has special rust inhibitor (SRI).

10. Provide special templates, drop plates, mounting brackets, or adapters for arms as required for details, overhead stops, and other door hardware items interfering with closer mounting.

2.18 ELECTRO-MECHANICAL AUTOMATIC OPERATORS

A. Manufacturers and Products:


B. Requirements:

1. Provide low energy automatic operator units that are electro-mechanical design complying with ANSI A156.19.
   a. Opening: Powered by DC motor working through reduction gears.
   b. Closing: Spring force.
   d. Operation: Motor is off when door is in closing mode. Door can be manually operated with power on or off without damage to operator. Provide variable adjustments, including opening and closing speed adjustment.
   e. Cover: Aluminum.

2. Provide units with manual off/auto/hold-open switch, push and go function to activate power operator, vestibule interface delay, electric lock delay, hold-open delay adjustable from 2 to 30 seconds, and logic terminal to interface with accessories, mats, and sensors.

3. Provide drop plates, brackets, or adapters for arms as required to suit details.

4. Provide hard-wired motion sensors and/or actuator switches for operation as specified. Provide weather-resistant actuators at exterior applications.

5. Provide key switches, with LED’s, recommended and approved by manufacturer of automatic operator as required for function as described in operation description of hardware sets. Cylinders: Refer to “KEYING” article, herein.

6. Provide complete assemblies of controls, switches, power supplies, relays, and parts/material recommended and approved by manufacturer of automatic operator for each individual leaf. Actuators control both doors simultaneously at pairs. Sequence operation of exterior and vestibule doors with automatic operators to allow ingress or egress through both sets of openings as directed by Architect. Locate actuators, key switches, and other controls as directed by Architect.

7. Provide units with inputs for smoke evacuation doors, where specified, which allow doors to power open upon fire alarm activation and hold open indefinitely or until fire alarm is reset, presence detector input, which prevents closed door from opening or door that is fully opened from closing, hold open toggle input, which allows remote activation for indefinite hold open and close second time input is activated, vestibule inputs, which allow sequencing operation of two units, and SPDT relay for interfacing with latching or locking devices.

2.19 DOOR TRIM

A. Manufacturers:
1. Scheduled Manufacturer: Ives.

B. Requirements:

1. Provide push plates 4 inches (102 mm) wide by 16 inches (406 mm) high by 0.050 inch (1 mm) thick and beveled 4 edges. Where width of door stile prevents use of 4 inches (102 mm) wide plate, adjust width to fit.
2. Provide push bars of solid bar stock, diameter and length as scheduled. Provide push bars of sufficient length to span from center to center of each stile. Where required, mount back to back with pull.
3. Provide offset pulls of solid bar stock, diameter and length as scheduled. Where required, mount back to back with push bar.
4. Provide flush pulls as scheduled. Where required, provide back-to-back mounted model.
5. Provide pulls of solid bar stock, diameter and length as scheduled. Where required, mount back to back with push bar.
6. Provide pull plates 4 inches (102 mm) wide by 16 inches (406 mm) high by 0.050 inch (1 mm) thick, beveled 4 edges, and prepped for pull. Where width of door stile prevents use of 4 inches (102 mm) wide plate, adjust width to fit.
7. Provide wire pulls of solid bar stock, diameter and length as scheduled.
8. Provide decorative pulls as scheduled. Where required, mount back to back with pull.

2.20 PROTECTION PLATES

A. Manufacturers:

1. Scheduled Manufacturer: Ives.

B. Requirements:

1. Provide kick plates, mop plates, and armor plates minimum of 0.050 inch (1 mm) thick as scheduled. Furnish with sheet metal or wood screws, finished to match plates.
2. Sizes of plates:
   a. Kick Plates: 10 inches (254 mm) high by 2 inches (51 mm) less width of door on single doors, 1 inch (25 mm) less width of door on pairs
   b. Mop Plates: 4 inches (102 mm) high by 2 inches (51 mm) less width of door on single doors, 1 inch (25 mm) less width of door on pairs
   c. Armor Plates: 36 inches (914 mm) high by 2 inches (51 mm) less width of door on single doors, 1 inch (25 mm) less width of door on pairs

2.21 OVERHEAD STOPS AND OVERHEAD STOP/HOLDERS

A. Manufacturers:

1. Scheduled Manufacturers: Glynn-Johnson
2. Acceptable Manufacturers: Hager, Rockwood

B. Requirements:

1. Provide heavy duty concealed mounted overhead stop or holder as specified for exterior and interior vestibule single acting doors.
2. Provide heavy duty concealed mounted overhead stop or holder as specified for double acting doors.
3. Provide heavy or medium duty and concealed or surface mounted overhead stop or holder for interior doors as specified. Provide medium duty surface mounted overhead stop for interior doors and at any door that swings more than 140 degrees before striking wall, open against equipment, casework, sidelights, and where conditions do not allow wall stop or floor stop presents tripping hazard.
4. Where overhead holders are specified provide friction type at doors without closer and positive type at doors with closer.

2.22 DOOR STOPS AND HOLDERS

A. Manufacturers:

1. Scheduled Manufacturer: Ives.

B. Provide door stops at each door leaf:

1. Provide wall stops wherever possible. Provide convex type where mortise type locks are used and concave type where cylindrical type locks are used.
2. Where a wall stop cannot be used, provide universal floor stops for low or high rise options.
3. Where wall or floor stop cannot be used, provide medium duty surface mounted overhead stop.

2.23 THRESHOLDS, SEALS, DOOR SWEPS, AUTOMATIC DOOR BOTTOMS, AND GASKETING

A. Manufacturers:

1. Scheduled Manufacturer: National Guard Products.

B. Requirements:

1. Provide thresholds, weatherstripping (including door sweeps, seals, astragals) and gasketing systems (including smoke, sound, and light) as specified and per architectural details. Match finish of other items.
2. Size of thresholds:
   a. Saddle Thresholds: 1/2 inch (13 mm) high by jamb width by door width
   b. Bumper Seal Thresholds: 1/2 inch (13 mm) high by 5 inches (127 mm) wide by door width
3. Provide door sweeps, seals, astragals, and auto door bottoms only of type where resilient or flexible seal strip is easily replaceable and readily available.

2.24 SILENCERS

A. Manufacturers:

1. Scheduled Manufacturer: Ives.
B. Requirements:
   1. Provide "push-in" type silencers for hollow metal or wood frames.
   2. Provide one silencer per 30 inches (762 mm) of height on each single frame, and two for each pair frame.
   3. Omit where gasketing is specified.

2.25 MAGNETIC HOLDERS

A. Manufacturers:
   1. Scheduled Manufacturer: LCN.

B. Requirements:
   1. Provide wall or floor mounted electromagnetic door release as specified with minimum of 25 pounds of holding force. Coordination projection of holder and armature with other hardware and wall conditions to ensure that door sits parallel to wall when fully open. Wire magnetic holders on fire-rated doors into the fire control panel for fail-safe operation.

2.26 LATCH PROTECTORS

A. Manufacturers:
   1. Scheduled Manufacturer: Ives.

B. Provide latch protectors of type required to function with specified lock.

2.27 FINISHES

A. Finish: BHMA 626/652 (US26D); except:
   1. Hinges at Exterior Doors: BHMA 630 (US32D)
   2. Continuous Hinges: BHMA 630 (US32D)
   4. Protection Plates: BHMA 630 (US32D)
   5. Overhead Stops and Holders: BHMA 630 (US32D)
   6. Door Closers: Powder Coat to Match
   7. Wall Stops: BHMA 630 (US32D)
   8. Latch Protectors: BHMA 630 (US32D)
   9. Weatherstripping: Clear Anodized Aluminum
   10. Thresholds: Mill Finish Aluminum
PART 3 - EXECUTION

3.1 EXAMINATION

A. Prior to installation of hardware, examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, labeled fire-rated door assembly construction, wall and floor construction, and other conditions affecting performance.

B. Existing Door and Frame Compatibility: Field verify existing doors and frames receiving new hardware and existing conditions receiving new openings. Verify that new hardware is compatible with existing door and frame preparation and existing conditions.

C. Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.

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

3.2 PREPARATION

A. Where on-site modification of doors and frames is required:

1. Remove existing hardware being replaced, tag, and store according to contract documents.
2. Field modify and prepare existing door and frame for new hardware being installed.
3. When modifications are exposed to view, use concealed fasteners, when possible.
4. Prepare hardware locations in accordance with:

   a. Steel Doors and Frames: For surface applied door hardware, drill and tap doors and frames according to ANSI/SDI A250.6.
   b. Wood Doors: DHI WDHS.5 "Recommended Hardware Reinforcement Locations for Mineral Core Wood Flush Doors."
   c. Doors in rated assemblies: NFPA 80 for restrictions on on-site door hardware preparation.

A. Existing frames and doors to be retrofitted with new hardware:

1. Field-verify conditions and dimensions prior to ordering hardware. Fill existing hardware cut outs not being reused by the new hardware. Remove existing hardware not being reused, return to Owner unless directed otherwise.
2. Remove existing floor closers not scheduled for reuse, fill cavities with non-shrinking concrete and finish smooth.
3. Cut and weld existing steel frames currently prepared with 2.25 inch height strikes. Cut an approximate 8 inch section from the strike jamb and weld in a reinforced section to accommodate specified hardware’s strike.
4. Patch and weld flush filler pieces into existing door hardware preparations in steel doors and frames, leave surfaces smooth.
5. Glue in solid wood block fillers to fill cut outs in existing wood doors, sand surfaces smooth. Alternatively, use an approved epoxy-based wood filler product, submit product data for approval.
3.3 INSTALLATION

A. Mounting Heights: Mount door hardware units at heights to comply with the following, unless otherwise indicated or required to comply with governing regulations.

2. Custom Steel Doors and Frames: HMMA 831.

B. Install each hardware item in compliance with manufacturer's instructions and recommendations, using only fasteners provided by manufacturer.

C. Do not install surface mounted items until finishes have been completed on substrate. Protect all installed hardware during painting.

D. Set units level, plumb and true to line and location. Adjust and reinforce attachment substrate as necessary for proper installation and operation.

E. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.

F. Install operating parts so they move freely and smoothly without binding, sticking, or excessive clearance.

G. Hinges: Install types and in quantities indicated in door hardware schedule but not fewer than quantity recommended by manufacturer for application indicated or one hinge for every 30 inches (750 mm) of door height, whichever is more stringent, unless other equivalent means of support for door, such as spring hinges or pivots, are provided.

H. Intermediate Offset Pivots: Where offset pivots are indicated, provide intermediate offset pivots in quantities indicated in door hardware schedule but not fewer than one intermediate offset pivot per door and one additional intermediate offset pivot for every 30 inches (750 mm) of door height greater than 90 inches (2286 mm).

I. Lock Cylinders: Install construction cores to secure building and areas during construction period.

1. Replace construction cores with permanent cores as indicated in keying section.
2. OPTION: Furnish permanent cores to Owner for installation.

J. Lead Protection: Lead wrap hardware penetrating lead-lined doors. Levers and roses to be lead lined. Apply kick and armor plates on lead-lined doors with adhesive as recommended by manufacturer.

K. Wiring: Coordinate with Division 26, ELECTRICAL sections for:

1. Conduit, junction boxes and wire pulls.
2. Connections to and from power supplies to electrified hardware.
3. Connections to fire/smoke alarm system and smoke evacuation system.
4. Connection of wire to door position switches and wire runs to central room or area, as directed by Architect.
5. Testing and labeling wires with Architect's opening number.

L. Key Control System: Tag keys and place them on markers and hooks in key control system cabinet, as determined by final keying schedule.
M. Door Closers: Mount closers on room side of corridor doors, inside of exterior doors, and stair side of stairway doors from corridors. Closers shall not be visible in corridors, lobbies and other public spaces unless approved by Architect.

N. Closer/Holders: Mount closer/holders on room side of corridor doors, inside of exterior doors, and stair side of stairway doors.

O. Power Supplies: Locate power supplies as indicated or, if not indicated, above accessible ceilings or in equipment room, or alternate location as directed by Architect.

1. Configuration: Provide [one power supply for each door opening][least number of power supplies required to adequately serve doors] with electrified door hardware.

P. Thresholds: Set thresholds in full bed of sealant complying with requirements specified in Division 07 Section "Joint Sealants."

Q. Stops: Provide floor stops for doors unless wall or other type stops are indicated in door hardware schedule. Do not mount floor stops where they may impede traffic or present tripping hazard.

R. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.

S. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.

T. Door Bottoms: Apply to bottom of door, forming seal with threshold when door is closed.

3.4 FIELD QUALITY CONTROL

A. Architectural Hardware Consultant: Engage qualified independent Architectural Hardware Consultant to perform inspections and to prepare inspection reports.

1. Architectural Hardware Consultant will inspect door hardware and state in each report whether installed work complies with or deviates from requirements, including whether door hardware is properly installed and adjusted.

3.5 ADJUSTING

A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

1. Spring Hinges: Adjust to achieve positive latching when door is allowed to close freely from an open position of 30 degrees.

2. Electric Strikes: Adjust horizontal and vertical alignment of keeper to properly engage lock bolt.

3. Door Closers: Adjust sweep period to comply with accessibility requirements and requirements of authorities having jurisdiction.

B. Occupancy Adjustment: Approximately three[six] <Insert number> months after date of Substantial Completion, Installer's Architectural Hardware Consultant shall examine and readjust each item of door hardware, including adjusting operating forces, as necessary to ensure function of doors, door hardware, and electrified door hardware.
3.6 CLEANING AND PROTECTION

A. Clean adjacent surfaces soiled by door hardware installation.

B. Clean operating items as necessary to restore proper function and finish.

C. Provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of Substantial Completion.

3.7 DEMONSTRATION

A. Provide training for Owner's maintenance personnel to adjust, operate, and maintain door hardware and door hardware finishes. Refer to Division 01 Section "Demonstration and Training."

3.8 DOOR HARDWARE SCHEDULE

A. Locksets, exit devices, and other hardware items are referenced in the following hardware sets for series, type and function. Refer to the above-specifications for special features, options, cylinders/keying, and other requirements.

B. The hardware sets represent the design intent and direction of the owner and architect. They are a guideline only and should not be considered a detailed hardware schedule. Discrepancies and/or conflicting hardware, including missing hardware, should be brought to the attention of the architect. Corrections should be made prior to the bidding process. Omitted items not included in a hardware set should be scheduled with appropriate additional required for proper application and functionality.

HW SET 01

For use on mark/door #/s:

47

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HW SET 02 - Head, jamb, and meeting-stile seals: integral part of alum/glass frame and door system

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6” STILES REQUIRED FOR LOCKSET

HW SET 03 - POWER SUPPLY, ELECTRIC STRIKE, DOOR CONTACT, CARD READER, AND WIRING, BY VVLS

For use on mark/door # (s):

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<tbody>
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<td>1006 -SUPPLIED AND INSTALLED BY VVLS</td>
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HW SET 04

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DOOR HARDWARE
UNLV – MSL INTERIOR RENOVATIONS

087100-29
5/22/2017
### HW SET 05

For use on mark/door #s:

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### HW SET 06 - REMOVE DOOR CLOSER

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**SOUND SEAL**

**HW SET 07 - REMOVE DOOR CLOSER**

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**DOOR HARDWARE**

**UNLV –MSL INTERIOR RENOVATIONS**
## SOUND SEAL

### HW SET 08 - REMOVE DEADBOLT AND DOOR CLOSER

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<tr>
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<tr>
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<td>AUTO OPERATOR</td>
<td>MAGIC FORCE LOW ENERGY</td>
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### HW SET 09 - REMOVE DEADBOLT

For use on mark/door #/(s):

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<tr>
<td>3</td>
<td>SILENCER</td>
<td>SR64</td>
<td>RE-USE BALANCE OF DOOR, FRAME &amp; HARDWARE</td>
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### HW SET 10 - REMOVE DOOR CLOSER

For use on mark/door #/(s):

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**DOOR HARDWARE**

**087100-31**

**UNLV – MSL INTERIOR RENOVATIONS**

**5/22/2017**
## HW SET 11 - REMOVE DOOR CLOSER

For use on mark/door #(s): 29

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## HW SET 12 - ADJUST DOOR CLOSER AND REPLACE IF REQUIRED

REPAIR AND PAINT DOOR

For use on mark/door #(s): 17 2 48

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## HW SET 13

For use on mark/door #(s): 13.1 27

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HW SET 14 - ADJUST DOOR CLOSER AND REPLACE IF REQUIRED

For use on mark/door #((s):

9

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KEYMARK K600 2C 7P- 0-BIT w/2 keyblanks --KEYING BY OWNER RE-USE EXISTING DOORS, FRAMES, & HARDWARE

End of Section
## Door Schedule

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PART 1  GENERAL

1.1  SECTION INCLUDES

   A. Glass and glazing for sections referencing this section for products and installation.

1.2  RELATED SECTIONS

   A. Section 07 90 00 - Joint Protection: Sealant and back-up material.
   B. Sections 08 11 13 - Hollow Metal Doors and Frames: Door lite frames.
   C. Section 08 41 13 - Aluminum Framed Entrances and Storefronts (where/when applicable).

1.3  REFERENCES

   B. ASTM C1036 - Flat Glass.
   C. ASTM C1048 - Heat Treated Flat Glass.
   E. ASTM E773 - Test Method for Seal Durability of Sealed Insulating Glass Units.
   F. ASTM E774 - Sealed Insulating Glass Units.
   J. FS TT-S-00230 - Sealing Compounds, Synthetic-Rubber Base, Single Component, Chemically Curing.
   K. FS TT-S-01543 - Sealing Compound, Rubber Base.
   M. UL - Underwriters’ Laboratories.

1.4  SUBMITTALS

   A. Submit under provisions of Section 01 33 00.
   B. Product Data on Glass Types Specified: Provide structural, physical and environmental characteristics, size limitations, special handling or installation requirements.
   C. Product Data on Glazing Compounds: Provide chemical, functional, and environmental characteristics, limitations, special application requirements. Identify available colors.
D. Samples: Submit two samples 12 x 12 inch in size, illustrating each glass unit. Submit two (2) additional samples of Type 3 glazing for review by Summerlin.

E. Manufacturer's Installation Instructions: Indicate special precautions required.

F. Manufacturer's Certificate: Certify that sealed insulated environmental glass, meet or exceed specified requirements.

1.5 QUALITY ASSURANCE


1.6 ENVIRONMENTAL REQUIREMENTS

A. Do not install glazing when ambient temperature is less than 50 degrees F.

B. Maintain minimum ambient temperature before, during and 24 hours after installation of glazing compounds.

1.7 FIELD MEASUREMENTS

A. Verify that field measurements are as indicated on shop drawings.

1.8 COORDINATION

A. Coordinate Work under provisions of Section 01 31 13.

B. Coordinate the work with glazing frames, wall openings, and perimeter air and vapor seal to adjacent Work.

1.9 WARRANTY

A. Provide ten (10) year manufacturer's warranty under provisions of Section 01 78 36.

B. Warranty: Include coverage for sealed glass units from seal failure, interpane dusting or misting, and replacement of same.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Float Glass:
   2. PPG.
   3. Pilkington.
   4. Saint Gobian.
   5. Visteon.

B. Float Glass Fabricators (Tempered, Non-Coated, Insulated):
   1. ACI.
   2. AFGD.
   3. Hehr Glass.
   5. Oldcastle Glass.

C. Custom Laminated/Security Glass:
   2. Hehr Glass.
4. Oldcastle Glass.

E. Fire Rated Safety Glass:
1. Inter Edge Technologies.
2. SAFTI, O'Keefe's.
3. Technical Glass Products.

F. Sealants:
1. Zero/International INO.

G. Substitutions: Under provisions of Section 01 25 00.

2.2 FLAT GLASS MATERIALS (Refer to Drawings)
A. Glass (Type 1): Clear; 1/4 inch thick minimum.

2.3 GLAZING COMPOUNDS
A. Acrylic Sealant: FS TT-S-00230, Type II, Class A; single component; cured Shore A hardness of 15-25 color to match window frame.
B. Silicone Sealant: FS TT-S-01543, Class A; single component; solvent curing; capable of water immersion without loss of properties; cured Shore A hardness of 15-25 color to match window frame.

2.4 GLAZING ACCESSORIES
A. Setting Blocks: Neoprene, 80 - 90 Shore A durometer hardness, length of 0.1 inch for each square foot of glazing or minimum 4 inch x width of glazing rabbet space minus 1/16 inch x height to suit glazing method and pane weight and area.
B. Spacer Shims: Neoprene, 50 - 60 Shore A durometer hardness, minimum 3 inch long x one half the height of the glazing stop x thickness to suit application, self adhesive on one face.
C. Glazing Tape: Preformed silicone compound with integral resilient tube spacing device; 10 - 15 Shore A durometer hardness; coiled on release paper; black color.
D. Glazing Splines: Resilient polyvinyl chloride extruded shape to suit glazing channel retaining slot; black color.
E. Glazing Clips: Manufacturer's standard type.

PART 3 EXECUTION
3.1 EXAMINATION
A. Verify that openings for glazing are correctly sized and ready to receive glazing.
B. Verify that surfaces of glazing channels or recesses are clean, free of obstructions, and ready to receive glazing.

3.2 PREPARATION
A. Clean contact surfaces with solvent and wipe dry.
B. Seal porous glazing channels or recesses with substrate compatible primer or sealer.
C. Prime surfaces scheduled to receive sealant.

3.3 INTERIOR - WET/DRY METHOD (TAPE AND SEALANT)
A. Cut glazing tape to length and install against permanent stops, projecting 1/16 inch above sight line.
B. Place setting blocks at 1/4 points with edge block no more than 6 inches from corners.
C. Rest glazing on setting blocks and push against tape to ensure full contact at perimeter of pane or unit.
D. Install removable stops, with spacer shims inserted between glazing and applied stops at 24 inch intervals, 1/4 inch below sight line.
E. Fill gaps between pane and applied stop with acrylic sealant to depth equal to bite on glazing, to uniform and level line.
F. Trim protruding tape edge.

3.4 CLEANING
A. Clean work under provisions of 01 74 23.
B. Remove glazing materials from finish surfaces.
C. Remove labels after work is complete.
D. Clean glass.

3.5 PROTECTION OF FINISHED WORK
A. Protect finished work under provisions of Section 01 45 17.
B. After installation, mark pane with an 'X' by using removable plastic tape or paste.

END OF SECTION
SECTION 09 21 16

GYPSUM BOARD ASSEMBLIES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Light gage metal stud wall framing.
B. Gypsum board.
C. Glass mat faced gypsum tile backerboard.
D. Cement backerboard.
E. Taped and sanded joint treatment.
F. Gypsum Board Primer Coat Treatment.
G. Textured finish.
H. Installation of acoustic insulation.

1.2 RELATED SECTIONS

A. Section 05 40 00 - Cold Formed Metal Framing.
B. Section 07 21 16 - Blanket Insulation: Thermal and acoustical insulation.
C. Section 08 11 13 - Hollow Metal Doors and Frames.
D. Section 08 31 13 - Access Doors and Frames: Metal access panels.
E. Section 09 51 13 - Acoustical Panel Ceilings.
F. Section 09 90 00 - Painting and Coating.
G. Section 10 11 00 - Visual Display Surfaces.

1.3 REFERENCES

A. ANSI A118.9 - Specifications for Cementitious Backer Units.
B. ASTM C36 - Gypsum Wallboard.
C. GA-252 - Fire Resistant Gypsum Sheathing.
E. ASTM C475 - Joint Treatment Materials for Gypsum Wallboard Construction.
F. ASTM C630 - Water Resistant Gypsum Backing Board.
G. ASTM C645 - Non-Load (Axial) Bearing Steel Studs, Runners (Track), and Rigid Furring Channels for Screw Application of Gypsum Board.
H. ASTM C754 - Installation of Framing Members to Receive Screw Attached Gypsum Wallboard, Backing Board, or Water Resistant Backing Board.


J. ASTM C1002 - Steel Drilled Screws for the Application of Gypsum Board.

K. ASTM C1178 - Glass Mat Water Resistant Gypsum Backing Panel.

L. GA-216 - Recommended Specifications for the Application and Finishing of Gypsum Board.


O. GA-201 - Gypsum Board for Walls and Ceilings.

1.4 SYSTEM DESCRIPTION

A. Acoustic Attenuation for Interior Partitions: 47 STC in accordance with ASTM E90.

1.5 QUALITY ASSURANCE

A. Perform work in accordance with GA-201, GA-216, GA-252, and GA-600.

B. Applicator: Company specializing in gypsum board systems work with 5 years documented experience and approved by manufacturer.

1.6 SUBMITTALS

A. Submit shop drawings and product data under provisions of Section 01 33 00.

B. Indicate on shop drawings, special details associated with acoustic insulation and furring, abuse resistant installations, and joints at top of walls. Indicate on shop drawings the out-of-plane tolerance to be adhered to for the finished surface of gypsum board walls.

C. Provide product data on metal framing, gypsum board, gypsum sheathing and joint tape.

PART 2 PRODUCTS

2.1 MANUFACTURERS - GYPSUM BOARD ASSEMBLY

A. U.S. Gypsum Company.

B. Pabco.

C. Georgia Pacific.

D. National Gypsum.

E. Substitutions: Under provisions of Section 01 25 00.
2.2 MANUFACTURERS - GYPSUM DRYWALL SYSTEMS

A. U.S. Gypsum Company.
B. Pabco.
C. Georgia Pacific.
D. National Gypsum.
E. Substitutions: Under provisions of Section 01 25 00.

2.3 MANUFACTURERS - NON-STRUCTURAL METAL FRAMING

A. Cemco.
B. Clark Dietrich
C. Knoor Steel Framing Systems.
D. Substitutions: Under provisions of Section 01 25 00.

2.4 FRAMING MATERIALS

A. Studs and Tracks: ASTM C645; GA 216 and GA 600; galvanized sheet steel, 20 gage or 16 gage as indicated on drawings; 20 gage minimum, 'C' shape, with knurled faces.
B. Furring, Ceiling, Framing and Accessories: As specified in Section 09 22 03.
C. Fasteners: ASTM C1002; GA 216.

2.5 GYPSUM BOARD MATERIALS

A. Standard Gypsum Board: ASTM C36; 1/2 and 5/8 inch thick, maximum permissible length; ends square cut, tapered edges.
B. Fire Rated Gypsum Board (For Repairs): ASTM C36; fire resistive type, UL rated; 5/8 inch thick, maximum permissible length; ends square cut, tapered edges.
C. Glass Mat Faced Gypsum Board: ASTM C1178; glass mat moisture resistant coating, both sides; water resistant core, water retardant face; 5/8" thick. Denshield - manufactured by Georgia Pacific. To be installed at all wet areas, as indicated on drawings, and above all showers.

2.6 ACCESSORIES

A. Acoustical Sealant: Non-hardening, non-skinning, for use in conjunction with gypsum board.
B. Corner Beads: Metal.
C. Edge Trim: GA 201 and GA 216; Type U exposed reveal bead.
D. Joint Materials: ASTM C475; GA 201 and GA 216; reinforcing tape, joint compound,
adhesive and water.

E. Fasteners: ASTM C1002; Type S12 and GA 216.

F. Control Joints: USG Control Joint No. 093.

G. Gypsum Board Primer: USG, Sheetrock First Coat.


PART 3 EXECUTION

3.1 INSPECTION

A. Verify that site conditions are ready to receive work and opening dimensions are as indicated on shop drawings.

B. Beginning of installation means acceptance of existing surfaces.

3.2 METAL STUD INSTALLATION

A. Install studding in accordance with ASTM C754, GA-216 and GA-600.

B. Metal Stud Spacing: 16 inches on center for interior partitions unless specifically noted otherwise on drawings.

C. Refer to Drawings for indication of partitions extending to finished ceiling only and for partitions extending through the ceiling and bracing. Maintain clearance under structural building members as detailed to avoid deflection transfer to studs. Provide extended leg ceiling runners as detailed.

D. Door Opening Framing: Install 16 gage double studs at door jambs. Weld double studs together with 2" long welds at 24" o.c., full height of double studs on both sides of studs, or use pre-engineered jamb stud as approved equal by Architect. Install stud tracks on each side of opening, at frame head height, and between studs and adjacent studs.

E. Blocking: Bolt or screw steel channels to studs. Install blocking for support of plumbing fixtures, toilet partitions, wall cabinets, toilet and shower accessories, door hardware and magnetic hold-opens, and all equipment.

F. Coordinate installation of bucks, anchors, blocking, electrical and mechanical work placed in or behind partition framing.

G. At Contractor’s option, the use of Pro X Header by Brady is an acceptable product for use at headers.

3.3 ACOUSTICAL ACCESSORIES INSTALLATION

A. Place acoustical insulation in all partitions shown on drawings to receive sound insulation tight within spaces, around cut openings, behind and around electrical and mechanical items within or behind partitions and tight to items penetrating partitions.

B. Install acoustical sealant at gypsum board perimeter of partitions shown on drawings to receive sound insulation. Install at side and bottom edges of partitions and at penetrations of partitions by conduit, pipe, ductwork, and rough-in boxes.
3.4 GYPSUM BOARD INSTALLATION

A. Install gypsum board in accordance with GA 201, GA 216, GA-600, and manufacturer's instructions. Do not install moisture-resistant gypsum board on any toilet or shower room ceiling.

B. Erect single layer standard gypsum board in most economical direction, with ends and edges occurring over framing members or metal stud blocking.

C. Erect all types of single layer fire rated gypsum board vertically, with edges and ends occurring over framing members or metal stud blocking.

D. Use screws when fastening gypsum board to metal furring or framing.

E. Double Layer Applications: Secure second layer to first with adhesive and sufficient fasteners to hold in place. Fasten through first and second layer into framing members. Apply adhesive per manufacturer's instructions.

F. Treat cut edges and holes in moisture resistant gypsum board and exterior gypsum soffit board with sealant.

G. Place control joints consistent with lines of building spaces and as shown on the drawings.

H. Place corner beads at external corners. Use longest practical length. Place edge trim where gypsum board abuts dissimilar materials.

I. Install glass mat faced gypsum tile backerboard on 16 gauge metal studs in accordance with manufacturer's instructions and TCA Handbook. Method W-245.

J. Hold gypsum board 1/4" maximum from top of slab and caulk the resulting joint.

K. Provide perimeter relief for gypsum surfaces where a partition or furred wall abuts a structural element. Apply appropriate edge trim to the face-layer perimeter and apply sealant to close the gap.

3.5 JOINT TREATMENT

A. At all unfinished gypsum board walls and furred surfaces above ceilings, or otherwise concealed from view, install tape embedded in one coat of joint compound with one additional coat of joint compound applied over all taped joints, corners, fastener heads, angles and other gypsum board accessories. Clean excess compound from joint. Sanding is not required at these areas.

B. At all gypsum board walls, ceilings and furred surfaces scheduled to receive paint, install tape embedded in one coat of joint compound and apply three additional coats of joint compound over all taped joints, corners, fastener heads, angles and other gypsum board accessories. Finish as required by the paint manufacturer's installation instructions.

C. At all gypsum board walls and furred surfaces scheduled to receive ceramic tile, install tape embedded in one coat of joint compound with no finish coats at all joints and corners, and install one coat of joint compound at all fastener heads, angles and other gypsum board accessories, per the requirements of the Tile Council of America methods scheduled for application and the tile backerboard manufacturer.

D. Joint compound at all areas scheduled to receive finishes shall be sanded smooth and shall be free of tool marks and ridges.
E. Feather the final joint compound coat at areas scheduled for paint finish onto adjoining surfaces so that the camber is a maximum 1/32 inch.

3.6 TEXTURE FINISH

A. Apply Gypsum Board Primer prior to installing texture finishes materials in accordance with manufacturer’s instructions.

B. Spray apply texture finish materials.

C. Provide light orange peel finish on all gypsum board walls scheduled for paint finish.

D. Provide roller smooth finish on all ceilings and soffits scheduled for paint finish.

3.7 TOLERANCES

A. Maximum Variation from True Flatness: 1/8 inch in 10 feet in any direction. Surfaces of walls must not exceed this variation within 6'-0" of floor or work may be rejected.

3.8 FINISHES

A. Painted surfaces as specified in Drawings.

END OF SECTION
PART 1  GENERAL

1.01  SECTION INCLUDES

A. Portland cement plaster system.
B. Metal lathing.

1.02  RELATED SECTIONS

A. Section 07 90 00 - Joint Protection.
B. Section 09 21 16 - Gypsum Board Assemblies.
C. Section 09 90 00 - Painting and Coating.

1.03  REFERENCES

A. ASTM C150 - Portland Cement.
B. ASTM C206 - Finishing Hydrated Lime.
C. ASTM C631 - Bonding Compounds for Interior Plastering.
D. ASTM C847 - Metal Lath.
F. ASTM C926 - Application of Portland Cement-Based Plaster.
H. PCA (Portland Cement Association) - Plaster (Stucco) Manual.

1.04  QUALITY ASSURANCE

A. Applicator: Company specializing in cement plaster work with 5 years documented experience.
B. Apply cement plaster in accordance with ASTM C926 and PCA Plaster (Stucco) Manual.

1.05  SUBMITTALS

A. Submit product data under provisions of Sections 01 33 00 and 01 33 23.
B. Provide product data on plaster materials, characteristics and limitations of products specified.

1.06  ENVIRONMENTAL REQUIREMENTS

A. Do not apply plaster when substrate or ambient air temperature is less than 50 degrees F nor more than 80 degrees F.
B. Maintain minimum ambient temperature of 50 degrees F during and after installation of plaster.
PART 2   PRODUCTS

2.01  PLASTER BASE COAT MATERIALS
A. Cement: ASTM C150, Normal - Type I Portland.
B. Lime: ASTM C206, Type S.
C. Aggregate: In accordance with ASTM C897 and PCA Plaster (Stucco) Manual.
D. Water: Clean, fresh, potable and free of mineral or organic matter which can affect plaster.
E. Bonding Agent: ASTM C631; type recommended for bonding cement plaster to concrete masonry surfaces; Thorobond as manufactured by Thoro Products.
F. Plaster Mix Reinforcement: Glass fibers, 1/2 inch nominal length, alkali resistant.

2.02  PLASTER FINISH COAT MATERIALS
A. Cement: As specified for plaster base coat, grey color.
B. Lime: As specified for plaster base coat.
C. Aggregate: Natural colored grey sand, as specified for plaster base coat.
D. Water: Clean, fresh, potable and free of mineral or organic matter which can affect plaster.
E. Finish: To match existing.

2.03  CEMENT PLASTER MIXES
A. Mix and proportion cement plaster in accordance with ASTM C926, Type C, PCA Plaster (Stucco) Manual, manufacturer's instructions, or as following sentences indicate.
B. Base and Brown Coat: One part cement, minimum 3-1/2 to maximum 4 parts aggregate, and minimum 15 percent to maximum 25 percent hydrated lime, glass fibers at a rate of one pound per sack of cement.
C. Finish Coat: One part cement, 3 parts aggregate maximum, 30 percent minimum to 60 percent hydrated lime.
D. Mix only as much plaster as can be used in one hour.
E. Mix materials dry, to uniform color and consistency, before adding water.
F. Protect mixtures from freezing, frost, contamination, and evaporation.
G. Do not retemper mixes after initial set has occurred.

2.04  LATHING MATERIALS AND ACCESSORIES
A. Acceptable Manufacturers:
   2. Alabama Metal Industries.
   3. Tree Island Industries - K Lath.
B. Metal Lath: ASTM C847; 3/8" rib lath, 3.4 lb./sq. yd., galvanized.
C. Corner Mesh: Formed sheet steel; minimum 26 gage thick; expanded flanges shaped to permit complete embedding in plaster; minimum 2 inch size.

D. Strip Mesh: Expanded metal lath, minimum 26 gage thick; 2 inches wide x 24 inches long.

E. Anchorages: Tie wire, nails, screws and other metal supports, of type and size to suit application; to rigidly secure lathing materials in place.

F. Tie Wire: Galvanized Steel; minimum 18 gage.

G. Finishes:
   1. Framing Materials: Galvanized.

PART 3 EXECUTION

3.01 INSPECTION

A. Verify that surfaces and site conditions are ready to receive work. Verify that lath is flat and secured to substrate or framing, and joints and perimeter accessories are in place.

B. Mechanical and Electrical: Verify services above ceilings and soffits have been tested and approved.

C. Beginning of installation means acceptance of existing conditions.

3.02 PREPARATION

A. Dampen masonry surfaces to reduce excessive suction.

B. Clean surfaces of all foreign matter or bituminous materials.

C. Apply bonding agent.

3.03 INSTALLATION - LATHING MATERIALS AND ACCESSORIES

A. Apply metal lath taut, with long dimension perpendicular to supports.

B. Lap ends minimum one inch. Secure end laps with tie wire where they occur between supports.

C. Lap sides of diamond mesh lath minimum 1-1/2 inches.

D. Attach metal lath to metal supports using tie wire at maximum 6 inches on center.

E. Attach metal lath to exterior or moisture resistant gypsum board using gypsum board screws at 12 inches o.c.; occurring at furring channel locations.

F. Attach metal lath to concrete or masonry using wire hair pins or hooks. Space attachment 24 inches on centers.

G. Continuously reinforce internal angles with corner mesh, except where the metal lath returns 3 inches from corner to form the angle reinforcement; fasten at perimeter edges only.

H. Place beaded external angle with mesh at corners; fasten at outer edges only.
I. Place base screed at termination of plaster areas; secure rigidly in place.

J. Place strip mesh diagonally at corners of lathed openings. Secure rigidly in place.

K. Place 4 inch wide strips of metal lath centered over junctions of dissimilar backing materials. Secure rigidly in place.

L. Place casing beads at terminations of plaster finish. Butt and align ends. Secure rigidly in place.

M. Position and install control joints.

N. Space control joints a maximum of 10 feet apart on all cement plaster soffit work. Refer to Reflected Ceiling Plans for locations.

3.04 TOLERANCES

A. Maximum Variation from True Lines and Levels: 1/8 inch in 10 feet.

B. Maximum Variation from True Position: 1/8 inch.

3.05 PLASTERING

A. Apply plaster in accordance with ASTM C926, and PCA Plaster (Stucco) Manual. Apply plaster coats on horizontal surfaces as required by these references for conditions of Work.

B. Apply scratch coat to a nominal thickness of 3/8 inch, brown coat to a nominal thickness of 3/8 inch and a finish coat to a nominal thickness of 1/8 inch over metal lathed vertical surfaces.

C. Apply brown coat to nominal thickness of 3/8 inch and finish coat to nominal thickness of 1/8 inch over masonry or concrete vertical surfaces.

D. Moist cure scratch and brown coats twice daily. Apply brown coat following initial set of scratch coat. Moist cure brown coat 7 days following application.

E. After curing, dampen base coat prior to applying finish coat. Repair cracking and checking with latex patching compound before finish coat.

F. Apply finish coat 7 days after application of brown coat is finished.

G. Avoid excessive working of surface. Delay trowelling as long as possible to avoid drawing excess fines to surface.

H. Moist cure finish coat for minimum period of 48 hours.

I. Clean control and expansion joints full length.

J. Protect surfaces near the work of this section from damage or disfigurement.

K. Cement plaster surface to be painted. Colors as shown on drawings.

L. All cement plaster surfaces to have sand finish.

3.06 CONTROL AND CONTRACTION JOINTS

A. After initial set, scribe contraction joints in exterior work every 3'-4" (40 inches) in both directions by cutting through 2/3 of the cement plaster depth, neatly, in straight lines.
SECTION 09 51 13
ACOUSTICAL PANEL CEILINGS

PART 1  GENERAL

1.1  SECTION INCLUDES
A. Suspended metal grid ceiling system.
B. Acoustical geometric panels.
C. Support hangers for light fixtures.

1.2  RELATED SECTIONS
A. Section 08 31 13 - Access Doors and Frames.
B. Mechanical - Air Outlets and Inlets: Air diffusion devices in ceiling system.
C. Electrical - Interior Lighting: Light fixtures in ceiling system.
D. Fire Sprinkler System: Existing pipes and devices.
E. Fire Alarm: Existing devices.

1.3  REFERENCES
A. ASTM C635 - Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings.
B. ASTM C636 - Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels.
D. FS HH-I-521 - Insulation Blankets, Thermal Mineral Fiber, for Ambient Temperatures.

1.4  SYSTEM DESCRIPTION
A. Suspension system to rigidly secure acoustical ceiling system including integral mechanical and electrical components in a true and level plane with maximum deflection of 1/360 of its unsupported span.

1.5  QUALITY ASSURANCE
A. Manufacturer: Company specializing in manufacture of ceiling suspension system and ceiling tile panels with three years minimum experience.
B. Installer: Company with three years minimum documented experience.

1.6  REGULATORY REQUIREMENTS
A. Conform to International Building Code for combustibility requirements for materials.
B. Ceiling system must be braced per IBC requirements for Seismic Category as identified in the Structural General Notes.
1.7 SUBMITTALS

A. Provide product data on metal grid system components, and acoustic units. Indicate hanging system, lateral force bracing method, and interrelation of mechanical ductwork to grid system.

B. Submit samples under provisions of Section 01 33 00.

C. Submit two samples full size, illustrating material and finish of acoustic units.

D. Submit manufacturer's installation instructions under provisions of Section 01 33 00.

E. Submit method to be used for hanging of grid system.

1.8 ENVIRONMENTAL REQUIREMENTS

A. Maintain uniform temperature of minimum 60 degrees F, and humidity of 20 to 40 percent prior to, during, and after installation.

1.9 SEQUENCING/SCHEDULING

A. Schedule installation of acoustic units after interior wet work is dry.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS - SUSPENSION SYSTEM

A. Donn Products.

B. Armstrong World Industries.

C. Chicago Metallic Corporation.

D. USG Interiors.

E. Celotex Brand Ceiling Suspension Systems.

F. Substitutions: Under provisions of Section 01 25 00.

2.2 SUSPENSION SYSTEM MATERIALS

A. Grid: ASTM C635, intermediate duty, exposed T downward access removable T; components die cut and interlocking with hemmed edges.

B. Accessories: Stabilizer bars, clips, splices, edge moldings, and hold down clips as required for suspended grid system.

C. Grid Materials: Commercial quality cold rolled steel with galvanized coating.

D. Exposed Grid Surface Width: 15/16 inch.

E. Acoustic Ceiling and Open Cell Grid Finish: Match existing. Provide matching touch-up paint.
F. Support Channels and Hangers: Galvanized steel; size and type to suit application, to rigidly secure acoustic ceiling system including integral mechanical and electrical components with maximum deflection of 1/360.

2.3 ACCEPTABLE MANUFACTURERS - ACOUSTIC UNITS

A. Armstrong.

B. Rockfon.

2.4 ACOUSTIC UNIT MATERIALS

A. Lay-in ceiling panels matching existing at each location; Nominal sizes of existing are 12 inch x 12 inch, 24 inch x 24 inch, and 24 inch x 48 inch. Color to match existing – Paint touch-up where required.

2.5 ACOUSTIC UNIT MATERIALS (ALTERNATE)

A. Lay-in acoustical tile to match existing 24 inch x 48 inch.

PART 3 EXECUTION

3.1 INSPECTION

A. Verify that existing conditions are ready to receive work.

B. Verify that layout of hangers will not interfere with other work.

C. Beginnings of installation means acceptance of existing conditions.

3.2 INSTALLATION

A. Install system in accordance with ASTM C636 and manufacturer’s installation instructions, as supplemented in this Section.

B. Install system capable of supporting imposed loads to a deflection of 1/360 maximum.

C. Install after major above ceiling work is complete. Coordinate the location of hangers with other work.

D. Install hangers. Submit method of hanging to Architect and Owner prior to installation of hangers.

E. Hang system independent of walls, columns, ducts, pipes and conduit. Where carrying members are spliced, avoid visible displacement of face plane of adjacent members.

F. Lateral Force Bracing: Splay 4 #12 gauge wires 90 degrees from each other, 45 degrees from ceiling plane maximum, 2 inches from cross runner intersection; fasten struts to main runner and roof support structure of adequate strength to resist vertical component induced by bracing wires; restraint points - 12 inches o.c. with first point 6 feet from wall. Ceiling areas of 144 square feet or less surrounded by walls which connect directly to the structure above, do not require lateral force bracing.

G. Where ducts or other equipment prevent the regular spacing of hangers, reinforce the nearest affected hangers and related carrying channels to span the extra distance.
H. Locate system on room axis according to Reflected Ceiling Plans.

I. Do not support components on main runners or cross runners if weight causes total dead load to exceed deflection capability. Support fixture loads by supplementary hangers located within 6 inches of each corner; or support components independently.

J. Do not eccentrically load system, or produce rotation of runners.

K. Install edge molding at intersection of ceiling and vertical surfaces, using longest practical lengths. Miter corners. Provide edge moldings at junctions with other interruptions.

L. Form to accommodate plus or minus one inch movement. Maintain visual closure.

M. Fit acoustic units in place, free from damaged edges or other defects detrimental to appearance and function.

N. Install acoustic units level, in uniform plane, and free from twist, warp and dents.

O. Install hold-down clips to retain panels tight to grid system within 20 ft of an exterior door.

P. Install hanger wires so as to provide direct support at each corner of all light fixtures. This support shall be for the light fixture and independent of the ceiling suspension system.

Q. Cut all extra wires at bottom of roof deck.

3.3 TOLERANCES

A. Variation from Flat and Level Surface: 1/8 inch in 10 ft.

B. Variation from Plumb of Grid Members Caused by Eccentric Loads: Two degrees maximum.

END OF SECTION
PART 1  GENERAL

1.01  SECTION INCLUDES

A. Resilient tile flooring.
B. Static dissipative resilient flooring.
C. Floor preparation for resilient tile flooring.
D. Resilient tile base.
E. Resilient tile and base accessories.

1.02  RELATED SECTIONS

A. Section 03 30 00 – Cast-in-Place Concrete.
B. Section 09 68 13 – Carpet Tile.

1.03  REFERENCES

C. ASTM F 710 – Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring.
F. ASTM F 1861 – Standard Specification for Resilient Wall Base, Type TS, Group 1.
1.04 SUBMITTALS

A. Submit under provisions of Section 01 33 00.

B. Product Data: Submit manufacturer’s data on specified products.

C. Samples:
   1. Submit four (4) samples, 12 x 12 inches (nominal) in size, illustrating color and pattern for each floor tile and base.
   2. Submit four (4) samples of base material for each color specified, 6” in length.

D. Submit layout diagrams of each area of floor scheduled to receive flooring. Indicate patterns, joints, cut, flooring, and reference point.

E. Submit manufacturer’s installation instructions under provisions of Section 01 33 00.

F. Provide letter from manufacturer, installer, and contractor stating surface and substrate are acceptable for installation of the specified product.

1.05 OPERATION AND MAINTENANCE DATA

A. Submit cleaning and maintenance data under provisions of Section 01 78 23.

B. Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning, stripping, and re-waxing.

C. Manufacturer’s representative to provide a physical maintenance training demonstration to Owner’s maintenance staff.

D. Submit cleaning and maintenance data for flooring and base products.

E. Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning, stripping, and re-waxing.

1.06 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum ten (10) years documented experience.

B. Installer: Company specializing in performing Work of this Section with minimum ten (10) years documented experience.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Store materials for three (3) days prior to installation in area of installation to achieve temperature stability.

B. Maintain ambient temperature as required by manufacturer.

C. Protect roll materials from damage by storing on end and in original undamaged packaging until ready for use.

D. Maintain temperature in storage area between 55 degrees F and 90 degrees F.
1.08 EXTRA STOCK
A. Provide 50 sq. ft. of each color of tile flooring and 50 lineal feet of base.
B. Submit chart showing manufacturer and color designation of all field and accent tiles installed.

1.09 WARRANTY
A. Provide manufacturer’s fifteen (15) year warranty.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS – RESILIENT TILE FLOORING
A. Johnsonite.
B. Centiva.
C. Parterre Flooring Systems.
D. Substitutions: Under provisions of Section 01 25 13.

2.02 ACCEPTABLE MANUFACTURERS – RESILIENT BASE
A. Johnsonite.
B. Roppe.
C. Allstate.
D. Burke.
E. Substitutions: None

2.03 RESILIENT TILE FLOORING MATERIALS
A. 1. Resilient Tile Flooring (VCT-1) Basis of Design: Johnsonite Model Azrock Collection Textile 12” x 24”, Thickness 0.08 inches, Color V-280 Raw Silk.
2. Resilient Tile Flooring (VCT-2) Basis of Design: For Patching of existing: match color, size and brand.
B. Resilient Dissipative Tile Flooring (SDT-1) Basis of Design: Roppe Model ESD Static Disipative Vynil 24” x 24”, Thickness 0.08, Color 701 Neutron Gray

2.04 RESILIENT BASE MATERIALS
A. Resilient Base (RB-1): Johnsonite; standard toe; 4”; color 48 Grey WG.

2.05 ACCESSORIES
A. Subfloor Filler: Cementitious, non-shrinking latex fortified hydraulic cement patching compound recommended by flooring material manufacturer.
B. Primers and Adhesives: Waterproof; types recommended by flooring manufacturer.
C. Conductive Adhesive: Recommended Conductive Adhesive by flooring manufacturer.
D. Grounding Strips: Recommended Grounding Strips by flooring manufacturer.
E. Sealer and Wax: Types recommended by flooring manufacturer.
F. Moldings, Edge Strips, Transitions and Reducers: Same material and color as resilient base.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that substrate surfaces prepared to receive finishes are smooth and flat with maximum variation of 1/8 inch in 10 ft, and are ready to receive Work.
B. Verify concrete floors are dry to a maximum moisture content of 7 percent, and exhibit negative alkalinity, carbonization, or dusting. Test to ensure a moisture vapor transmission does not exceed 5 lb/1,000 sf./24 hours (ASTM F1869).
C. Beginning of installation means acceptance of existing substrate and site conditions.

3.02 PREPARATION

A. Remove sub-floor ridges and bumps, grind as required. Fill low spots, cracks, joints, holes, and other defects with subfloor filler.
B. Apply, trowel, and float filler to leave a smooth, flat, hard surface.
C. Prohibit traffic from area until filler is cured.
D. Vacuum clean substrate.
E. Apply primer to surfaces.

3.03 INSTALLATION OF TILE FLOORING

A. Install flooring in strict accordance with manufacturer’s recommendations.
B. Install flooring wall-to-wall before the installation of floor-set cabinets, casework, furniture, equipment, movable partitions, etc. Extend flooring into toe spaces, door recesses, closets, and similar openings as shown on the Drawings. Terminate flooring at centerline of door openings where adjacent floor finish is dissimilar.
C. Scribe, cut, and fit to permanent fixtures, columns, walls, partitions, pipes, outlets, and built-in furniture and cabinets. Install tile to pattern as shown.
D. Install flooring with adhesives, tools, and procedures in strict accordance with the manufacturer’s written instructions. Observe the recommended adhesive trowel notching, open times, and working times. Spread only enough adhesive to permit installation of materials before initial set.

3.04 INSTALLATION OF STATIC DISSIPATIVE FLOORING

A. Comply with manufacturer’s written instructions for installing resilient sheet flooring.
B. Install with manufacturer’s adhesive specified for the site conditions and follow adhesive label for proper use.

C. Roll the flooring in both directions using a 100-pound three-section roller.

3.05 INSTALLATION OF BASE

A. Fit joints tightly and make vertical. Maintain minimum dimension of 24 inches between joints.

B. At external corners, use pre-molded units cut to fit. At exposed ends, use pre-molded units. Miter internal corners.

C. Install base on solid backing. Bond tightly to wall and floor surfaces.

D. Scribe and fit to door frames and other interruptions.

E. Install transitions and reducers of solid shape appropriate for application.

F. Install toeless base at carpet flooring.

3.06 INSTALLATION OF ACCESSORIES

A. Apply top-set wall base to walls, columns, casework, and other permanent fixtures in areas where top-set base is required. Install base in lengths as long as practical, with inside corners fabricated from base materials that are mitered or coped. Tightly bond base to vertical substrate with continuous contact at horizontal and vertical surfaces.

B. Fill voids with plastic filler along the top edge of the resilient wall base or integral cover cap on masonry surfaces or other similar irregular substrates.

C. Place resilient edge strips tightly butted to flooring, and secure with adhesive recommended by the edge strip manufacturer. Install edge strips at edges of flooring that would otherwise be exposed.

3.07 CLEANING

A. Remove excess adhesive from floor, base, and wall surfaces without damage.

B. Clean, seal, and maintain resilient flooring products.

3.08 PROTECTION OF INSTALLED CONSTRUCTION

A. Prohibit traffic on resilient flooring for 48 hours after installation.

B. Protect installed flooring as recommended by the flooring manufacturer against damage from rolling loads, other trades, or the placement of fixtures and furnishings.

3.09 FLOOR SURFACE TREATMENT

A. All resilient flooring surfaces on which pedestrians can walk shall be finished such that the minimum static coefficient of friction between the surface and normal hard soled shoes in strict accordance with ADA Guidelines, latest edition.

END OF SECTION
SECTION 09 68 13
CARPET TILE

PART 1  GENERAL

1.01   SECTION INCLUDES

A. Carpet Tile and installation.

b. Floor preparation for carpet tile.

1.02    RELATED SECTIONS

A. Section 09 65 19 - Resilient Flooring and Base.

1.03   SUBMITTALS

A. Shop Drawing showing columns, doorways, enclosing walls or partitions, built-in cabinets, and locations where cutouts are required as well as direction of carpet pile and pattern, location of edge moldings and edge bindings shall be submitted to the Architect for approval prior to installation.

B. Carpet schedule using same room designations indicated on drawings.

C. Product Data: Provide data on specified products, describing physical and performance characteristics, sizes, patterns, colors available, and method of installation.

D. Verification Samples: Submit two 12” x 12” samples illustrating color, pattern, and backing for each carpet material specified.

E. Manufacturer’s Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.

F. Maintenance Data: Include maintenance procedures, recommendations for maintenance materials and equipment, and suggested schedule for cleaning.

G. Manufacturer’s Carpet Warranty.

H. Certifications: Manufacturer to submit copies of the following independent laboratory reports showing compliance with requirements per these methods outlined in Part 2 of this document. Submitted results shall represent average results for production goods of the specified style.
   2. Flooring Radiant Panel / ASTM E-648- Requirement: Class I (Above .45 w/cm).
   3. CRI VOC Chamber Test/Indoor Air Quality test (CRI-IAQ) Green Label Plus Test.
   4. Lightfastness: Rating of not less than 5 on International Grey Scale after 40 SFU’s when tested in accordance with AATCC Test Method 16E.
   5. Crockfastness: Minimum stain rating on International Grey Scale of not less than 5 wet or dry when tested in accordance with AATCC Test Method 165.
   6. Atmospheric Fading: Burned Gas shall not be less than 5 on International Grey Scale after two cycles on each test as per AATCC Test Method 129 Ozone and AATCC Test Method 23.

1.04  ENVIRONMENTAL REQUIREMENTS

A. The maximum amount of moisture evacuation from the floor is 3.0 pounds per 1,000 S.F. in 24 hours. The acceptable pH level of the substrate is between 7.0 and 9.0. Flooring contractor is responsible for floor testing.
B. All material used in sub-floor preparation and repair shall be recommended by the carpet manufacturer and shall be chemically and physically compatible with the carpet system being bid.

C. Maintain minimum 65 degrees F ambient temperature and maximum 65% Relative Humidity for 48 hours prior to, during, and 48 hours after installation.

D. Do not install carpet until space is enclosed and weatherproof, wet-work in space is completed and nominally dry, work above ceilings is complete, and ambient temperature and humidity conditions are and will be continuously maintained at values near those indicated for final occupancy.

E. New concrete must be clean, dry and cured for a minimum of sixty (60) days and free of parting agents. Floors must be sealed.

1.05 EXTRA MATERIALS

A. Provide additional 5% of each type, color, and pattern furnished; product to be boxed and, when necessary, palletized. Coordinate storage location with Owner.

1.06 WARRANTY

A. Provide manufacturer's lifetime warranty against excessive surface wear. Excessive wear means no more than 10% loss of pile fiber weight measured before and after use as tested under ASTM D-3936.

1.07 QUALITY ASSURANCE

A. Manufacturer Qualifications:
   1. Company specializing in manufacturing specified carpet with minimum 10 years documented experience.
   2. Upon request, manufacturer to provide representative to assist in project start-up and to inspect installation while in process and upon completion. Representative will notify designated contact if any installation instructions are not followed.

B. Installer Qualifications:
   1. Flooring contractor must be certified by the carpet manufacturer prior to bid.
   2. Flooring contractor to be a specialty contractor normally engaged in this type of work and shall have prior experience in the installation of these types of materials.

1.08 DELIVERY, STORAGE, & HANDLING

A. Deliver materials to the site in manufacturer’s original packaging listing manufacturer’s name, product name, identification number, and related information.

B. Store in a dry location, between 60 degrees F and 80 degrees F and a relative humidity below 65%. Protect from damage and soiling. Store in pallet form as supplied by Manufacturer. Do not stack pallets.

C. Make stored materials available for inspection by the Owner’s representative.

D. Store materials in area of installation for minimum period of 48 hours prior to installation.

E. Store in accordance with manufacturer’s requirements.
1.09 PROJECT CONDITIONS

A. Sub-floor preparation is to include all required work to prepare the existing floor for installation of the product as specified in this document and Manufacturer’s installation instructions.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. J & J Flooring Group.
B. Mohawk.
C. Shaw Contract Group.
D. Substitutions: Under provisions of Section 01 25 13.

2.02 CARPET TILE

A. Basis of Design: Shaw disperse 24” x 24” collection Diffuse and Disperse. Construction with multi-level pattern loop, fiber eco solution nylon 6 with 100% solution dyed method. Tufted weight of 16, 9.0 stitches per inch. Primary backing to be synthetic polyolefin composite. Surface treatments with non C8 fluorocarbon chemistry. Recycled content by weight equal to 41 per cent or better with Pre-consumer recycled of 28 per cent and post-consumer recycle of 13 per cent.

2.03 ADHESIVES

A. As recommended by the carpet manufacturer for areas with new construction subgrade leveled flooring.
B. For installation over existing resilient flooring, Basis of Design: LokDots adhesive rolls and handheld applicator in accordance with Lok-Dots by Shaw, application style number: Shaw Contract Group 00LDA Patcraft 03LDA Phily Queen 01LDA. Pressure sensitive odor free carpet tile installation system material. Apply a minimum of 15 dots per 24 x 24 inch tile. At cut tile apply dots to perimeter of cut tile.

2.04 ACCESSORIES

A. Materials recommended by manufacturer for patching leveling, priming, etc.
B. Transition and edge strips as indicated on the Drawings.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that sub-floor is smooth and flat within specified tolerances and ready to receive carpet.
B. Verify that substrate surface is dust-free and free of substances that would impair bonding of product to the floor.
C. Verify that concrete surfaces are ready for installation by conducting moisture and pH testing. Results must be within limits recommended by Manufacturer.
D. There will be no exceptions to the provisions stated in the Manufacturer’s installation instructions.

E. Verify that raised access floor panels are smooth, level, secure and free of any material that will affect the adhesive bond. Carpet modules must be offset from access panel seams. Gaps between panels must not exceed 1/16”.

3.02 PREPARATION

A. Prepare sub-floor to comply with criteria established in manufacturer’s installation instructions. Use only preparation materials that are acceptable to the manufacturer.
   1. Remove all deleterious substances from substrate(s) that would interfere with or be harmful to the installation.
   2. Remove sub-floor ridges and bumps. Fill cracks, joints, holes, and other defects with a compatible latex patching compound.

3.02 INSTALLATION

A. Install product in accordance with manufacturer’s installation instructions.

B. Where demountable partitions or other items are indicated for installation on top of finished carpet tile floor, install carpet tile before installation of these items.

C. Cut and fit carpet tile to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings.

D. Extend carpet tile into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.

E. Roll with a 75 lb. roller for complete contact of carpet with mill-applied adhesive to sub-floor. Carpet to be securely adhered in accordance with ADA requirements.

F. Trim carpet neatly at walls and around interruptions.

G. Completed carpet is to be smooth and free of bubbles, puckers, and other defects.

3.04 PROTECTION

A. Use plywood over the carpet when heavy objects are moved within 24 hours after installation.

B. A non-staining building material paper must be placed over the carpet to protect it when additional construction activity is to take place.

3.05 CLEANING

A. Remove excess adhesive and/or other from floor and wall surfaces without damage.

B. All rubbish, wrappings, debris, trimmings, etc. to be removed from site and disposed of properly.

C. Clean and vacuum carpet surfaces using a beater brush/bar commercial vacuum.

D. After each area of carpet is installed, protect from soiling and damage by other trades.

END OF SECTION
SECTION 09 77 10

FABRIC-WRAPPED ACOUSTIC WALL PANEL

PART 1  GENERAL

1.1  WORK INCLUDED

A. Acoustic wall panel.

1.2  RELATED WORK

A. Section 09 21 16 - Gypsum Board Assemblies: Wall substrate.
B. Section 09 90 00 - Painting and Coating: Priming of substrate surfaces.

1.3  REFERENCES

B. FS CCC-W-408 - Wall Covering, Vinyl Coated.
C. FS L-P-1040 - Plastic Sheets and Strips, Polyvinylfloride.

1.4  QUALITY ASSURANCE

A. Manufacturer: Company specializing in manufacturing acoustic wall panel with three years documented experience.
B. Applicator: Company specializing in installing wall panels with three years documented experience and approved by wall covering manufacturer.

1.5  REGULATORY REQUIREMENTS

A. Conform to applicable code for flame/fuel/smoke ratings of 25/35/50 when tested to ANSI/ASTM E84, NFPA 255, and UL 723.

1.6  SUBMITTALS

A. Submit shop drawings and product data under provisions of Section 01 33 23.
B. Provide product data on wallcovering and installation requirements.
C. Submit samples under provisions of Sections 01 33 00 and 01 33 23.
D. Submit two samples of acoustic wall panel, 8 x 8 inch in size, illustrating color, finish, and texture.
E. Submit manufacturer's installation instructions under provisions of Sections 01 33 00 and 01 33 23.
F. Submit manufacturer's certificate under provisions of Section 01 78 39, and individual specification sections, that products meet or exceed specified requirements.
G. Submit test reports verifying flame/fuel/smoke ratings, when tested by UL and an agency.
approved by authority having jurisdiction.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site under provisions of Section 01 45 17.
B. Store and protect products under provisions of Section 01 45 17.
C. Inspect roll materials on site to verify acceptance.
D. Protect packaged adhesive from temperature cycling and cold temperatures.

1.8 ENVIRONMENTAL REQUIREMENTS

A. Provide continuous ventilation and heating facilities to maintain substrate surface and ambient temperatures above 60 degrees F, unless required otherwise by manufacturer’s instructions.
B. Package and label each panel by destination room number, store where directed.

PART 2 PRODUCTS

2.1 MANUFACTURERS - ACOUSTIC WALL PANELS

A. MPC, Inc.
B. Wall Technology Inc.
C. Conwed.
D. Decoustics.
E. Lamvin, Inc.
F. Tectum.
G. Quiet Technology Systems.
H. Sound Seal.
I. Substitutions: Under provisions of Section 01 25 00.

2.2 ADDITIONAL MANUFACTURERS - TACKABLE ACOUSTIC WALL PANELS

A. Armstrong World Industries, Inc.
B. Sound Concepts Canada, Inc.
C. Sound Stop Tackable Wall Panels.
D. Wall Technology, Inc. – TK125WP-C.
E. Substitutions: Under provisions of Section 01 25 00.

2.3 MATERIALS - WALL PANELS

B. Core: 7 lb./c.f. fiberglass.
C. Vinyl Corners: Heat sealed, fully tailored.
D. Frame: Standard with manufacturer.
E. Mounting: TBD
F. Dimensions: 1-1/8 inch thick; width and heights per interior elevations.

PART 3 EXECUTION

3.1 INSPECTION

A. Verify that substrate surfaces are painted and ready to receive work.
B. Beginning of installation means acceptance of existing surfaces and substrate.

3.2 INSTALLATION

A. Mount panels in accordance with manufacturer’s instructions.
B. Coordinate panel installation with the locations of any fire alarm system devices, motion detectors, exit signs or other electrical devices and with the location of any HVAC grilles in the areas shown to receive panels, to avoid interfering with the function of these items. Install panels fabricated as required to be clear of such devices where conflicts may exist.
C. Install termination trim.
D. Install continuous bead of clear caulking at all panel edges to wall, creating a continuous perimeter seal to wall.

3.3 CLEANING

A. Clean panels of dust, dirt, and other contaminants under provisions of Sections 00 74 13 and 00 74 23.
B. Touch-up minor finish imperfection per manufacturer’s recommendation.
C. Remove and replace work which cannot be successfully cleaned or repaired.

3.4 PROTECTION

A. Protect finished installation from any soiling or damage.

END OF SECTION
SECTION 09 84 00
SOUND-ABSORBING CEILING UNITS

PART 1  GENERAL

1.1  SECTION INCLUDES

A. Fixed Sound-Absorbing Panels.

1.2  SYSTEM DESCRIPTION

A. Noise Reduction Coefficient (NRC): Minimum 75 when tested in accordance with ASTM C423.

1.3  SUBMITTALS

A. Shop Drawings:
   1. Indicate layout, dimensions, and finish of acoustical wall panels, frame profiles, and core materials.
   2. Indicate interface with adjacent materials.

B. Product Data: Submit data on core material and accessory materials.

C. Samples: Submit three 8 inch x 10 inch samples of each component illustrating construction, profile and surface texture and finish.

D. Manufacturer's Installation Instructions:
   1. Submit manufacturers written installation instructions.
   2. Submit special procedures, and perimeter conditions requiring special attention.

1.4  CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: Submit panel care and maintenance procedures, recommended maintenance materials, suggested schedule for cleaning, recommended procedures for removal of stains, and warranty.

1.5  QUALITY ASSURANCE

A. Surface Burning Characteristics:
   1. Comply with:
      a. Maximum 25/450 flame spread/smoke developed index when tested in accordance with ASTM E84.

1.6  ENVIRONMENTAL REQUIREMENTS

A. Do not install acoustical wall treatment until space has been enclosed and is watertight, wet work is complete and dry and adjacent and related work is completed.

B. Do not install acoustical unit until ambient temperature and humidity level will be continuously maintained at conditions indicated for Owner occupancy and per manufacturer's recommendations.
PART 2  PRODUCTS

2.1  MANUFACTURERS - ACOUSTIC CEILING UNITS

A. Tectum, Inc., Finale Panel.
B. Substitutions: Under provisions of Section 01 25 00.

2.2  MATERIAL

A. Material:
   1. Aspen wood fibers bonded with inorganic hydraulic cement.
   3. Thickness: 1 inch baseboard and 1 inch Tectum furring with SoniCor fiber core between the furring, 2 inches total.
   4. Noise Reduction Coefficient (NRC): Minimum 0.75.
   5. Color: Refer to Finish Materials List in Section 09 60 00.
   6. Interior Composite Wood and Agrifiber Products: Contain no added urea-formaldehyde resins.

2.3  ACCESSORIES

A. Fasteners: Type recommended and provided by panel manufacturer to suit application.
B. Adhesive: Type recommended by panel manufacturer.
   1. Interior Adhesives: Do not exceed maximum allowable volatile organic compound content in accordance with SCAQMD Rule 1168.

PART 3  EXECUTION

3.1  EXAMINATION

A. Verify substrate is flat, dry, plumb and level and ready to receive the work of this section.
B. Verify adjacent and related work is complete.

3.2  INSTALLATION

A. Secure panels as recommended by manufacturer. Apply adhesive where recommended by manufacturer.
B. All fastening devices shall be painted to match ceiling panel in complete installation.
C. Prior to final inspection, review installation with Architect and replace all unsatisfactory panels.

3.3  ERECTION TOLERANCES

A. Maximum Variation From Indicated Position: 1/4 inch.
B. Maximum Offset From Indicated Alignment: 1/16 inch.
C. Maximum Out of Square: 1/4 inch difference in panel diagonals.
3.4 SCHEDULES
   A. Refer to drawings and Finish Materials List.

3.5 CLEANING
   A. Clean panels of dust, dirt, and other contaminants under provisions of Sections 00 74 13 and 00 74 23.
   B. Touch-up minor finish imperfection per manufacturer’s recommendation.
   C. Remove and replace work which cannot be successfully cleaned or repaired.

3.4 PROTECTION
   A. Protect finished installation from any soiling or damage.

END OF SECTION
PART 1  GENERAL

1.1  SECTION INCLUDES
   A. Surface preparation and field application of paints and coatings.

1.2  RELATED SECTIONS
   A. Section 07 84 00 – Firestopping.
   B. Section 08 41 13 – Aluminum Framed Entrances and Storefronts.
   C. Section 09 21 16 – Gypsum Board Assemblies.
   D. Section 22 05 53 – Mechanical Identification.
   E. Section 26 05 53 – Electrical Identification.

1.3  REFERENCES

1.4  DEFINITIONS
   A. Conform to ANSI/ASTM D16 for interpretation of terms used in this Section.

1.5  QUALITY ASSURANCE
   A. Product Manufacturer: Company specializing in manufacturing quality paint and finish products with three years experience.
   B. Applicator: Company specializing in commercial painting and finishing with three years documented experience.
   C. Dry film thickness shall be as scheduled and will be tested for compliance. Areas failing test for thickness will be remediated as directed by Owner or Owner's representative at Contractor's expense.

1.6  REGULATORY REQUIREMENTS
   A. Conform to applicable code for flame/fuel/smoke rating requirements for finishes.

1.7  TESTS
   A. Provide analysis and testing of coating finish under provisions of Section 01 43 26.
   B. Dry Film Thickness Testing will be conducted by Owner or Owner's Representative at their discretion.

1.8  SUBMITTALS
   A. Submit product data under provisions of Section 01 33 23.
B. Provide product data on all finishing products and special coating.

C. Submit samples under provisions of Section 01 33 23.

D. Submit two samples, 4 x 6 inch minimum in size, illustrating range of colors and textures available for each color of surface finishing product scheduled.

E. Submit manufacturer's application instructions under provisions of Section 01 33 23.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site under provisions of Section 01 45 17.

B. Store and protect products under provisions of Section 01 45 17.

C. Deliver products to site in sealed and labeled containers; inspect to verify acceptance.

D. Container labeling to include manufacturer's name, type of paint, brand name, brand code, coverage, surface preparation, drying time, cleanup, color designation, and instructions for mixing and reducing.

E. Store paint materials at minimum ambient temperature of 45 degrees F and a maximum of 90 degrees F, in well ventilated area, unless required otherwise by manufacturer's instructions.

F. Take precautionary measures to prevent fire hazards and spontaneous combustion.

1.10 ENVIRONMENTAL REQUIREMENTS

A. Provide continuous ventilation and heating facilities to maintain surface and ambient temperatures above 45 degrees F for 24 hours before, during, and 48 hours after application of finishes, unless required otherwise by manufacturer's instructions.

B. Do not apply exterior coatings during rain or snow, or when relative humidity is above 50 percent, unless required otherwise by manufacturer's instructions.

C. Minimum Application Temperatures for Latex Paints: 45 degrees F for interiors; 50 degrees F for exterior; unless required otherwise by manufacturer's instructions.

D. Minimum Application Temperature for Varnish Finishes: 65 degrees F for interior or exterior, unless required otherwise by manufacturer's instructions.

E. Provide lighting level of 80 ft candles measured mid-height at substrate surface.

F. Paints containing mercury compounds are not allowed on Clark County School District projects.

1.11 EXTRA STOCK

A. Provide five gallons (one container) of each color and surface texture to Owner.

B. Label each container with color, texture, room locations, in addition to the manufacturer's label.

C. Provide chart showing manufacturer, color and mixing formula of all colors of paint and stain installed.

D. Provide one (1) set of “draw down” samples to match requirements of paragraph 1.8 D
PART 2  PRODUCTS

2.1  MANUFACTURERS - PAINT

A. Dunn Edwards Paints.
B. PPG.
C. Sherwin Williams.
D. Vista Paint.
E. Substitutions: Under provisions of Section 01 25 13.

2.2  MANUFACTURERS - PRIMER AND STAIN

A. USG – Sheetrock First Coat.
B. Substitutions: Under provisions of Section 01 25 13.

2.3  MATERIALS

A. Coatings: Ready mixed, except field catalyzed coatings. Process pigments to a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating.

B. Coatings: Good flow and brushing properties; capable of drying or curing free of streaks or sags.

C. Paint Formulation Standards:
   1. Interior or exterior acrylic enamel, semi-gloss:
      a. Solids by volume - 30% minimum.
      b. Acrylic resins by weight - 20% minimum.
      c. Titanium Dioxide pigment by weight - 15% minimum.
      d. Dry Heat Resistance - 250°F for non-galvanized and 150°F for galvanized exterior metal surfaces.
   2. Interior acrylic enamel, gloss:
      a. Solids by volume - 30% minimum.
      b. Acrylic resins by weight - 25% minimum.
      c. Titanium Dioxide pigment by weight - 15% minimum.
   3. Interior or exterior alkyd enamel, semi-gloss:
      a. Solids by volume - 50% minimum.
      b. Alkyd resins by weight - 30% minimum.
      c. Titanium Dioxide pigment by weight - 15% minimum.
      d. Dry Heat Resistance - 250°F for non-galvanized and 150°F for galvanized exterior metal surfaces.

D. Accessory Materials: Linseed oil, shellac, turpentine, paint thinners and other materials not specifically indicated but required to achieve the finishes specified, of commercial quality.

E. Gloss Range: Comply with ATSM D523 for gloss range. Refer to paragraphs 3.7 and 3.8 for applicable gloss level.
   Gloss to be as follows:
   Flat: 15% measured at 85 degree meter.
   Eggshell: 5% to 20% measure at 60 degree meter.
   Satin: 15% to 35% measured at 60 degree meter.
   Semi Gloss: 30% to 65% measured at 60 degree meter.
   Gloss: Over 65% measured at 60 degree meter.
PART 3  EXECUTION

3.1  INSPECTION

A. Verify that surfaces and substrate conditions are ready to receive work as instructed by the product manufacturer.

B. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially affect proper application.

C. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces are below the following maximums:
   1. Plaster and Gypsum Wallboard: 12 percent.
   2. Masonry, Concrete, and Concrete Unit Masonry: 12 percent.

D. Beginning of installation means acceptance of existing surfaces and substrate.

3.2  PREPARATION

A. Remove electrical plates, hardware, light fixture trim, and fittings prior to preparing surfaces or finishing.

B. Correct minor defects and clean surfaces which affect work of this Section.

C. Shellac and seal marks which may bleed through surface finishes.

D. Impervious Surfaces: Remove mildew by scrubbing with solution of tri-sodium phosphate and bleach. Rinse with clean water and allow surface to dry.

E. Aluminum Surfaces Scheduled for Paint Finish: Remove surface contamination by steam or high pressure water. Remove oxidation with acid etch and solvent washing. Apply etching primer immediately following cleaning.

F. Asphalt, Creosote, or Bituminous Surfaces Scheduled for Paint Finish: Remove foreign particles to permit adhesion of finishing materials. Apply compatible sealer or primer.

G. Insulated Coverings: Remove dirt, grease, and oil from canvas and cotton.

H. Concrete Floors: Remove contamination, acid etch, and rinse floors with clear water. Verify required acid-alkali balance is achieved. Allow to dry.


J. Galvanized Surfaces: Remove surface contamination and oils and wash with non-oil based solvent. Wipe clean. Apply coat of etching primer. Do not allow any oil or grease residue to remain on the metal surface.

K. Concrete and Unit Masonry Surfaces Scheduled to Receive Paint Finish: Remove dirt, loose mortar, scale, salt or alkali powder, and other foreign matter. Remove oil and grease with a solution of tri-sodium phosphate; rinse well and allow to dry. Remove stains caused by weathering of corroding metals with a solution of sodium metasilicate after thoroughly wetting with water. Allow to dry.

L. Plaster Surfaces: Fill hairline cracks, small holes, and imperfections with latex patching plaster. Make smooth and flush with adjacent surfaces. Wash and neutralize high alkali surfaces.

M. Uncoated Steel and Iron Surfaces: Remove grease, scale, dirt, and rust. Where heavy
coatings of scale are evident, remove by wire brushing or sandblasting; clean by washing with non-oil based solvent. Wipe clean. Apply a treatment of phosphoric acid solution, ensuring weld joints, bolts, and nuts are similarly cleaned. Spot prime paint after repairs.

N. Shop Primed Steel Surfaces: Sand and scrape to remove loose primer and rust. Feather edges to make touch-up patches inconspicuous. Clean surfaces with non-oil based solvent. Touch-up bare steel surfaces with matching primer. Roughen all glossy surfaces to receive finish coats.

O. Interior Wood Items Scheduled to Receive Finish: Wipe off dust and grit prior to priming. Seal knots, pitch streaks, and sappy sections with sealer. Fill nail holes and cracks after primer has dried; sand between coats.

P. Metal Doors Scheduled for Painting: Seal top and bottom edges with primer.

3.3 PROTECTION

A. Protect elements surrounding the work of this Section from damage or disfiguration.

B. Repair damage to other surfaces caused by work of this Section.

C. Furnish drop cloths, shields, and protective methods to prevent spray or droppings from disfiguring other surfaces.

D. Remove empty paint containers from site.

3.4 APPLICATION

A. Apply products in accordance with manufacturer's instructions.

B. Do not apply finishes to surfaces that are not dry.

C. Apply each coat to uniform finish.

D. Apply each coat of paint slightly darker than preceding coat unless otherwise approved.

E. Sand lightly between coats to achieve required finish.

F. Allow applied coat to dry per paint manufacturer’s instructions before next coat is applied.

G. Where clear finishes are required, tint fillers to match wood. Work fillers into the grain before set. Wipe excess from surface.

H. Prime back surfaces of interior and exterior woodwork with primer paint.

I. Prime back surfaces of interior woodwork scheduled to receive stain or varnish finish with gloss varnish reduced 25 percent with mineral spirits.

J. At completion of painting application, a dry film thickness test shall be conducted by the Owner’s Representative on selected areas to establish correct paint thickness. Areas failing such testing shall be remediated at Contractor’s expense.

3.5 FINISHING MECHANICAL AND ELECTRICAL EQUIPMENT

A. Refer to Divisions 22 and 26 for schedule of color coding and identification banding of equipment, ductwork, piping, and conduit.

B. Paint shop primed equipment.
C. Remove unfinished louvers, grilles, covers, and access panels on mechanical and electrical components and paint separately, except where items are prefinished.

D. Prime and paint insulated and exposed pipes, conduit, boxes, insulated and exposed ducts, hangers, brackets, collars and supports, and mechanical equipment.

E. Replace identification markings on mechanical or electrical equipment when painted accidentally.

F. Paint interior surfaces of air ducts that are visible through grilles and louvers with one coat of flat black paint, to limit of sight line. Paint dampers exposed behind louvers, grilles, and convectors and baseboard cabinets to match face panels.

G. Paint exposed conduit and electrical equipment occurring in finished areas.

H. Paint both sides and edges of fire-retardant-treated plywood backboards for electrical and telephone equipment before installing equipment. The fire-rated stamp must be visible, do not paint over.

I. Color code equipment, piping, conduit, and exposed ductwork in accordance with color schedule.

J. Replace electrical plates, hardware, light fixture trim, and fittings removed prior to finishing.

3.6 CLEANING

A. As Work proceeds, promptly remove paint where spilled, splashed, or spattered.

B. During progress of Work maintain premises free of unnecessary accumulation of tools, equipment, surplus materials, and debris.

C. Collect cotton waste, cloths, and material which may constitute a fire hazard, place in closed metal containers and remove daily from site.

3.7 SCHEDULE - INTERIOR SURFACES (DFT= Dry Film Thickness)

A. Cement Plaster
   1. One coat 100% acrylic primer.

B. Steel - Unprimed
   1. One coat 100% acrylic rust inhibitive metal primer, 1.25 mils DFT.
   2. Two coats 100% acrylic enamel, semi-gloss, 3.5 mils DFT.

C. Steel - Primed
   1. Touch-up with 100% acrylic rust inhibitive metal primer, 1.25 mils DFT.
   2. Two coats 100% acrylic enamel, semi-gloss, 3.5 mils DFT.

D. Steel - Galvanized
   1. One coat alkyd galvanized or non-ferrous metals primer, 1.3 mils DFT.
   2. Two coats 100% acrylic enamel, semi-gloss, 3.5 mils DFT.

E. Concrete tilt-Up Panels
   1. One coat acrylic primer/sealer/stain killer, 1.5 mils DFT.
   2. Two coats elastomeric smooth texture coatings, 12.0 mils DFT.
F. Wood - Painted
1. One 100% acrylic latex primer sealer, flat, 1.25 mils DFT.
2. Two coats 100% acrylic non-blocking enamel, semi-gloss, 3.5 mils DFT.

G. Wood - Transparent Finish
1. Filler coat (for open grained wood only).
2. One coat alkyd stain.
3. One coat interior wood sanding sealer, vinyl copolymer type.
4. Two coats polyurethane varnish, non-yellowing.

H. Gypsum Board - in Dry Areas
1. One coat 100% acrylic latex enamel primer, 1.2 mils DFT.
2. Two coats 100% acrylic enamel, 2.8 mils DFT:
   a. Walls - semi-gloss.
   b. Soffits and ceilings - semi-gloss.

I. Gypsum Board - in Wet Areas
1. One coat 100% acrylic enamel primer, 1.2 mils DFT.
2. Two coats 100% acrylic enamel: 2.8 mils DFT.
   a. Walls - semi-gloss.

J. Concrete - in Wet Areas
1. Two coats block filler, 12.0 mils DFT.
2. Two coats 100% acrylic enamel, gloss, 2.0 mils DFT.

K. Concrete - Dry Areas
1. Two coats block filler, 12.0 mils DFT.
2. Two coats 100% acrylic enamel, semi-gloss, 2.0 mils DFT.

L. Concrete - Sealed
1. Sealer - per manufacturer's recommendations.

3.8 SCHEDULE - SURFACE FINISH AND COLORS

A. See Finish Materials List on drawings.

END OF SECTION
SECTION 10 11 00
VISUAL DISPLAY SURFACES

PART 1 GENERAL

1.1 SECTION INCLUDES
A. Surfaced metal markerboards.
B. Tackboards.
C. Trim, marker tray, and accessories.

1.2 RELATED SECTIONS
A. Section 09 21 16 - Gypsum Board Assemblies: Substrate construction.

1.3 REFERENCES
A. AHA A135.4 - Basic Hardboard.
B. ASTM A424 - Steel Sheets for Porcelain Enameling.
C. ASTM B221 - Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes.
E. FS L-P-1040 - Plastic Sheets and Strips, Polyvinyl Fluoride.
F. NPA A208.1 - Mat Formed Wood Particleboard.
G. PEI (Porcelain Enamel Institute) - Performance specifications for Porcelain Enamel Chalkboards.

1.4 SUBMITTALS
A. Submit under provisions of Section 01 33 00.
B. Shop Drawings: Indicate wall elevations, dimensions, joint locations, and anchor details.
C. Product Data: Provide data on markerboards, tackboards, trim and accessories. Include color and finish of markerboards and trim.
D. Samples: Submit two samples illustrating color and texture of tackboard covering fabric; marker/projection screen surface.

1.5 OPERATION AND MAINTENANCE DATA
A. Submit under provisions of Section 01 78 23.
B. Maintenance Data: Include data on regular cleaning, stain removal, and protection of surfaces.

1.6 QUALIFICATIONS
A. Manufacturer: company specializing in manufacturing the Products specified in this section with minimum five years documented experience.
1.7 FIELD MEASUREMENTS
   A. Verify that field measurements are as indicated on shop drawings.

1.8 WARRANTY
   A. Provide five-year warranty under provisions of Section 01 78 36.
   B. Warranty: Provide 50-year warranty on writing surface. Include coverage of markerboard surface from discoloration due to cleaning, crazing or cracking, staining and warping.

PART 2 PRODUCTS

2.1 MANUFACTURERS
   A. NACO/GSI.
   B. Lemco.
   C. Platinum Visual Systems.
   D. Claridge.
   E. Shana-Han’s Ltd.
   F. Newline Products.
   G. Polyvision.
   H. Substitutions: Under provisions of Section 01 25 00.

2.2 MARKERBOARD MATERIAL
   A. Sheet Steel: ASTM A424, Type I, commercial quality.

2.3 TACKBOARD SURFACING MATERIAL

2.4 CORE AND FRAME MATERIALS
   A. Hardboard: AHA A135.4, tempered, smooth face.
   B. Particle Board: NPA A208.1, wood chips, set with waterproof resin binder, sanded faces.
   C. Foil Backing: Aluminum foil sheet, 0.015 inch thick.
   D. Frame and Chalkrail: Aluminum extrusions, ASTM B221, 6064 alloy, T5 temper.

2.5 ACCESSORIES
   A. Adhesives: Type used by manufacturer.
   B. Map Supports: Formed aluminum sliding roller brackets to fit map rail.
   C. Flag Holders: Cast aluminum bored to receive one-half inch diameter flag staff, bracketed to fit top rail of markerboard and tackboard.
   D. Field Applied Trim: Snap on trim, with no visible screws or exposed joints.
E. Marker Tray: Furnish standard continuous, solid extrusion (blade tray) type aluminum chalk tray with ribbed section and smoothly curved exposed ends, for each markerboard.

F. Map Rail: Furnish map rail at the top of each markerboard unit, complete with the following accessories:
1. Display Rail: Provide continuous cork display rail integral with the map rail.
2. End Stops: Provide one end stop at each end of the map rail.
3. Map Hooks: Provide 2 map hooks with flexible metal clips for each 4 feet of map rail or fraction thereof.

G. Temporary Protective Cover: Sheet polyethylene, 8 mil thick.

H. Provide instructions for markerboard cleaning on metal plate attached to perimeter frame near chalkrail.

I. Provide liquid cleaner and cleaning towel kit for marker/projection screen wallcovering.

2.6 FABRICATION - MARKERBOARDS

A. Outer Face Sheet: Steel, 28 gage enameling grade steel. Pressure laminated to core.

B. Core: Particleboard, 7/16 inch thick, complying to requirements of ANSI A208.1, Grade 1-M-1. Not to emit significant quantities of formaldehyde.

C. Backing Surface: 28 gage galvanized steel or 0.015 inch aluminum sheet.

D. Splice Joint: Concealed spline of sheet steel.

E. Laminating Adhesive: Moisture resistant thermoplastic type adhesive.

2.7 FABRICATION - TACKBOARDS

A. Outer Facing: Cork, 1/4 inch thick. Laminated to core.

B. Core: Hardboard, 1/4 inch thick.

C. Backing Surface: Moisture barrier.

2.8 FABRICATION - FRAME AND TRIM

A. Frame: Aluminum, of channel profile; concealed fasteners; 1 inch wide map rail with 3/4 inch x 1/4 inch cork insert over markerboard and tackboard surfaces. Two (2) map hooks with flexible metal clips per 4 feet of rail.

B. Marker Tray: 2-3/4 inch deep aluminum, ribbed profile, one piece, full length of markerboard. Provide marker tray at all markerboards.

2.9 FINISHES

A. Markerboard: Porcelain enamel, glass fibered, Type A acid-resistant; heat-fused to steel face sheet; ground enamel base coat on both sides of steel face sheet; color coat on writing surface; manufactured as specified by the Porcelain Enamel Institute. Medium gloss finish.

B. Aluminum Frame, Marker Tray, and Accessories: Mill finish natural aluminum.

2.10 SIZES

A. As noted on Floor Plans and Elevation Drawings.

PART 3 EXECUTION
3.1 EXAMINATION

A. Verify that wall surfaces are ready to receive work and positioning dimensions are as indicated on shop drawings.

3.2 INSTALLATION

A. Install markerboards and tackboards in accordance with manufacturer's instructions.

B. Secure units level and plumb.

C. Markerboards: Butt panels tight with concealed spline to hairline joint.

3.3 CLEANING

A. Clean work under provisions of Section 01 74 23.

B. Cover markerboard and tackboard surfaces with protective cover, taped to frame.

C. Remove temporary protective cover at date of Substantial Completion.

END OF SECTION
SECTION 10 21 23
CUBICLE CURTAINS

PART 1     GENERAL

1.1     SECTION INCLUDES

A. Overhead metal curtain track and guides.
B. Cubicle and shower curtains as identified in the Drawings.

1.2     RELATED SECTIONS

A. Section 09 51 13 - Acoustical Panel Ceilings: Suspended ceiling system.

1.3     REFERENCES

A. National Fire Protection Association - Standard 701.

1.4     PERFORMANCE REQUIREMENTS

A. Track: To support vertical test load of 50 lbs without visible deflection of track or damage to supports.
B. Size track to support moving loads, sufficiently rigid to resist visible deflection.

1.5     SUBMITTALS

A. Submit shop drawings under provisions of Section 01 33 00.
B. Submit shop drawings indicating a reflected ceiling plan view of curtain track, hangers and suspension points, attachment details, schedule of curtain sizes.
C. Submit product data under provisions of Section 01 33 23.
D. Submit product data for curtain fabric characteristics. Include manufacturer's standard color chart with proposed color indicated.
E. Submit 12 x 12 inch sample patch of curtain cloth with representative hem stitch detail, heading with reinforcement, and carrier attachment to curtain header.
F. Submit manufacturer's installation instructions under provisions of Section 01 33 23.

1.6     MAINTENANCE DATA

A. Submit maintenance data under provisions of Section 01 78 23.
B. Include recommended cleaning methods and materials and stain removal methods.

1.7     REGULATORY REQUIREMENTS

A. Conform to NFPA Std. 701 for flame resistance requirements for curtain fabric.

1.8     DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site under provisions of Section 01 45 17.
B. Store and protect products under provisions of Section 01 45 17.
C. Accept curtain materials on site and inspect for damage.
D. Store curtain materials on site and deliver to the Owner for installation when requested.

PART 2  PRODUCTS

2.1  MANUFACTURERS - CUBICLE TRACKS AND CURTAINS

A. Capital Cubicle Co., Inc.
B. General Cubicle Co.
C. Imperial Fastener Co., Inc.
D. A.R. Nelson Co., Inc.
E. OB/Masco Drapery Hardware Co.
F. Watrous, Inc.
G. Automatic Device Co.
H. Belton Manufacturing Corp.
I. Clicheze Corporation (Basis of Design).
J. Substitutions: Under provisions of Section 01 25 00.

2.2  TRACK MATERIALS

A. Track: Extruded aluminum sections, one piece per cubicle track run.
B. Track Ends: Positive stop to fit track extrusion.
C. Attachment Clips: Per manufacturers.
D. Carriers: Nylon roller to accurately fit track, designed to eliminate bind when curtain is pulled, and fitted to curtain to prevent accidental curtain removal.

2.3  CURTAIN MATERIALS

A. Curtain: 100% polyester, closely woven, anti-bacterial, self deodorizing, sanitized, flame-proofed to requirements of NFPA Standard 701. Color: Refer to Drawings.

2.4  FINISHING

A. Exposed Aluminum Surfaces: Clear anodized aluminum.

2.5  FABRICATION

A. Manufacture curtains of one OR two piece(s), sized 10 percent wider than track length. Terminate cubicle curtain 1 inch from floor; Refer to drawings for curtains of one or two pieces.
B. Curtain heading of triple thickness 2 inches wide, with grommeted holes for carriers 6 inches on center, double fold bottom hem 2 inches wide included lead weights. Lockstitch seams in two rows. Turn seam edges and lockstitch.

C. Fabricate track bend with minimum 12-inch radius, without deforming track section, or impeding movement of carriers.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that surfaces and above ceiling supports are ready to receive work.

B. Verify field measurements are as shown on Drawings.

C. Beginning of installation means installer accepts existing surfaces and conditions.

3.2 INSTALLATION

A. Install curtain track secure and rigid, true to ceiling line.

B. Attach track to ceiling grid with attachment clips at 2'-0" o.c.

C. Install end cap and stop devices.

D. Install curtains on carriers ensuring smooth operation.

END OF SECTION
SECTION 10 28 00
TOILET ACCESSORIES

PART 1  GENERAL

1.1  SECTION INCLUDES

A. Toilet accessories.
B. Attachment hardware.

1.2  PRODUCTS FURNISHED BUT NOT INSTALLED UNDER THIS SECTION

A. Section 09 21 16 - Gypsum Board Assemblies: Installation of concealed anchor devices.

1.3  RELATED SECTIONS

A. Section 09 21 16 - Gypsum Board Assemblies: In-wall framing and plates for support of accessories.

1.4  REFERENCES

B. ANSI/ASTM A123 - Zinc (Hot-Dip Galvanized) Coatings on Products Fabricated from Rolled, Pressed, and Forged Steel Shapes, Plates, Bars and Strips.
D. ANSI/ASTM A386 - Zinc Coating (Hot-Dip) on Assembled Steel Products.
F. ASTM A167 - Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet and Strip.
G. ASTM A269 - Seamless and Welded Austenitic Stainless Steel Tubing for General Service.
H. NEMA LD-3 - High Pressure Decorative Laminates.

1.5  SUBMITTALS

A. Submit product data under provisions of Section 01 33 23.
B. Provide product data on accessories describing size, finish, details of function, attachment methods.
C. Submit manufacturer's installation instructions under provisions of Section 01 33 23.
1.6  KEYING
   A. Supply two keys for each accessory to Owner.
   B. Master key all accessories.

1.7  REGULATORY REQUIREMENTS

1.8  SEQUENCING AND SCHEDULING
   A. Coordinate the work of this Section with the placement of internal wall reinforcement and reinforcement of toilet partitions to receive anchor attachments.

PART 2  PRODUCTS

2.1  MANUFACTURERS
   A. Bobrick Washroom Equipment.
   B. Bradley Corporation.
   C. Gamco Equipment.
   D. Substitutions: Under provisions of Section 01 25 00.

2.2  MATERIALS
   B. Stainless Steel Sheet: ASTM A167, Type 304.
   C. Fasteners, Screws, and Bolts: Hot dip galvanized, security type.
   D. Tubing: ASTM A269, stainless steel.
   E. Adhesive: Two component epoxy type, Contact type, waterproof.
   F. Expansion Shields: Fiber, lead, or rubber as recommended by accessory manufacturer for component and substrate.

2.3  FABRICATION
   A. Weld and grind smooth joints of fabricated components.
   B. Form exposed surfaces from single sheet of stock, free of joints.
   C. Form surfaces flat without distortion. Maintain flat surfaces without scratches or dents.
   D. Back paint components where contact is made with building finishes to prevent electrolysis.
   E. Shop assemble components and package complete with anchors and fittings.
F. Provide steel anchor plates, adapters, and anchor components for installation.

G. Hot dip galvanize exposed and painted ferrous metal and fastening devices.

2.4 FACTORY FINISHING

A. Galvanizing: ANSI/ASTM A123 to 1.25 oz/sq yd.

B. Shop Primed Ferrous Metals: Pretreat and clean, spray apply one coat primer and bake.

C. Chrome/Nickel Plating: ANSI/ASTM B456, Type SC 2 satin finish.

D. Stainless Steel: No. 4 satin luster finish.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that site conditions are ready to receive Work of this Section.

B. Beginning of installation means acceptance of existing conditions, substrate.

3.2 PREPARATION

A. Deliver inserts and rough-in frames to site at appropriate time for building-in.

B. Provide templates and rough-in measurements as required.

C. Verify exact location of accessories for installation.

3.3 INSTALLATION

A. Install fixtures, accessories and items in accordance with manufacturers' instructions.

B. Install plumb and level, securely and rigidly anchored to substrate.

3.4 SCHEDULE

A. Sanitary Napkin Dispenser: Fabricate cabinet of satin stainless steel, minimum 0.05 inch (18 gauge) thick, all welded construction. Provide door of seamless satin stainless steel, minimum 0.05 inch (18 gauge) thick, with returned edges and equipped with tumbler lockset. Provide identification reading “tampons” and “napkins” at coin slots; brand name advertising not allowed. Capacity not less than 15 napkins and 20 tampons.

1. Mounting:

2. Operation: Convertible free/twenty-five cent single coin operation, with locked coin box keyed separately from door and other accessory units.

B. Partition Mounted Sanitary Napkin Disposal Units: Fabricate of Type 304 satin stainless steel, 18 gauge, for mounting to toilet partition, self-closing door, and removable stainless steel receptacle of all welded construction. No. B-354.

C. Surface Mounted Sanitary Napkin Disposal Unit: Fabricate of
Type 304 satin stainless steel, 18 gauge, for nominal 4-inch wall depth, cover secured with piano hinge, radiused corners, all welded construction. No. B-2706.

D. Grab Bar: Type 304 polished stainless steel, 18 gauge, 1-1/4 inch o.d., ends welded to flanges; distance to finished wall: 1-1/2 inches; with concealed mounting plates firmly attached to sustain loads in excess of 900 lbs. and complying with ADAAG requirements. Lengths as shown on drawings.

E. Roll Toilet Tissue Dispenser, Compact Side by Side, Owner Furnished, Owner Installed: Georgia Pacific, #56784. Provide this dispenser at all toilets.

F. Robe Hooks
1. Double Prong Hook. Bobrick B-672, satin finish. To be surface mounted at back of door at each stall. Mount them at accessible height in compliance with ANSI – A 117.1

G. Wall-Mounted Baby Changing Station: Bobrick KB200-SS. Polypropylene cabinet and bed with stainless steel veneer; color – Grey.

H. Surface-Mounted Seat-Cover Dispenser: Bobrick B-221 type 304, 22gauge stainless steel with all welded construction. Exposed surfaces shall have satin finish. Dispenser shall have a concealed opening in bottom for filling. It shall hold 250 paper toilet seat covers in one box. It shall be mounted meeting accessibility requirements as indicated per drawings.

END OF SECTION
PART 1 GENERAL

1.1 SECTION INCLUDES

A. Manually operated roller shades.

1.2 RELATED SECTIONS

A. Section 09 21 16 – Gypsum Board Assemblies.
B. Section 09 51 13 – Acoustical Panel Ceilings.

1.3 SUBMITTALS

A. Submit under provisions of Section 01 33 00.
B. Product Data: Provide data indicating physical and dimensional characteristics, and operating features.
C. Samples: Submit two samples each, illustrating blade materials, finish, and color; cord and bead chain type and color; valance type and color.
D. Manufacturer’s Installation Instructions: Indicate special procedures, perimeter conditions requiring special attention, attachment details.

1.4 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the products specified in this section with minimum three years experience.

1.5 FIELD MEASUREMENTS

A. Verify that field measurements are as indicated on shop drawings.

1.6 COORDINATION

A. Coordinate work under provisions of Section 01 31 13.
B. Install the work after window, ceiling, and painting work is completed in rooms scheduled to receive work of this section.

1.7 EXTRA MATERIALS

A. Provide under provisions of Section 01 78 43.
B. Provide ten (10) additional blades of each color of the longest length.
C. Provide three (3) extra control cords and bead chains.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver components in factory-labeled packages, marked with manufacturer and product name, fire-test-response characteristics, and location of installation using same room designations indicated on Drawings and in the Window Treatment Schedule.
1.9 WARRANTY

A. Warranty: Provide manufacturer’s standard warranties, including the following:
1. Roller Shade Hardware, and Shadecloth: Manufacturer’s standard non-depreciating twenty-five year limited warranty.
   a. Standard non-depreciating 10-year limited warranty.
2. Roller Shade Installation: One year from date of Substantial Completion.

PART 2 PRODUCTS

2.1 MANUFACTURER

A. MechoSystems: EuroTwill Reversible Weave – 6000 Series; 3% open.


2.2 SHADE BANDS

A. Shade Bands: Construction of shade band includes the fabric, the enclosed hem weight, shade roller tube, and the attachment of the shade band to the roller tube. Sewn hems and open hem pockets are not acceptable.
1. Concealed Hembar: Shall be continuous extruded aluminum for entire width of shade band and with the following characteristics:
   a. Hembar shall be heat sealed on all sides.
   b. Open ends shall not be accepted.
2. Shade Band and Shade Roller Attachment:
   a. Use extruded aluminum shade roller tube of a diameter and wall thickness required to support shade fabric without excessive deflection.
   b. Provide for positive mechanical attachment of shade band to roller tube; shade band shall be made removable / replaceable with a “snap-on” snap-off” spline mounting, without having to remove shade roller from shade brackets.
   c. Mounting Spline shall not require use of adhesives, adhesive tapes, staples, and/or rivets.
   d. Any method of attaching shade band to roller tube that requires the use of: adhesive, adhesive tapes, staples, and/or rivets, does not meet the performance requirements of this specification and shall not be accepted.

2.3 ROLLER SHADE FABRICATION

A. Fabricate shade cloth to hang flat without buckling or distortion. Fabricate with heat-sealed trimmed edges to hang straight without curling or raveling. Fabricate unguided shadecloth to roll true and straight without shifting sideways more than 1/8 inch in either direction per 8 feet of shade height due to warp distortion or weave design.

B. Provide battens in standard shades as required to assure proper tracking and uniform rolling of the shade bands. Contractor shall be responsible for assuring the width-to-height (W:H) ratios shall not exceed manufacturer’s standards or, in absence of such standards, shall be responsible for establishing appropriate standards to assure proper tracking and rolling of the shadecloth within specified standards. Battens shall be roll-formed stainless steel or tempered steel, as required.

C. For railroaded shade bands, provide seams in railroaded multi-width shade bands as required to meet size requirements and in accordance with seam alignment as acceptable to Architect. Seams shall be properly located. Furnish battens in place of plain seams when the width, height, or weight of the shade exceeds manufacturer’s standards. In absence of such standards, assure proper use of seams or battens as required to, and assure the proper tracking of the railroaded multi-width shade bands.
D. Provide battens for railroaded shades when width-to-height (W:H) ratios meet or exceed manufacturer’s standards. In absence of manufacturer’s standards, be responsible for proper use and placement of battens to assure proper tracking and roll of shade bands.

E. Blackout shade bands, when used in side channels, shall have horizontally mounted, roll-formed stainless steel or tempered-steel battens not more than 3 feet on center extending fully into the side channels. Battens shall be concealed in an integrally colored fabric to match the inside and outside colors of the shade band, in accordance with manufacturer’s published standards for spacing and requirements.
1. Battens shall be roll formed of stainless steel or tempered steel and concave to match the contour of the roller tube.

2.4 ROLLER SHADE COMPONENTS

A. Access and Material Requirements:
1. Provide shade hardware allowing for the removal of shade roller tube from brackets without removing hardware from opening and without requiring end or center supports to be removed.
2. Provide shade hardware that allows for removal and re-mounting of the shade bands without having to remove the shade tube, drive, or operating support brackets.
3. Use only Delran engineered plastics by DuPont for all plastic components of shade hardware. Styrene based plastics, and/or polyester, or reinforced polyester shall not be accepted.

B. Manual Operated Chain Drive Hardware and Brackets:
1. Provide for universal, regular, and offset drive capacity, allowing drive chain to fall at front, rear or non-offset for all shade drive end brackets. Universal offset shall be adjustable for future change.
2. Provide hardware capable for installation of a removable fascia, for both regular and/or reverse roll, which shall be installed without exposed fastening devices of any kind.
3. Provide shade hardware system that allows for removable regular and/or reverse roll fascias to be mounted continuously across two or more shade bands without requiring exposed fasteners of any kind.
4. Provide shade hardware system that allows for operation of multiple shade bands (multi-banded shades) by a single chain operator, subject to manufacturer’s design criteria. Connectors shall be offset to assure alignment from the first to the last shade band.
5. Provide shade hardware system that allows multi-banded manually operated shades to be capable of smooth operation when the axis is offset a maximum of 6 degrees on each side of the plane perpendicular to the radial line of the curve, for a 12 degrees total offset.
6. Provide positive mechanical engagement of drive mechanism to shade roller tube. Friction fit connectors for drive mechanism connection to shade roller tube are not acceptable.
7. Provide shade hardware constructed of minimum 1/8-inch thick plated steel or heavier as required to support 150 percent of the full weight of each shade.
8. Drive Bracket / Brake Assembly:
   a. MechoShade Drive Bracket model M5 shall be fully integrated with all MechoShade accessories, including, but not limited to: SnapLoc fascia, room darkening side / sill channels, center supports and connectors for multi-banded shades.
   b. M5 drive sprocket and brake assembly shall rotate and be supported on a welded 3/8-inch steel pin.
   c. The brake shall be an over running clutch design which disengages to 90 percent during the raising and lowering of a shade. The brake shall withstand a pull force of 50 lbs. in the stopped position.
d. The braking mechanism shall be applied to an oil-impregnated hub on to which the brake system is mounted. The oil impregnated hub design includes an articulated brake assembly, which assures a smooth, non-jerky operation in raising and lowering the shades. The assembly shall be permanently lubricated. Products that require externally applied lubrication and or not permanently lubricated are not acceptable.

e. The entire M5 assembly shall be fully mounted on the steel support bracket, and fully independent of the shade tube assembly, which may be removed and reinstalled without effecting the roller shade limit adjustments.

9. Drive Chain: #10 qualified stainless steel chain rated to 90 lb. minimum breaking strength. Nickel plate chain shall not be accepted.

2.5 SHADECLOTH

A. Visually Transparent Single-Fabric Shadecloth: MechoSystems, EuroTwill 6000 Series: 0.010 diameter, Opaque, non-raveling vinyl-polyester yarn, fabric thickness 0.025 inches.
   1. Extra Dense Twill Weave 6000 Series, 3% open.
   2. Color. Per Finish Materials Schedule (Refer to Set of Documents).

B. Fascia:
   1. Continuous removable extruded aluminum fascia that attaches to shade mounting brackets without the use of adhesives, magnetic strips, or exposed fasteners.
   2. Fascia shall be able to be installed across two or more shade bands in one piece.
   3. Fascia shall fully conceal brackets, shade roller and fabric on the tube.
   4. Provide bracket / fascia end caps where mounting conditions expose outside of roller shade brackets.

C. Room Darkening Side and Sill Channels:
   1. Extruded aluminum with polybond edge seals and SnapLoc-mounting brackets and with concealed fastening. Exposed fastening is not acceptable. Channels shall accept one-piece exposed blackout hembar with vinyl seal to assure side light control and sill light control.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that openings are ready to receive the work.

B. Coordinate with other trades for securing tracks to substrates and other finished surfaces.

3.2 INSTALLATION

A. In rooms with markerboard or tackboards, do not install cords over markerboards and tackboards.

B. Install blinds in accordance with manufacturer's instructions.

C. Securely anchor units with clips, brackets, and anchorages suited to type of substrate.

D. Install valance to conceal head track and mounting hardware.

E. Blinds to be installed where scheduled.
3.3 ADJUSTING

A. Adjust work to permit unencumbered operation of hardware.

B. Adjust shades for smooth operation.

3.4 CLEANING

A. Clean work under provisions of 01 74 23.

B. Clean blind surfaces just prior to occupancy.

END OF SECTION
PART 1  GENERAL

1.1  SECTION INCLUDES
A. Special fabricated cabinet units.
B. Cabinet hardware.

1.2  RELATED SECTIONS
A. Section 06 20 00 - Finish Carpentry.
B. Section 07 90 00 - Joint Protection.
C. Section 09 21 16 - Gypsum Board Assemblies.

1.3  REFERENCES
A. ANSI/BHMA A156.9 - Cabinet Hardware.
B. AWI - Quality Standards.
D. FS MMM-A-130 - Adhesive, Contact.
E. ADA Guidelines.
F. PS 51 - Hardware and Decorative Plywood.
G. PS 58 - Basic Hardwood.

1.4  SUBMITTALS
A. Submit under provisions of Section 01 33 00.
B. Shop Drawings: Indicate materials, component profiles and elevations, assembly methods, joint details, fastening methods, accessory listings, hardware location, location of plumbing and electrical service connections, and schedule of finishes; 3/4" = 1'-0" at details and 1/4" = 1'-0" at plans and elevations.
C. Product Data: Manufacturer’s catalog with specifications and construction details.
D. Samples: Submit two samples illustrating each scheduled cabinet finish.
E. Samples: Submit eight samples illustrating each scheduled plastic laminate finish and PVC edging.
F. Samples: Submit two samples of pulls, hinges and locks, illustrating hardware finish.
1.5 QUALITY ASSURANCE
   A. Perform work in accordance with AWI Premium quality.
   B. Provide laminate clad casework and countertops furnished by the same supplier for single responsibility and integration with other building trades.
   C. Manufacturers shall show evidence of at least five (5) years experience and installations for similar types of projects.
   D. Casework must conform to design quality of materials, workmanship and function of casework specified and shown on drawings.

1.6 QUALIFICATIONS
   A. Manufacturer: Company specializing in manufacturing the products specified in this section with minimum five years documented experience.

1.7 DELIVERY, STORAGE, AND HANDLING
   A. Deliver, store and handle products to site under at time of installation to avoid damage.
   B. Protect units from moisture damage.
   C. Deliver laminate clad casework only after wet operations in building are completed.
   D. Store completed laminate clad casework and countertops in a ventilated place, protected from the weather, with relative humidity range of 20% to 50%.
   E. Protect finished surfaces from soiling and damage during handling and installation. Keep covered with a protective covering.

1.8 FIELD MEASUREMENTS
   A. Verify that field measurements are as indicated on shop drawings.

1.9 COORDINATION
   A. Coordinate work under provisions of Section 01 31 13.
   B. Material supplier shall attend Pre-Installation Meeting with General Contractor to coordinate delivery and installation.
   C. Coordinate the submittals and fabrication work with construction schedule to avoid delays. Present the schedule required for this work as part of the shop drawings submittal.

1.10 WARRANTY
   A. All materials and workmanship will carry a five (5) year warranty.
PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS:

A. Anderson.
B. Caseworx, Inc.
C. Classy.
D. Form-A-Fab.
E. Granite Mill.
F. LSI Corporation of America, Inc.
G. Stevens Industries.
H. TMI Systems Design Corporation.
I. Valley Custom Interiors.
J. Western Casework.
K. Substitutions: Under provisions of Section 01 25 00.

NOTE:

1. For purpose of determining quality and performance requirements, this specification is based on TRIMLINE built-in casework systems by TMI SYSTEMS DESIGN CORPORATION, 50 South Third Avenue West, Dickinson, North Dakota 58601.
2. Storage systems are fully modular and dimensionally integrated to allow end user interchange of doors, and interior components; products that do not have this standard feature/benefit will not be considered.

2.2 MATERIALS:

A. Definitions: Identification of casework parts by surface visibility.

1. Unit Body Open Interiors: Any storage unit surface without solid door fronts.
2. Unit Body Closed Interiors: Any storage unit surface behind solid door fronts.
3. Unit Body Exposed Side: Any storage unit exterior side surface that is visible after installation.
4. Concealed Surfaces: Any surface not normally visible after installation.

B. Core Materials:

1. Particleboard up to 7/8 Inch Thick: Minimum density 47 lb. industrial grade western particleboard of fir or pine, ANSI A 208 1-1999, M-3 requirements.
2. Particleboard 1” Thick or More: Industrial grade 45 lb. density particleboard of fir or pine, ANSI A208 1-1999, M-2 requirements.
3. Hardboard: Prefinished hardboard in 1/4” thickness meeting or exceeding commercial standards CS-251.

C. Decorative Laminates - As manufactured by Arborite Plus, Formica, Nevamar, Pionite, or Wilsonart:

1. High pressure decorative laminate HGS (.048), NEMA Test LD-3 - 2005.
2. High pressure decorative laminate HGP (.039), NEMA Test LD-3 - 2005.
3. High pressure decorative laminate VGS (.028), NEMA Test LD-3 - 2005.
5. Mélamine laminate tested to meet NEMA Test LD-3 - 2005.
6. High pressure backer BKH (.048), (.039), (.028), NEMA Test LD-3-2005.
D. Laminate Color Selection:
1. Colors shall be selected from manufacturer's standard solid and pattern offering. Colors as selected per architect.
2. Colors for cabinet surfaces grade GP28 shall be selected from manufacturer's standard and pattern selection.
3. Melamine Color: As selected per architect.

E. Plastic Edging for Components of Unit Body Casework and Shelving:
1. 1mm PVC banding machine applied with waterproof hot melt adhesive.
2. PVC Color: Match Laminate color.

F. Metal Parts:
1. Countertop support brackets shall be as specified in Section 05 50 00, Legs and other metal parts shall be stainless steel.

2.3 CABINET HARDWARE:

A. Hinges:
1. Paragraph 2.4, A, 1, revised to "Frameless Concealed Hinges (European Type): BHMA A156.9, B01602, 135 degrees of opening, self-closing. Minimum five (5) hinges per door or one per each additional 18 inches of height.

B. Pulls:
1. Door and drawer fronts shall be U-shaped pull, 4-inch long, stainless steel with satin finish. Conform to ADA requirements.

C. Adjustable Shelf Supports:
1. Shall be injection molded polycarbonate, clear color to blend with selected interior finish, friction fit into cabinet end panels and vertical dividers, readily adjustable on 32mm (approximately 1-1/4") centers. Each shelf support shall have two (2) integral support pins, 5mm diameter, to interface pre-drilled holes, and to prevent accidental rotation of support. The supports shall be automatically adaptable to 1" or 1-1/4" thick shelving and shall provide non-tip feature for shelving. Supports are designed to readily permit field fixing of shelf if desired. Structural load to 1200 lbs. (300 lbs. per support) without failure.

E. Locks:
1. Five-pin tumbler, cam style lock with strike. Lock for sliding 3/4 inch thick doors is National #M2-3708-157 lock, National #M2-3709-100 strike and National #M5-0057-110 escutcheon plunger lock with strike.
2. Elbow catch or chain bolt used to secure inactive door on all locked cabinets.

F. Cabinet Movement Seismic Restraint: 2012 IBC Code with South Nevada Amendments, AWI, ASCE 7 Compliant.

2.4 FABRICATION:

A. Fabricate laminate clad casework to dimensions, profiles, and details shown.

B. Cabinet Joinery:
1. Tops and bottoms shall be joined to cabinet ends using a minimum of six (6) dowels at each joint for eighteen (18) to twenty-four (24) inch deep cabinets. All dowels are to be industrial grade hardwood laterally fluted, with chamfered ends and a minimum diameter of ten (10) millimeters. Internal cabinet components such as fixed horizontals, rails and verticals are to be doweled in place. Dowels are to be securely glued and cabinets clamped under pressure during assembly to assure secure joints and cabinet squareness.

C. Unit Door:
1. Shall be 3/4-inch thick particleboard and laminated with high pressure decorative laminate VGS color specified for the exposed surface and high pressure laminate cabinet liner CLS on the interior surface to match melamine.
2. All edges shall be finished with 1mm PVC.
3. Double doors shall be used on all cabinets in excess of 24 inches in width.

D. Unit Body Closed Interiors:
1. Exposed cabinet sides shall be 3/4-inch thick particleboard laminated on the exterior with high pressure decorative laminate VGS in color as selected per architect with high pressure cabinet liner CLS to match melamine color. The front edge shall be edgebanded with 1mm PVC.
2. Unexposed cabinet sides shall be 3/4-inch thick particleboard laminated both sides with melamine. The front edge shall be edgebanded with 1mm PVC.
3. Unit top or subtop shall be 3/4-inch thick particleboard laminated both sides with melamine and front edge with 1mm PVC. All subtops shall be full depth.
4. Bottom of base units shall be 3/4-inch thick particleboard laminated both sides with melamine and front edged with 1mm PVC.
5. Fixed intermediates shall be 1 1/4-inch thick particleboard laminated both sides with melamine and front edged with 1mm PVC. An intermediate will be provided on all units over 36 inches wide.
6. Unit backs shall be 1/2-inch thick prefinished hardboard. Color to match interior. Exposed back on cabinet to be 3/4-inch thick particleboard laminated with CLS on the interior to match melamine color and VGS on the exterior as selected.
7. Adjustable shelves shall be 1-inch thick particleboard up to 30 inches wide and 1-1/4 inch thick particleboard over 30 inches wide, laminated both sides with melamine.
8. Shelves shall be edged front edge only with 1mm PVC.

E. Bases:
1. All base and tall units shall have an integral base. Rubber vinyl base covering will be furnished and applied by the General Contractor.

PART 3 EXECUTION

3.1 INSPECTION
A. The installer must examine the job-site and the conditions under which the work under this section is to be performed, and notify the contractor in writing of unsatisfactory conditions. Do not proceed with work under this section until unsatisfactory conditions have been corrected in a manner acceptable to the installer.

3.2 PREPARATION
A. Condition laminate clad casework to average prevailing humidity conditions in installation areas prior to installing.

3.3 INSTALLATION
A. Install casework with factory-trained supervision authorized by manufacturer. Erect casework, plumb, level, true and straight with no distortions. Shim as required. Where laminate clad casework abuts other finished work, scribe and cut to accurate fit.
B. Adjust casework and hardware so that doors and drawers operate smoothly without warp or bind. Lubricate operating hardware as recommended by manufacturer.
3.4 CLEANING AND PROTECTION

A. Repair or remove and replace defective work as directed upon completion of installation.

B. Clean plastic surfaces, repair minor damage per plastic laminate manufacturer's recommendations. Replace other damaged parts or units.

C. Advise contractor of procedures and precautions for protection of casework from damage by other trades until acceptance of the work by the architect and owner at the time of substantial completion.

END OF SECTION
PART 1  GENERAL

1.1  SECTION INCLUDES

A. Solid surfacing countertops.

1.2  RELATED SECTIONS

A. Section 07 90 00 - Joint Protection.
B. Electrical - See Electrical Drawings.

1.3  REFERENCES


1.4  SUBMITTALSP

A. Product Data: For each type of product specified. Indicate product description, fabrication information, and compliance with specified performance requirements.
B. Shop Drawings:
   1. Show location of each item, dimensioned plans and elevations, large-scale details, attachment devices and other components drawn accurately to scale. Show the following:
      a. Full-size details, edge details, attachments, etc.
      b. Locations and sizes of furring, blocking, including concealed blocking and reinforcement specified in other Sections.
      c. Locations and sizes of cutouts and holes for electrical grommets and other items installed in quartz surface.
      d. Seam locations.
C. Samples: Two (2) samples of each specified material, minimum 6” x 6” in size, illustrating color, texture and finish.
D. Maintenance and care data including repair and cleaning instructions.
E. Maintenance kit for finishes per Section 01 78 43.

1.5  QUALITY ASSURANCE

A. Qualifications: Shop that employs skilled workers who custom fabricate products similar to those required for this project and whose products have a record of successful in-service performance.
B. Fabricator/Installer Qualifications: Work of this Section shall be by a certified fabricator/installer, certified in writing by the manufacturer.
1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver no components to project site until areas are ready for installation.

B. Store components indoors prior to installation.

C. Handle materials to prevent damage to finished surfaces.
   1. Provide protective coverings to prevent physical damage or staining following installation for duration of project.

1.7 WARRANTY

A. Provide manufacturer’s 10-year warranty against defects in materials.
   1. Warranty shall provide material to repair or replace defective materials.

PART 2 PRODUCTS

2.1 MANUFACTURER (SOLID SURFACING)

A. DuPont.

B. Samsung.

C. Substitutions: Submit to Architect for approval.

2.2 MATERIALS

A. Solid Surfaces: Solid Polymer components. Cast, nonporous, filled polymer, not coated, laminated or of composite construction with through body colors meeting ANSI Z124.3 or ANSI Z124.6, having minimum physical and performance properties specified.

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<td>Tensile Modulus</td>
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Izod Impact 0.28 ft.-lbs./in. of notch Method 3.6
(Notched Specimen) ASTM D256
Ball Impact No fracture – ½ lb. ball: NEMA LD 3-2000
Resistance: Sheets ½" slab – 36" drop Method 3.8
  ⅛" slab – 144" drop
Weatherability ΔE*94<5 in 1,000 hours ASTM G155
Specific Gravity: 1.7
Water Absorption Long-term ASTM D570
  0.4% (3/4")
  0.6% (1/2")
  0.8% (1/4")
Toxicity 99 (solid colors) Pittsburgh Protocol
  66 (patterned colors) Test ("LC50" Test)
Flammability All colors ASTM E84,
  (Class I and Class A) NFPA 255 and
  UL 723
Flame Spread Index <25
Smoke Developed Index <450

† Approximate weight per square foot: ¼" 2.2 lbs., ½" 4.4 lbs.

2. Thickness 1-1/8"; feather miter edge; or equal.
3. Color: As specified on drawings.

B. Joint Adhesive: As approved by manufacturer, to match solid surfacing color.

2.5 FABRICATION

A. Fabricate components to greatest extent practical to sizes and shapes indicated, in accordance with approved shop drawings and manufacturer’s printed instructions and technical bulletins.

B. Form joints between components using manufacturer’s standard joint adhesive joints. Reinforce as required.

C. Provide factory cutouts for plumbing fittings and bath accessories as indicated on the drawings.

D. Rout and finish component edges.
   1. Rout cutouts, radii and contours to template.
   2. Smooth radius edges.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install components plumb and level, in accordance with approved shop drawings and product installation details.
   1. Tops:
      a. Flat and true to within 1/8" of a flat surface over a 10’ length.
      b. Allow a minimum of 1/16” to a maximum of 1/8” clearance between surface and each wall.

B. Form field joints using manufacturer’s recommended adhesive, with joint widths no greater than 1/8” in finished work.
C. Provide backsplashes and endsplashes as indicated on the drawings.
   1. Adhere to countertops using manufacturer’s standard color-matched silicone sealant.

D. Keep components and hands clean during installation.
   1. Remove adhesives, sealants and other stains.
   2. Components shall be clean on date of substantial completion.

3.2 CLEANING AND PROTECTION

A. Keep components clean during installation.

B. Remove adhesives, sealants and other stains.

C. Protect surfaces from damage until date of substantial completion.

D. Replace damaged work.

END OF SECTION
DIVISION 22 – PLUMBING
22 05 00. ................................................................................................................ Plumbing General Requirements
22 11 16. ................................................................................................................ Domestic Water Piping
22 11 19. ................................................................................................................ Domestic Water Piping Specialties
22 13 16. .................................................................................................................. Sanitary Waste and Vent Piping
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DIVISION 23 – HEATING, VENTILATING AND AIR CONDITIONING (HVAC)
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END OF SPECIFICATION INDEX
PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. 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. Grout.
   8. Equipment installation requirements common to equipment sections.

1.03 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

C. 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.

F. “Provide” and “Install” means item with all appurtenances, shall be furnished and installed by contractor unless otherwise is directed in the drawings.

G. Examples include installations within unheated shelters.
1.04 SUBMITTALS

A. Product Data: For the following:
   1. Transition fittings.
   2. Dielectric fittings.
   3. Mechanical sleeve seals.
   4. Escutcheons.

B. Welding certificates.

1.05 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.

D. Submit shop drawings and product data grouped to include complete submittals of related systems, Products, and accessories in a single submittal.

E. Mark dimensions and values in units to match those specified.

F. Submit miscellaneous items specified on the drawings but not covered in the specifications. Make no substitutions without prior approval from the Engineer.

1.06 REGULATORY REQUIREMENTS

A. Requirements of Regulatory Agencies:
   1. ASME Boiler Pressure Vessel Codes, Section VII, Pressure Vessels; Section IX, Welding Qualifications.
   2. ASHRAE.
   3. UL Publications.
   4. ASTM.
   5. ANSI B31.1, "Code for Pressure Piping."
   6. TEMA.
   7. OSHA.
   8. EPA.
   9. ARI.
   10. NFPA.
   11. UMC.
   12. UPC.
   13. IBC

1.07 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.

1.08 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 "Access Doors and Frames."

PART 2 - PRODUCTS

2.01 MATERIALS AND EQUIPMENT

A. Deliver products in the manufacturer's original unopened, labeled containers and adequately protect against moisture, tampering or damage from improper handling or storage. Do not deliver materials to the job before they are ready for installation, unless adequate security is provided.

B. UNLV P.M. may require removal from the premises of such material or Work that in his opinion is not in accordance with Contract Documents. He may also require substitution, without delay, of unsatisfactory Work.

C. Repair and refinish work damaged by the Work of this Division, to UNLV P.M.'s satisfaction. Obtain finishing materials from equipment manufacturer.

2.02 MANUFACTURERS (All pipe and accessories shall be manufactured in the U.S.A.).

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.

2.03 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.

2.04 JOINING MATERIALS

A. Refer to individual Division 22 piping Sections for special joining materials not listed below.

B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of
piping system contents.
1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
   a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
   b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
2. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.

C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

D. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.

E. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

F. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.

G. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

H. 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.

I. Fiberglass Pipe Adhesive: As furnished or recommended by pipe manufacturer.

2.05 TRANSITION FITTINGS

A. AWWA Transition Couplings: Same size as, and with pressure rating at least equal to and with ends compatible with, piping to be joined.
   1. Manufacturers:
      b. Dresser Industries, Inc.; DMD Div.
      c. Ford Meter Box Company, Incorporated (The); Pipe Products Div.
      d. JCM Industries.
      e. Smith-Blair, Inc.
      f. Viking Johnson.
   2. Underground Piping NPS 1-1/2 inches and Smaller: Manufactured fitting or coupling.
   4. Aboveground Pressure Piping: Pipe fitting.

B. Plastic-to-Metal Transition Fittings: CPVC and PVC one-piece fitting with manufacturer’s Schedule 80 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.
   1. Manufacturers:
      a. Eslon Thermoplastics.

2.06 DIELECTRIC FITTINGS
A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.

B. Insulating Material: Suitable for system fluid, pressure, and temperature.

C. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig minimum working pressure at 180 deg F.
   1. Manufacturers:
      a. Capitol Manufacturing Co.
      b. Eclipse, Inc.
      c. Epco Sales, Inc.
      e. Watts Industries, Inc.; Water Products Div.
      f. Zurn Industries, Inc.; Wilkins Div.

D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig minimum working pressure as required to suit system pressures.
   1. Manufacturers:
      a. Capitol Manufacturing Co.
      b. Epco Sales, Inc.

E. Dielectric-Flange Kits: Companion-flange assembly for field assembly. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.
   1. Manufacturers:
      a. Advance Products & Systems, Inc.
      b. Calpico, Inc.
      c. Central Plastics Company.
      d. Pipeline Seal and Insulator, Inc.
   1. Separate companion flanges and steel bolts and nuts shall have 150- or 300-psig minimum working pressure where required to suit system pressures.

F. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.
   1. Manufacturers:
      a. Calpico, Inc.
      b. Lochinvar Corp.

G. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 deg F.
   1. Manufacturers:
      a. Perfection Corp.
      b. Precision Plumbing Products, Inc.
      c. Sioux Chief Manufacturing Co., Inc.
      d. Victaulic Co. of America.

2.07 MECHANICAL SLEEVE SEALS

A. Description: Modular sealing element unit, designed for field assembly, to fill
annular space between pipe and sleeve.

1. Manufacturers:
   a. Thunderline.

2. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.

3. Pressure Plates: Include two for each sealing element.

4. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.08 SLEEVES

A. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.

C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
   1. Underdeck Clamp: Clamping ring with set screws.

2.09 ESCUTCHEONS

A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.

B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.

C. One-Piece, Cast-Brass Type: With set screw.
   1. Finish: Polished chrome-plated.

D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.
   1. Finish: Polished chrome-plated.

E. One-Piece, Floor-Plate Type: Cast-iron floor plate.

F. Split-Casting, Floor-Plate Type: Cast brass with concealed hinge and set screw.

2.10 GROUT

A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.
   2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION
3.01 EXCAVATION AND BACKFILL

A. General: Excavation and backfill, if required to install the Work specified in this Division shall be performed in compliance with the following requirements.

B. Excavation: Bury piping outside the building to a depth of not less than 2'-6" below finish grade unless noted otherwise.

C. Backfilling: Do not backfill until final inspection and approval for the piping installation by the UNLV Inspection Services.

3.02 PIPING SYSTEMS - COMMON REQUIREMENTS

A. Install piping according to the following requirements and Division 22 Sections specifying piping systems.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

F. Install piping to permit valve servicing.

G. Install piping at indicated slopes.

H. Install piping free of sags and bends.

I. Install fittings for changes in direction and branch connections.

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. Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish.
      c. Insulated Piping: One-piece, stamped-steel type with spring clips.
      d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
      e. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece or split-casting, cast-brass type with polished chrome-plated finish.
f. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge and set screw.

g. Bare Piping in Unfinished Service Spaces: One-piece, stamped-steel type with concealed hinge and set screw or spring clips.

h. Bare Piping in Equipment Rooms: One-piece, cast-brass type.

M. Sleeves are not required for core-drilled holes.

N. Permanent sleeves are not required for holes formed by removable PE sleeves.

O. 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 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 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
      b. Steel Sheet Sleeves: For pipes NPS 6 and larger, penetrating gypsum-board partitions.
      c. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Refer to Division 07 Section "Sheet Metal Flashing and Trim" for flashing.
         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 "Thermal and Moisture Protection" for materials and installation.

P. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
   1. Install steel pipe for sleeves smaller than 6 inches in diameter.
   2. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.
   3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

Q. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
   1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
R. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 Section "Penetration Firestopping" for materials.

S. Verify final equipment locations for roughing-in.

T. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.03 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.


F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

I. 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. ABS Piping: Join according to ASTM D 2235 and ASTM D 2661 Appendixes.
3. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
4. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
5. PVC Nonpressure Piping: Join according to ASTM D 2855.
6. PVC to ABS Nonpressure Transition Fittings: Join according to ASTM D 3138 Appendix.

3.04 PIPING CONNECTIONS
A. Make connections according to the following, unless otherwise indicated:
   1. Install unions, in piping NPS 2 and smaller, at final connection to each piece of equipment.
   2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.
   3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.

3.05 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

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

3.06 MECHANICAL INSTALLATIONS

A. The requirements of this Section apply to all the Work of Division.
B. It is the intention of the Contract Documents including Specifications and Drawings to provide finished Work, tested and ready for operation and complete in every regard. Provide Work not shown or specified and accessories necessary to make the Work shown on the Drawings complete and ready for operation. Should there appear to be discrepancies or questions of intent in the Contract Documents, refer the matter to the UNLV P.M. for his decision. The decision of the UNLV P.M. is final.
C. Drawings are diagrammatic and are intended to convey scope of Work and to indicate general arrangement. They are not intended to show every detail including offset or fitting or every structural difficulty that may be encountered during the Work. Except as otherwise indicated, locations of items are approximate only. Exact locations necessary to secure proper conditions and results must be determined at Project Site and must be approved by the Owner. Do not scale Drawings.
E. Except as otherwise indicated, make only approved modifications in layout as needed to prevent conflict with other Work or for proper execution of Work.
F. Include Work not usually shown or specified, but necessary for proper installation and operation of a system or piece of equipment in Work.

3.07 PAINTING

A. Painting of plumbing systems, equipment, and components is specified in Division 09 Sections "Interior Painting" and "Exterior Painting."
B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.
3.08  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.

3.09  GROUTING

A. Mix and install grout for plumbing equipment base bearing surfaces, pump and other equipment base plates, and anchors.

B. Clean surfaces that will come into contact with grout.

C. Provide forms as required for placement of grout.

D. Avoid air entrapment during placement of grout.

E. Place grout, completely filling equipment bases.

F. Place grout on concrete bases and provide smooth bearing surface for equipment.

G. Place grout around anchors.

H. Cure placed grout.

END OF SECTION
SECTION 22 11 16
DOMESTIC WATER PIPING

PART 1 – GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:

1. Under-building slab and aboveground domestic water pipes, tubes, fittings, and specialties inside the building.
2. Encasement for piping.
4. Flexible connectors.
5. Escutcheons.
6. Sleeves and sleeve seals.
7. Wall penetration systems.

1.03 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Domestic water piping and support and installation shall withstand effects of earthquake motions determined according to the IBC.

1.04 SUBMITTALS

A. Product Data: For the following products:

1. Specialty valves.
2. Transition fittings.
3. Dielectric fittings.
4. Flexible connectors.
5. Backflow preventers.
7. Sleeves and sleeve seals.

1.05 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.

1.06 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided.
1.07 DELIVERY STORAGE AND PROTECTION

A. Division 1 - Material and Equipment: Transport, handle, store, and protect products.

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

2.01 PIPING MATERIALS (all pipe and fitting shall be manufactured in the U.S.A.)

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.

2.02 COPPER TUBE AND FITTINGS

A. Hard Copper Tube: ASTM B 88, Type L water tube, drawn temper.
   4. 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.

B. Soft Copper Tube: ASTM B 88, Type K water tube, annealed temper.

2.03 PIPING JOINING MATERIALS

A. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free, unless otherwise indicated; full-face or ring type unless otherwise indicated.

B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

C. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

D. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.

2.04 ENCASEMENT FOR PIPING

A. Standard: ASTM A 674 or AWWA C105.

B. Form: Sheet or Tube.
C. Material: LLDPE film of 0.008-inch minimum thickness.

D. Color: Black or Natural.

2.05 SPECIALTY VALVES

A. Comply with requirements in Division 22 Section "General-Duty Valves for Plumbing Piping" for general-duty metal valves.

B. Comply with requirements in Division 22 Section "Domestic Water Piping Specialties" for balancing valves, drain valves, backflow preventers, and vacuum breakers.

2.06 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.

2.07 DIELECTRIC FITTINGS

A. General Requirements: Assembly of copper alloy and ferrous materials or ferrous material body with separating nonconductive insulating material suitable for system fluid, pressure, and temperature.

B. Dielectric Unions:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      b. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
      c. Zurn Plumbing Products Group; Wilkins Water Control Products.

   2. Description:
      a. Pressure Rating: 150 psig at 180 deg F.
      b. End Connections: Solder-joint copper alloy and threaded ferrous.

C. Dielectric Flanges:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

   2. Description:
      a. Factory-fabricated, bolted, companion-flange assembly.
      b. Pressure Rating: 150 psig (1035 kPa), 175 psig (1200 kPa) minimum, 300 psig (2070 kPa) as required for the project.
      c. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.
2.08 FLEXIBLE CONNECTORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Flexicraft Industries.
2. Hyspan Precision Products, Inc.
3. Metraflex, Inc.
4. Proco Products, Inc.

B. Bronze-Hose Flexible Connectors: Corrugated-bronze tubing with bronze wire-braid covering and ends brazed to inner tubing.

1. Working-Pressure Rating: Minimum 200 psig, 250 psig as required.
2. End Connections NPS 2 and Smaller: Threaded copper pipe or plain-end copper tube.
3. End Connections NPS 2-1/2 and Larger: Flanged copper alloy.

C. Stainless-Steel-Hose Flexible Connectors: Corrugated-stainless-steel tubing with stainless-steel wire-braid covering and ends welded to inner tubing.

1. Working-Pressure Rating: Minimum 200 psig, 250 psig as required.
2. End Connections NPS 2 and Smaller: Threaded steel-pipe nipple.
3. End Connections NPS 2-1/2 and Larger: Flanged steel nipple.

2.09 ESCUTCHEONS

A. General: Manufactured ceiling, floor, and wall escutcheons and floor plates.

B. One Piece, Cast Brass: Polished, chrome-plated finish with setscrews.


D. Split Casting, Cast Brass: Polished, chrome-plated finish with concealed hinge and setscrew.

E. One-Piece Floor Plates: Cast-iron flange.

F. Split-Casting Floor Plates: Cast brass with concealed hinge.

2.10 SLEEVES

A. Cast-Iron Wall Pipes: Fabricated of cast iron, and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.

B. Galvanized-Steel-Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

C. Molded-PE Sleeves: Reusable, PE, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.

D. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc-coated, with plain ends.
E. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.

   1. Underdeck Clamp: Clamping ring with setscrews.

2.11 SLEEVE SEALS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   1. Thunderline.

B. Description: Modular sealing element unit, designed for field assembly, used to fill annular space between pipe and sleeve.

   1. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
   2. Pressure Plates: Carbon steel.
   3. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, of length required to secure pressure plates to sealing elements.

PART 3 – EXECUTION

3.01 EARTHWORK

A. Comply with requirements in Division 31 Section "Earth Moving" for excavating, trenching, and backfilling.

3.02 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 shutoff valve immediately upstream of each dielectric fitting.

C. Install water-pressure-reducing valves downstream from shutoff valves. Comply with requirements in Division 22 Section "Domestic Water Piping Specialties" for pressure-reducing valves.

D. Install domestic water piping level and plumb.

E. Install seismic restraints on piping. Comply with requirements in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment" for seismic-restraint devices.

F. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.

G. 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.

H. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.

I. Install piping adjacent to equipment and specialties to allow service and maintenance.
J. Install piping to permit valve servicing.

K. 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.

L. Install piping free of sags and bends.

M. Install fittings for changes in direction and branch connections.

N. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.

O. Install pressure gages on suction and discharge piping from each plumbing pump and packaged booster pump. Comply with requirements in Division 22 Section "Meters and Gages for Plumbing Piping" for pressure gages. (Unless otherwise specified on drawings).

P. Install thermostats in hot-water circulation piping. Comply with requirements in Division 22 Section "Domestic Water Pumps" for thermostats.

3.03 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. Brazed Joints: Join copper tube and fittings according to CDA's "Copper Tube Handbook," "Brazed Joints" Chapter.

D. Soldered Joints: Apply ASTM B 813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B 828 or CDA's "Copper Tube Handbook."

E. Flanged Joints: Select appropriate asbestos-free, nonmetallic gasket material in size, type, and thickness suitable for domestic water service. Join flanges with gasket and bolts according to ASME B31.9.

F. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

3.04 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 or gate valves for piping NPS 2 and smaller. Use butterfly or gate valves for piping NPS 2-1/2 and larger.

C. Install drain valves for equipment at base of each water riser, at low points in horizontal piping, and where required to drain water piping. Drain valves are specified in Division 22 Section "Domestic Water Piping Specialties."

1. Hose-End Drain Valves: At low points in water mains, risers, and branches.

D. Install calibrated balancing valves in each hot-water circulation return branch and discharge side of each pump and circulator. Set calibrated balancing valves partly open to restrict but not stop flow. Comply with requirements in Division 22 Section "Domestic Water Piping Specialties" for calibrated balancing valves.
E. Locate valves for easy access and operation; where concealed, access doors shall be provided. Coordinate requirements with Prime Contractor.

F. Do not locate valves with stems below horizontal.

3.05 TRANSITION FITTING INSTALLATION
A. Install transition couplings at joints of dissimilar piping.

3.06 DIELECTRIC FITTING INSTALLATION
A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.

3.07 FLEXIBLE CONNECTOR INSTALLATION
A. Install flexible connectors in suction and discharge piping connections to each domestic water pump and in suction and discharge manifold connections to each domestic water booster pump. (Unless otherwise specified on drawings.)

B. Install bronze-hose flexible connectors in copper domestic water tubing.

3.08 HANGER AND SUPPORT INSTALLATION
A. Comply with requirements in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment" for seismic-restraint devices.

B. Comply with requirements in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment" for pipe hanger and support products and installation.

1. Vertical Piping: MSS Type 8 or 42, clamps.
2. Individual, Straight, Horizontal Piping Runs:
   a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
   b. Longer Than 100 Feet MSS Type 43, adjustable roller hangers.
   c. Longer Than 100 Feet If Indicated: MSS Type 49, spring cushion rolls.

3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
4. Base of Vertical Piping: MSS Type 52, spring hangers.

C. Support vertical piping and tubing at base and at each floor.

D. Rod diameter may be reduced one size for double-rod hangers, to a minimum of 3/8 inch.

E. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 3/4 and Smaller: 60 inches with 3/8-inch rod.
2. NPS 1 and NPS 1-1/4: 72 inches with 3/8-inch rod.
3. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
4. NPS 2-1/2: 108 inches with 1/2-inch rod.
5. NPS 3 to NPS 5: 10 feet with 1/2-inch rod.

F. Install supports for vertical copper tubing every 10 feet.
G. Support piping and tubing not listed in this article according to MSS SP-69 and manufacturer’s written instructions.

3.09 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 exterior water-service piping. Use transition fitting to join dissimilar piping materials.

D. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:

   1. Domestic Water Booster Pumps: Cold-water suction and discharge piping.
   2. Water Heaters: Cold-water inlet and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
   3. Plumbing Fixtures: Cold- and hot-water supply piping in sizes indicated, but not smaller than required by plumbing code. Comply with requirements in Division 22 plumbing fixture Sections for connection sizes.
   4. Equipment: Cold- and hot-water supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 and larger.

3.10 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.
   4. Bare Piping in Unfinished Service Spaces: One piece, cast brass with polished chrome-plated finish.
   5. Bare Piping in Equipment Rooms: One piece, cast brass.
   6. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece floor plate.

3.11 SLEEVE INSTALLATION

A. General Requirements: Install sleeves for pipes and tubes passing through penetrations in floors, partitions, roofs, and walls. (wrap un-insulated copper pipe through ferrous sleeves or in contact with concrete with protective tape)

B. Sleeves are not required for core-drilled holes.

C. Permanent sleeves are not required for holes formed by removable PE sleeves.

D. Cut sleeves to length for mounting flush with both surfaces unless otherwise indicated.

E. Install sleeves in new partitions, slabs, and walls as they are built.

F. For interior wall penetrations, seal annular space between sleeve and pipe or pipe insulation using joint sealants appropriate for size, depth, and location of joint. Comply with requirements in Division 07 “Thermal and Moisture Protection” for joint sealants.
G. For exterior wall penetrations above grade, seal annular space between sleeve and pipe using joint sealants appropriate for size, depth, and location of joint. Comply with requirements in Division 07 “Thermal and Moisture Protection” for joint sealants.

H. For exterior wall penetrations below grade, seal annular space between sleeve and pipe using wall penetration systems specified in this Section.

I. Seal space outside of sleeves in concrete slabs and walls with grout.

J. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation unless otherwise indicated.

K. Install sleeve materials according to the following applications:

1. Sleeves for Piping Passing through Concrete Floor Slabs: Steel pipe.
2. Sleeves for Piping Passing through Concrete Floor Slabs of Mechanical Equipment Areas or Other Wet Areas: Steel pipe.
   a. Extend sleeves 2 inches above finished floor level.
   b. For pipes penetrating floors with membrane waterproofing, extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Comply with requirements in Division 07 “Thermal and Moisture Protection” for flashing.
3. Sleeves for Piping Passing through Gypsum-Board Partitions:
   a. Steel pipe sleeves for pipes smaller than NPS 6.
   b. Galvanized-steel sheet sleeves for pipes NPS 6 and larger.
   c. Exception: Sleeves are not required for water supply tubes and waste pipes for individual plumbing fixtures if escutcheons will cover openings.
4. Sleeves for Piping Passing through Concrete Roof Slabs: Steel pipe.
5. Sleeves for Piping Passing through Exterior Concrete Walls:
   a. Steel pipe sleeves for pipes smaller than NPS 6.
   b. Cast-iron wall pipe sleeves for pipes NPS 6 and larger.
   c. Install sleeves that are large enough to provide 1-inch annular clear space between sleeve and pipe or pipe insulation when sleeve seals are used.
6. Sleeves for Piping Passing through Interior Concrete Walls:
   a. Steel pipe sleeves for pipes smaller than NPS 6.
   b. Galvanized-steel sheet sleeves for pipes NPS 6 and larger.

L. 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 in Division 07 “Thermal and Moisture Protection” for firestop materials and installations.

3.12 SLEEVE SEAL INSTALLATION

A. Install sleeve seals in sleeves in exterior concrete walls at water-service piping entries into building.

B. Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble sleeve seal components and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
3.13 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.

3.14 TEST/FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Piping Inspections:
   1. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
   2. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:
      a. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
      b. Final Inspection: Arrange final inspection for authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
   3. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
   4. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

C. Piping Tests:
   1. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
   2. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.
   3. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
   4. Repair leaks and defects with new materials and retest piping or portion thereof until satisfactory results are obtained.
   5. 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.

F. The following tests shall be made in the presence of the UNLV Inspection Services and the UNLV Project Manager. Forty-eight (48) hours notification shall be made prior to tests.

G. Potable Water and Industrial Water Piping Leakage Test:
   1. General: After completion of the Work, but before final, acceptance is made, run a test over a four hour period of time to prove that the capacity and performance of all apparatus fittings and the system as a whole meets the requirements of the specifications.
2. Pressure Tests: Start and complete pressure tests in the presence of the UNLV Inspection Services.

3. Cold and hot water services within the Building shall be tested at 120 psi for a period of 4 hours. Any joints showing visible leakage shall be cut out and remade; opening of joints shall not be permitted. Retest sections of pipework containing remade joints.

3.15 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. Open throttling valves to proper setting.
4. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.
   a. Manually adjust ball-type balancing valves in hot-water-circulation return piping to provide flow of hot water in each branch.
   b. Adjust calibrated balancing valves to flows indicated.
5. Remove plugs used during testing of piping and for temporary sealing of piping during installation.
7. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.
8. Check plumbing specialties and verify proper settings, adjustments, and operation.

3.16 CLEANING

A. Clean and disinfect potable service entrance piping and water distribution piping as follows:

1. Purge new piping and parts of existing water piping that have been altered, extended, or repaired before using.
2. Use purging and disinfecting procedure prescribed by authorities having jurisdiction or, if method is not prescribed, procedure described in either AWWA C651 or AWWA C652 or as 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 50ppm (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 least200 ppm (200 mg/L) of chlorine. Isolate and allow to stand for 3 hours.
   c. Flush system with clean, potable water until chlorine is no longer in water coming from system after the standing time.
   d. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedure if biological examination shows contamination.

B. Prepare and submit reports for purging and disinfecting activities.

C. Clean interior of piping system. Remove dirt and debris as work progresses.
D. The contractor is required to perform the flushing and disinfection of the cold and tempered water loops in every phase of work.

E. During each phase of construction when the water supply system is open for remodel the contractor must flush and disinfect the system per Specification 221116, Paragraph 3.16 at the end of work in that phase.

F. Prepare and submit reports of purging and disinfecting activities.

G. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

3.17 PIPING SCHEDULE

A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.

B. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.

C. Aboveground domestic water piping, NPS 2 and smaller, shall be one of the following:

1. Hard copper tube, ASTM B 88, Type L wrought- copper solder-joint fittings; and soldered joints.

D. Aboveground domestic water piping, NPS 2-1/2 to NPS 4, shall be one of the following:

1. Hard copper tube, ASTM B 88, Type L wrought- copper solder-joint fittings; and soldered joints.

3.18 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 for piping NPS 2 1/2 and smaller. Use butterfly, ball, with flanged ends for piping NPS 3”.
2. Throttling Duty: Use ball valves for piping NPS 2 and smaller. Use butterfly or ball valves with flanged ends for piping NPS 2-1/2 and larger.

B. Use check valves to maintain correct direction of domestic water flow to and from equipment.

END OF SECTION
SECTION 22 11 19
DOMESTIC WATER PIPING SPECIALTIES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. This Section includes the following domestic water piping specialties:

2. Temperature-actuated water mixing valves.
3. Strainers.
4. Hose bibbs.
5. Drain valves.
7. Trap-seal primer valves.

1.03 EXPANSION TANK (DET) AS SPECIFIED IN THE DRAWINGS

Closed, welded steel, tested and stamped in accordance with Section 8D of ANSI/ASME Code, 125 psi rating, cleaned, prime coated, and supplied with steel support saddles, with tappings for installation of accessories. Tank shall be precharged with replaceable heavy duty Butyl Rubber Diaphragm.

1.04 ELECTRICAL WATER HEATER (EWH)

A. Electric water heater as specified on the Drawings.

1.05 PERFORMANCE REQUIREMENTS

A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig unless otherwise indicated.

1.06 SUBMITTALS

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

B. Operation and Maintenance Data: For domestic water piping specialties to include in emergency, operation, and maintenance manuals.

1.07 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
PART 2 – PRODUCTS

2.01 BALANCING VALVES

A. Copper-Alloy Calibrated Balancing Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   b. ITT Industries; Bell & Gossett Div.
   c. NIBCO INC.
   d. Taco, Inc.
   e. Watts Industries, Inc.; Water Products Div.

2. Type: Ball or Y-pattern globe valve with two readout ports and memory setting indicator.

3. Body: Bronze,

4. Size: Same as connected piping, but not larger than NPS 2.

5. Accessories: Meter hoses, fittings, valves, differential pressure meter, and carrying case.

2.02 TEMPERATURE-ACTUATED WATER MIXING VALVES

A. Water-Temperature Limiting Devices:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Leonard Valve Company.
   b. Powers; a Watts Industries Co.
   c. Symmons Industries, Inc.


4. Type: Thermostatically controlled water mixing valve.

5. Material: Bronze body with corrosion-resistant interior components.

6. Connections: Threaded union inlets and outlet.

7. Accessories: Check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.

8. Valve Finish: Rough bronze.

B. Primary, Thermostatic, Water Mixing Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Lawler Manufacturing Company, Inc.
   b. Leonard Valve Company.
   c. Powers; a Watts Industries Co.
   d. Symmons Industries, Inc.


4. Type: Cabinet-type, thermostatically controlled water mixing valve.

5. Material: Bronze body with corrosion-resistant interior components.

6. Connections: Threaded union inlets and outlet.

7. Accessories: Manual temperature control, check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.

8. Valve Pressure Rating: 125 psig minimum, unless otherwise indicated.


11. Cabinet: Factory-fabricated, stainless steel, for mounting as indicated and with
hinged, stainless-steel door.

2.03 STRAINERS FOR DOMESTIC WATER PIPING

A. Y-Pattern Strainers:

1. Pressure Rating: 125 psig minimum, unless otherwise indicated.
2. Body: Bronze for NPS 2 and smaller; cast iron for NPS 2-1/2 and larger.
3. End Connections: Threaded for NPS 2 and smaller, flanged for NPS 2-1/2 and larger.
4. Screen: Stainless steel with round perforations, unless otherwise indicated.
5. Perforation Size:
   a. Strainers NPS 2 and Smaller: 0.020 inch.
   b. Strainers NPS 2-1/2 to NPS 4: 0.045 inch
   c. Strainers NPS 5 and Larger: 0.10 inch.

2.04 HOSE BIBBS

A. Hose Bibbs:

4. Supply Connections: NPS 1/2 or NPS 3/4 threaded or solder-joint inlet.
5. Outlet Connection: Garden-hose thread complying with ASME B1.20.7.
8. Finish for Equipment Rooms: Rough bronze, or chrome or nickel plated.
10. Finish for Finished Rooms: Chrome or nickel plated.
11. Operation for Equipment Rooms: Wheel handle or operating key.
14. Include operating key with each operating-key hose bibb.
15. Include integral wall flange with each chrome- or nickel-plated hose bibb.

B. Washing Machine Wall Boxes:

2. Plastic or epoxy coated steel recessed wall box with face flange, overflow lip, fastening tabs, ½” or ¼” (refer to drawings) hot and cold bronze washing machine angle shutoff valves rated for 125 psi and 180 degrees F, long shank valve fittings for replacement of valves within box, 2” drain outlet fitting (where shown on the drawings).

2.05 DRAIN VALVES

A. Ball-Valve-Type, Hose-End Drain Valves:

2. Pressure Rating: 400-psig minimum CWP.
4. Body: Copper alloy.
5. Ball: Chrome-plated brass.
8. Inlet: Threaded or solder joint.

2.06 WATER HAMMER ARRESTERS

A. Water Hammer Arresters:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   b. MIFAB, Inc.
   c. PPP Inc.
   d. Sioux Chief Manufacturing Company, Inc.
   e. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
   f. Watts Drainage Products Inc.
   g. Zurn Plumbing Products Group; Specification Drainage Operation.

3. Type: Metal bellows
4. Size: ASSE 1010, Sizes AA and A through F or PDI-WH 201, Sizes A through F.

2.07 TRAP-SEAL PRIMER VALVES

A. Supply-Type, Trap-Seal Primer Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. PPP Inc.
   b. Sioux Chief Manufacturing Company, Inc.

5. Inlet and Outlet Connections: NPS 1/2 threaded, union, or solder joint.
6. Gravity Drain Outlet Connection: NPS 1/2 threaded or solder joint.
7. Finish: Chrome plated, or rough bronze for units used with pipe or tube that is not chrome finished.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Refer to Division 22 Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.

B. Install water control valves with inlet and outlet shutoff valves. Install pressure gages on inlet and outlet.

C. Install balancing valves in locations where they can easily be adjusted.

D. Install temperature-actuated water mixing valves with check stops or shutoff valves on inlets and with shutoff valve on outlet.

1. Install thermometers and water regulators if specified.
2. Install cabinet-type units recessed in or surface mounted on wall as specified.

E. Install Y-pattern strainers for water on supply side of each control valve, water pressure-reducing valve, solenoid valve, and pump.

F. Install water hammer arresters in water piping according to PDI-WH 201.

G. Install supply-type, trap-seal primer valves with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust valve for proper flow.

H. Install trap-seal primer systems with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust system for proper flow.

I. Washing Machine Boxes:
   1. Install in wall construction, secured to structure, directly behind proposed washing machine location.
   2. Provide water hammer arrestors at domestic water connections.

3.02 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping and specialties.

3.03 LABELING AND IDENTIFYING

A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:
   1. Calibrated balancing valves.
   2. Primary, thermostatic, water mixing valves.

B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Division 22 Section "Identification for Plumbing Piping and Equipment."

3.04 ADJUSTING

A. Set field-adjustable flow set points of balancing valves.

B. Set field-adjustable temperature set points of temperature-actuated water mixing valves.

END OF SECTION
SECTION 22 13 16
SANITARY WASTE AND VENT PIPING

PART 1 – GENERAL

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

1.02 SUMMARY
A. This Section includes the following for soil, waste, and vent piping inside the building:
   1. Pipe, tube, and fittings.
   2. Special pipe fittings.
   3. Encasement for underground metal piping.

1.03 DEFINITIONS
A. EPDM: Ethylene-propylene-diene terpolymer rubber.
B. LLDPE: Linear, low-density polyethylene plastic.
C. NBR: Acrylonitrile-butadiene rubber.
D. PE: Polyethylene plastic.
E. PVC: Polyvinyl chloride plastic.
F. TPE: Thermoplastic elastomer.

1.04 PERFORMANCE REQUIREMENTS
A. Components and installation shall be capable of withstanding the following minimum working pressure, unless otherwise indicated:
B. Seismic Performance: Soil, waste, and vent piping and support and installation shall be capable of withstanding the effects of seismic events determined according to IBC.

1.05 SUBMITTALS
A. Product Data: For pipe, tube, fittings, and couplings.
B. Shop Drawings:
   1. Design Calculations: Signed and sealed by a qualified professional engineer for selecting seismic restraints.
C. Field quality-control inspection and test reports.

1.06 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. PVC DWV pipe must be solid wall, not cellular core.

PART 2 – PRODUCTS

2.01 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. (all pipe and fittings shall be manufactured in the U.S.A.)

2.02 PIPING MATERIALS

A. Refer to Part 3 "Piping Applications" Article for applications of pipe, tube, fitting, and joining materials.

2.03 HUBLESS CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 888 or CISPI 301.

B. Shielded Couplings: ASTM C 1277 assembly of metal shield or housing, corrosion-resistant fasteners, and rubber sleeve with integral, center pipe stop.

1. Standard, Shielded, Heavy Duty, Type 304 Stainless-Steel Couplings: CISPI 310, with stainless-steel corrugated shield; stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve.

a. Manufacturers:
   1) ANACO.
   2) Fernco, Inc.
   3) Ideal Div.; Stant Corp.
   4) Mission Rubber Co.
   5) Tyler Pipe; Soil Pipe Div.

b. Laboratory Waste and Vent Pipe
   1) Orion
   2) Zurn Chemical Drainage Group

2.04 LABORATORY DRAINAGE (AW AND AV) SYSTEM

A. Underground/ aboveground Laboratory Piping: Install polypropylene pipe with mechanical joints and/or electrical fusion joints per manufacturer's recommendations. Pipe material shall be UL, NSF, IAPMO listed and meet requirements of UL-94-VO(non-combustible/ flame retardant), Fire Marshall for fire spread/ smoke development rates, when installed above grade. Piping shall match existing approved materials.

2.05 PVC SCHEDULE 40 SOLID WALL PIPE AND DWV FITTING SYSTEM

A. Pipe and fittings shall be manufactured from PVC compound with a cell class of 12454 per ASTM D 1784 and conform with National Sanitation Foundation (NSF) standard 14. Pipe shall
be iron pipe size (IPS) conforming to ASTM D 1785 and ASTM D 2665. Fittings shall conform to ASTM D 2665.

B. All pipe and fittings to be produced by a single manufacturer and to be installed in accordance with manufacturer’s recommendations and local code requirements. Testing with compressed air or gas may result in injury or death. Solvent cements shall conform to ASTM D 2564. Primer shall conform to ASTM F 656. The system to be manufactured by Charlotte Pipe and Foundry Co. and is intended for non-pressure drainage applications where the temperature will not exceed 140 degrees F.

PART 3 – EXECUTION

3.01 EXCAVATION

A. Refer to Division 31 Section for excavating.

3.02 PIPING APPLICATIONS

A. Flanges and unions may be used on aboveground pressure piping, unless otherwise indicated.

B. Aboveground, soil, waste piping and vent piping shall be the following:

1. 1-1/2-Inch NPS: Hub-less, cast-iron soil pipe; hub-less, cast-iron, soil-pipe fittings; and one of the following hub-less, cast-iron, soil-piping couplings:
   a. Couplings: Heavy-duty, Type 304, stainless steel.

2. 1-1/4- and 1-1/2-Inch NPS: Hard copper drainage tube; copper, solder-joint drainage fittings; and soldered joints.

3. 2- to 4-Inch NPS: Hub-less, cast-iron soil pipe; hub-less, cast-iron, soil-pipe fittings; and one of the following hub-less, cast-iron, soil-piping couplings:
   a. Couplings: Heavy-duty, Type 304, stainless steel.

4. 2- to 4-Inch NPS: Hard copper drainage tube; copper, solder-joint drainage fittings; and soldered joints.

C. Underground, soil, waste, and vent piping shall be the following:

1. 1-1/2-Inch NPS: Hub-less, cast-iron soil pipe; hub-less, cast-iron, soil-pipe fittings; and one of the following hub-less, cast-iron, soil-piping couplings:
   a. Couplings: Heavy-duty, Type 304, stainless steel.

2. 1-1/2-Inch NPS: PVC plastic pipe, solid wall only. Foam core or cellular core is not acceptable, PVC socket fittings, and solvent-cemented joints. Pipe and fittings shall be manufactured from PVC compound with a cell class of 12454 per ASTM D 1784 and conform with National Sanitation Foundation (NSF) standard 14.

3. 2- to 4-Inch NPS: Hub-less, cast-iron soil pipe, hub-less, cast-iron, soil-pipe fittings,

4. 2-to-4-Inch NPS: PVC plastic pipe, solid wall only. Foam core or cellular core is not acceptable, PVC socket fittings, and solvent-cemented joints. Pipe and fitting shall be manufactured from PVC compound with a cell class of 12454 per ASTM D 1784 and conform with National Sanitation Foundation (NSF) standard 14.

5. 2- to 4-Inch NPS: PVC plastic pipe, solid wall only. Foam or cellular core is not acceptable, PVC socket fittings, and solvent-cemented joints.

6. 5-and 6-Inch NPS: PVC plastic pipe, solid wall only. Foam core or cellular core is not acceptable, PVC socket fittings, and solvent-cemented joints. Pipe and fitting shall be manufactured from PVC compound with a cell class of 12454 per ASTM D 1784 and conform with National Sanitation Foundation (NSF) standard 14.
3.03 PIPING INSTALLATION

A. Basic piping installation requirements are specified in Division 22 Section "Common Work Results for Plumbing."

B. Install seismic restraints on piping. Seismic-restraint devices are specified in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment."

C. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers.

D. Install cleanout fitting with closure plug inside the building in sanitary force-main piping.

E. Install cast-iron sleeve with water stop and mechanical sleeve seal at each service pipe penetration through foundation wall. Select number of interlocking rubber links required to make installation watertight. Sleeves and mechanical sleeve seals are specified in Division 22 Section "Common Work Results for Plumbing."

F. Install wall-penetration fitting at each service pipe penetration through foundation wall. Make installation watertight.


1. Install encasement on underground piping according to ASTM A 674 or AWWA C105.

H. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-turn, double Y-branch and 1/8-bend fittings if 2 fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.

I. Lay buried building drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.

J. Install soil and waste drainage and vent piping at the following minimum slopes, unless otherwise indicated:

1. Building Sanitary Drain: 2 percent downward in direction of flow for piping NPS 3 and smaller; 1 percent downward in direction of flow for piping NPS 4 and larger.

2. Horizontal Sanitary Drainage Piping: 2 percent downward in direction of flow.

3. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.

K. Sleeves are not required for cast-iron soil piping passing through concrete slabs-on-grade if slab is without membrane waterproofing.

L. Install PVC soil and waste drainage and vent piping according to UPC/IAPMO standards.

M. Install underground PVC soil and waste drainage piping according to UPC/IAPMO standards.

N. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
3.04 JOINT CONSTRUCTION

A. Basic piping joint construction requirements are specified in Division 22 Section "Common Work Results for Plumbing."

B. Join hubless cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-coupling joints.

C. Soldered Joints: Use ASTM B 813, water-flushable, lead-free flux; ASTM B 32, lead-free-alloy solder; and ASTM B 828 procedure, unless otherwise indicated.

D. PVC Nonpressure Piping Joints: Join piping according to ASTM D 2665.

3.05 HANGER AND SUPPORT INSTALLATION

A. Seismic-restraint devices are specified in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment."

B. 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:
      a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
      b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
      c. Longer Than 100 Feet, if Indicated: MSS Type 49, spring cushion rolls.
   3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
   4. Base of Vertical Piping: MSS Type 52, spring hangers.

C. Install supports according to Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."

D. Support vertical piping and tubing at base and at each floor.

E. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch minimum rods.

F. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:
   1. NPS 1-1/2 and NPS 2: 60 inches with 3/8-inch rod.
   2. NPS 3: 60 inches with 1/2-inch rod.
   3. NPS 4 and NPS 5: 60 inches with 5/8-inch rod.
   4. NPS 6: 60 inches with 3/4-inch rod.

G. Install supports for vertical cast-iron soil piping every 15 feet.

H. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:
   1. NPS 1-1/4: 84 inches with 3/8-inch rod.
   2. NPS 1-1/2: 108 inches with 3/8-inch rod.
   3. NPS 2: 10 feet with 3/8-inch rod.
   4. NPS 2-1/2: 11 feet with 1/2-inch rod.
   5. NPS 3: 12 feet with 1/2-inch rod.
   6. NPS 4 and NPS 5: 12 feet with 5/8-inch rod.
   7. NPS 6: 12 feet with 3/4-inch rod.

I. Install supports for vertical steel piping every 15 feet.
J. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.06 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.

C. Connect drainage and vent piping to the following:
   1. Plumbing Fixtures: Connect drainage piping in sizes indicated, but not smaller than required by plumbing code.
   2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
   3. Plumbing Specialties: Connect drainage and vent piping in sizes indicated, but not smaller than required by plumbing code.
   4. Equipment: Connect drainage piping as indicated. Provide shutoff valve, if indicated, and union for each connection. Use flanges instead of unions for connections NPS 2-1/2 and larger.

D. Connect force-main piping to the following:
   1. Sanitary Sewer: To exterior force main or sanitary manhole.

3.07 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. 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. 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
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.

3.08 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
PART 1 – GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. This Section includes the following sanitary drainage piping specialties:
   1. Cleanouts.
   2. Floor drains.

1.03 DEFINITIONS

A. PVC: Polyvinyl chloride plastic.

1.04 SUBMITTALS

A. Manufacturer Seismic Qualification Certification: Submit certification that grease interceptors, grease removal devices, oil interceptors, accessories, and components will withstand seismic forces defined in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment." Include the following:
   1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
      a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."
   2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
   3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

B. Field quality-control test reports.
C. Operation and Maintenance Data: For drainage piping specialties to include in emergency, operation, and maintenance manuals.

1.05 QUALITY ASSURANCE

A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

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.

1.06 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.
B. Coordinate size and location of roof penetrations.

PART 2 – PRODUCTS

2.01 CLEANOUTS

A. Exposed Metal Cleanouts:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      c. Zurn Plumbing Products Group; Specification Drainage Operation.
   2. Standard: ASME A112.36.2M for cast iron for cleanout test tee.
   3. Size: Same as connected drainage piping
   4. Body Material: Hubless, cast-iron soil pipe test tee as required to match connected piping.
   5. Closure: Countersunk, cast-iron plug.
   6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.

B. Metal Floor Cleanouts:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      c. Zurn Plumbing Products Group; Specification Drainage Operation.
   2. Standard: ASME A112.36.2M for threaded, adjustable housing cleanout.
   3. Size: Same as connected branch.
   4. Type: Threaded, adjustable housing.
   5. Body or Ferrule: Cast iron.
   6. Outlet Connection: Threaded.
   7. Closure: Brass plug with tapered threads.
   8. Adjustable Housing Material: Cast iron with threads.
   9. Frame and Cover Material and Finish: Nickel-bronze, copper alloy
   10. Frame and Cover Shape: Round.
   11. Top Loading Classification: Heavy Duty.
   12. Riser: ASTM A 74, Service class, cast-iron drainage pipe fitting and riser to clean out.
   14. Size: Same as connected branch.

C. Cast-Iron Wall Cleanouts:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      c. Zurn Plumbing Products Group; Specification Drainage Operation.
   2. Standard: ASME A112.36.2M. Include wall access.
   3. Size: Same as connected drainage piping.
   4. Body: Hubless, cast-iron soil pipe test tee as required to match connected piping.
   5. Closure: Countersunk plug.
   6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.

2.02 FLOOR DRAINS
A. Cast-Iron Floor Drains:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Commercial Enameling Co.
      b. Josam Company; Josam Div.
      d. Zurn Plumbing Products Group; Specification Drainage Operation.
   2. Standard: ASME A112.6.3.

2.03 THROUGH-PENETRATION FIRESTOP ASSEMBLIES

A. Through-Penetration Firestop Assemblies:
   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:
      a. ProSet Systems Inc.
   2. Standard: UL 1479 assembly of sleeve and stack fitting with firestopping plug.
   3. Size: Same as connected soil, waste, or vent stack.
   4. Sleeve: Molded PVC plastic, of length to match slab thickness and with integral nailing flange on one end for installation in cast-in-place concrete slabs.
   6. Special Coating: Corrosion resistant on interior of fittings.

2.04 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

A. Floor-Drain, Trap-Seal Primer Fittings:
   1. Description: Cast iron, with threaded inlet and threaded or spigot outlet, and trap-seal primer valve connection.
   2. Size: Same as floor drain outlet with NPS 1/2 side inlet.

B. Air-Gap Fittings:
   1. Standard: ASME A112.1.2, for fitting designed to ensure fixed, positive air gap between installed inlet and outlet piping.
   2. Body: Bronze or cast iron.
   3. Inlet: Opening in top of body.
   4. Outlet: Larger than inlet.
   5. Size: Same as connected waste piping and with inlet large enough for associated indirect waste piping.

C. Sleeve Flashing Device:
   1. Description: Manufactured, cast-iron fitting, with clamping device, that forms sleeve for pipe floor penetrations of floor membrane. Include galvanized-steel pipe extension in top of fitting that will extend 2 inches above finished floor and galvanized-steel pipe extension in bottom of fitting that will extend through floor slab.
   2. Size: As required for close fit to riser or stack piping.

D. Stack Flashing Fittings:
   1. Description: Counterflashign-type, cast-iron fitting, with bottom recess for terminating roof membrane, and with threaded or hub top for extending vent pipe.
2. Size: Same as connected stack vent or vent stack.

E. Grease Interceptor (GI) and Sample Chamber
   2. Rough-in: Fully recessed deep rough-in, manholes shall be flush with floor.
   3. Accessories: Multi-weir baffle assembly, integral deep seal trap, removable integral flow control.
   4. Cover: Steel, epoxy coated, with gasket, securing handle, and enzyme injection port.
   5. Unit Rating: See plans
   6. Manufacturer: See plans

2.05 FLASHING MATERIALS

A. Lead Sheet: ASTM B 749, Type L51121, copper bearing, with the following minimum weights and thicknesses, unless otherwise indicated:
   1. General Use: 4.0-lb/sq. ft., 0.0625-inch thickness.
   2. Vent Pipe Flashing: 3.0-lb/sq. ft., 0.0469-inch thickness.

B. Copper Sheet: ASTM B 152/B 152M, of the following minimum weights and thicknesses, unless otherwise indicated:
   1. General Applications: 12 oz./sq. ft.
   2. Vent Pipe Flashing: 8 oz./sq. ft.

C. Zinc-Coated Steel Sheet: ASTM A 653/A 653M, with 0.20 percent copper content and 0.04-inch minimum thickness, unless otherwise indicated. Include G90 hot-dip galvanized, mill-phosphatized finish for painting if indicated.


E. Fasteners: Metal compatible with material and substrate being fastened.

F. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.

G. Solder: ASTM B 32, lead-free alloy.

H. Bituminous Coating: SSPC-Paint 12, solvent-type, bituminous mastic.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Refer to Division 22 Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.

B. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:
   1. Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
   2. Locate at each change in direction of piping greater than 45 degrees.
   3. Locate at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
   4. Locate at base of each vertical soil and waste stack.
C. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.

D. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.

E. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.
   1. Position floor drains for easy access and maintenance.
   2. Set floor drains below elevation of surrounding finished floor to allow floor drainage.
   3. Install floor-drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.
   4. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.

F. Install roof flashing assemblies on sanitary stack vents and vent stacks that extend through roof.

G. Install flashing fittings on sanitary stack vents and vent stacks that extend through roof.

H. Install floor-drain, trap-seal primer fittings on inlet to floor drains that require trap-seal primer connection.
   1. Exception: Fitting may be omitted if trap has trap-seal primer connection.
   2. Size: Same as floor drain inlet.

I. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.

J. Install sleeve flashing device with each riser and stack passing through floors with waterproof membrane.

K. Install solids interceptors with cleanout immediately downstream from interceptors that do not have integral cleanout on outlet. Install trap on interceptors that do not have integral trap and are connected to sanitary drainage and vent systems.

L. Install escutcheons at wall, floor, and ceiling penetrations in exposed finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding pipe fittings.

3.02 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment to allow service and maintenance.

3.03 FLASHING INSTALLATION

A. Fabricate flashing from single piece unless large pans, sumps, or other drainage shapes are required. Join flashing according to the following if required:
   1. Lead Sheets: Burn joints of lead sheets 6.0-lb/sq. ft., 0.0938-inch thickness or thicker. Solder joints of lead sheets 4.0-lb/sq. ft., 0.0625-inch thickness or thinner.
   2. Copper Sheets: Solder joints of copper sheets.

B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors.
and roofs with waterproof membrane.

1. Pipe Flashing: Sleeve type, matching pipe size, with minimum length of 10 inches and skirt or flange extending at least 8 inches around pipe.
2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches around sleeve.
3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches around specialty.

C. Set flashing on floors and roofs in solid coating of bituminous cement.
D. Secure flashing into sleeve and specialty clamping ring or device.
E. Install flashing for piping passing through roofs with counterflashing or commercially made flashing fittings, according to Division 07 Section "Flashing and Sheet Metal".
F. Extend flashing up vent pipe passing through roofs and turn down into pipe, or secure flashing into cast-iron sleeve having calking recess.
G. Fabricate and install flashing and pans, sumps, and other drainage shapes.

3.04 LABELING AND IDENTIFYING
A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:

3.05 FIELD QUALITY CONTROL
A. Tests and Inspections:
   1. Leak Test: After installation, charge system 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.

3.06 PROTECTION
A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.
B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION
PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. 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.

1.03 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawls, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and chases.

E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

F. The following are industry abbreviations for plastic materials:

1. CPVC: Chlorinated polyvinyl chloride plastic.
2. 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.
H. “Provide” and “Install” means item with all appurtenances, shall be furnished and installed by contractor unless otherwise is directed in the drawings.

### 1.04 SUBMITTALS

A. Product Data: For the following:
   1. Transition fittings.
   2. Dielectric fittings.
   3. Mechanical sleeve seals.
   4. Escutcheons.

B. Welding certificates.

### 1.05 QUALITY ASSURANCE

A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."

B. Electrical Characteristics for HVAC Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

C. Submit shop drawings and product data grouped to include complete submittals of related systems, Products, and accessories in a single submittal.

D. Mark dimensions and values in units to match those specified.

E. Submit miscellaneous items specified on the drawings but not covered in the specifications. Make no substitutions without prior approval from the Engineer.

### 1.06 REGULATORY REQUIREMENTS

A. Requirements of Regulatory Agencies:
   1. ASME Boiler Pressure Vessel Codes, Section VII, Pressure Vessels; Welding Qualifications.
   2. ASHRAE.
   3. UL Publications.
   4. ASTM.
   5. ANSI B31.1, "Code for Pressure Piping".
   6. TEMA.
   7. OSHA.
   8. EPA.
   9. ARI.
   10. NFPA.
   11. UMC.
   12. UPC.
   13. IBC

### 1.07 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.

1.08 COORDINATION
A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for HVAC installations.
B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.
C. Coordinate requirements for access panels and doors for HVAC items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Frames."

PART 2 – PRODUCTS

2.01 MATERIALS AND EQUIPMENT
A. Deliver products in the manufacturer's original unopened, labeled containers and adequately protect against moisture, tampering or damage from improper handling or storage. Do not deliver materials to the job before they are ready for installation, unless adequate security is provided.

B. UNLV P.M. may require removal from the premises of such material or Work that in his opinion is not in accordance with Contract Documents. He may also require substitution, without delay, of unsatisfactory Work.

C. Repair and refinish work damaged by the Work of this Division, to UNLV P.M.'s satisfaction. Obtain finishing materials from equipment manufacturer.

2.02 MANUFACTURERS (All pipe and accessories shall be U.S.A. manufactured).
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.

2.03 PIPE, TUBE, AND FITTINGS
A. Refer to individual Division 23 piping Sections for pipe, tube, and fitting materials and joining methods.

B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.04 JOINING MATERIALS
A. Refer to individual Division 23 piping Sections for special joining materials not listed below.

B. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.05 DIELECTRIC FITTINGS
A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.
B. Insulating Material: Suitable for system fluid, pressure, and temperature.

C. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig minimum working pressure at 180 deg F.
   1. Manufacturers:
      a. Capitol Manufacturing Co.
      b. Central Plastics Company.
      c. Eclipse, Inc.
      d. Epco Sales, Inc.
      g. Zurn Industries, Inc.; Wilkins Div.

D. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 deg F.
   1. Manufacturers:
      a. Perfection Corp.
      b. Precision Plumbing Products, Inc.
      c. Sioux Chief Manufacturing Co., Inc.
      d. Victaulic Co. of America.

2.06 MECHANICAL SLEEVE SEALS

A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
   1. Manufacturers:
      a. Thunderline.

   2. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.

   3. Pressure Plates: Stainless steel. Include two for each sealing element.

   4. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.07 SLEEVES

A. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.

C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
   1. Underdeck Clamp: Clamping ring with set screws.

E. Molded PVC: Permanent, with nailing flange for attaching to wooden forms.

G. Molded PE: Reusable, PE, tapered-cup shaped, and smooth-outer surface with nailing flange for attaching to wooden forms.

2.08 ESCUTCHEONS

A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.

B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.

C. One-Piece, Cast-Brass Type: With set screw.
   1. Finish: Polished chrome-plated.

D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.
   1. Finish: Polished chrome-plated.

E. One-Piece, Floor-Plate Type: Cast-iron floor plate.

F. Split-Casting, Floor-Plate Type: Cast brass with concealed hinge and set screw.

PART 3 - EXECUTION

3.01 PIPING SYSTEMS - COMMON REQUIREMENTS

A. Install piping according to the following requirements and Division 23 Sections specifying piping systems.

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. Install piping to permit valve servicing.

F. Install piping at indicated slopes.

G. Install piping free of sags and bends.

H. Install fittings for changes in direction and branch connections.

I. Install piping to allow application of insulation.

J. Select system components with pressure rating equal to or greater than system operating pressure.
K. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:

1. New Piping:
   a. New Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
   b. Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish.
   c. Insulated Piping: One-piece, stamped-steel type with spring clips.
   d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type.
   e. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece or split-casting, cast-brass type with polished chrome-plated finish.
   f. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with rough-brass finish.
   g. Bare Piping in Unfinished Service Spaces: One-piece, stamped-steel type with concealed or exposed-rivet hinge and set screw or spring clips.
   h. Bare Piping in Equipment Rooms: One-piece, cast-brass type.
   i. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.

L. Sleeves are not required for core-drilled holes.

M. Permanent sleeves are not required for holes formed by removable PE sleeves.

N. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.

O. 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 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 annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
   a. PVC Pipe Sleeves: For pipes smaller than NPS 6.

P. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

1. Install steel pipe for sleeves smaller than 6 inches in diameter.
2. 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.

Q. Fire-Barrier Pen penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 Section "Penetration Firestopping" for materials.
R. Verify final equipment locations for roughing-in.

S. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.02 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 23 Sections specifying piping systems.

B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.


3.03 PIPING CONNECTIONS

A. Make connections according to the following, unless otherwise indicated:

1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.

3.04 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.

B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.

C. Install HVAC equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.

D. Install equipment to allow right of way for piping installed at required slope.

3.05 MECHANICAL INSTALLATIONS

A. The requirements of this Section apply to all the Work of Division.

B. It is the intention of the Contract Documents including Specifications and Drawings to provide finished Work, tested and ready for operation and complete in every regard. Provide Work not shown or specified and accessories necessary to make the Work shown on the Drawings complete and ready for operation. Should there appear to be discrepancies or questions of intent in the Contract Documents, refer the matter to the UNLV P.M. for his decision. The decision of the UNLV P.M. is final.

C. Drawings are diagrammatic and are intended to convey scope of Work and to indicate general arrangement. They are not intended to show every detail including offset or fitting or every structural difficulty that may be encountered during the Work. Except as otherwise indicated, locations of items are approximate only. Exact locations necessary to secure proper conditions
and results must be determined at Project Site and must be approved by the Owner. Do not
scale Drawings.

D. Except as otherwise indicated, make only approved modifications in layout as needed to
prevent conflict with other Work or for proper execution of Work.

E. Include Work not usually shown or specified, but necessary for proper installation and operation
of a system or piece of equipment in Work.

3.06 PAINTING

A. Painting of HVAC systems, equipment, and components is specified in Division 09
Sections "Interior Painting" and "Exterior Painting."

B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and
procedures to match original factory finish.

3.07 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 HVAC materials and equipment.

C. Field Welding: Comply with AWS D1.1.

END OF SECTION
SECTION 23 05 13

COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 - GENERAL

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

1.02 SUMMARY
   
   A. Section includes general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on ac power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

1.03 COORDINATION
   
   A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:

      1. Motor controllers.
      2. Torque, speed, and horsepower requirements of the load.
      3. Ratings and characteristics of supply circuit and required control sequence.
      4. Ambient and environmental conditions of installation location.

PART 2 - PRODUCTS

2.01 GENERAL MOTOR REQUIREMENTS
   
   A. Comply with requirements in this Section except when stricter requirements are specified in HVAC equipment schedules or Sections.
   
   B. Comply with NEMA MG 1 unless otherwise indicated.
   
   C. Comply with IEEE 841 for severe-duty motors.

2.02 MOTOR CHARACTERISTICS
   
   A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 2,160 ft above sea level.
   
   B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

2.03 POLYPHASE MOTORS
   
   A. Description: NEMA MG 1, Design B, medium induction motor.
   
   B. Efficiency: Premium efficiency, as defined in NEMA MG 1.
   
   C. Service Factor: 1.15.
D. Multispeed Motors: Variable torque.
   1. For motors with 2:1 speed ratio, consequent pole, single winding.
   2. For motors with other than 2:1 speed ratio, separate winding for each speed.

E. Multispeed Motors: Separate winding for each speed.

F. Rotor: Random-wound, squirrel cage.

G. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.

H. Temperature Rise: Match insulation rating.

I. Insulation: Class F.

J. Code Letter Designation:
   1. Motors 15 HP and Larger: NEMA starting Code F or Code G.
   2. Motors Smaller than 15 HP: Manufacturer's standard starting characteristic.

K. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.

2.04 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS

A. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.

B. Motors Used with Variable Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.
   1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.
   2. Energy- and Premium-Efficient Motors: Class B temperature rise; Class F insulation.
   3. Inverter-Duty Motors: Class F temperature rise; Class H insulation.
   4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.

C. Severe-Duty Motors: Comply with IEEE 841, with 1.15 minimum service factor.

2.05 SINGLE-PHASE MOTORS

A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:
   1. Permanent-split capacitor.
   2. Split phase.
   3. Capacitor start, inductor run.
   4. Capacitor start, capacitor run.

B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.

C. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.

D. Motors 1/20 HP and Smaller: Shaded-pole type.
E. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

2.06 COUPLINGS

A. Couplings for direct drive equipment shall be flexible, self-aligning, non-lubricating type, rated at least 125% of motor rated horsepower.

B. Coupling halves shall be keyed and locked on shafts.

C. Manufacturer: Couplings shall be Fast's Standard, or John E. Lisee Pump, Inc.

2.07 BELT DRIVES

A. General
   1. Belt drives shall be V-belt type with appropriate sheaves.
   2. Minimum of two belts per drive.
   3. Motors 15 HP and smaller shall be provided with variable pitch sheaves and installed on motor slide rails.
   4. Motors 20 HP and larger shall have non adjustable drive sheave and be installed on motor slide rails.
   5. After air balance is completed and air balance has been accepted by the Engineer/UNLV P.M., change each variable pitch sheave to fixed pitch sheave.
   6. Manufacturer: Sheaves and belts shall be Browning, Dodge, or Gates.

B. Sheaves
   1. Sheaves shall be cast iron, machined and balanced.
   2. Variable pitch sheaves shall be selected for mid point of equipment operating capacity.
   3. Sheaves shall be keyed and located on shafts, with Allen head set screws. On fractional horsepower motors on NEMA frame size 48, smaller sheaves may be secured to shaft with set screws only.

C. Ratings
   1. Belt drives for one and two cylinder reciprocating compressors: Minimum horsepower rating, at design speed, of 1.7 times the motor nameplate horsepower rating.
   2. All other belt drives: On each two belts drive, each belt shall be rated for motor nameplate horsepower rating. On three belt or greater, drive shall be rated for 150% of motor nameplate horsepower rating.

2.08 GUARDS

A. General: All rotating elements on equipment shall have protective devices in accordance with the CCR Title 8, Division of Industrial Safety and General Industry Safety Orders and OSHA requirements.

B. Coupling guards shall completely enclose the rotating coupling and shall be constructed of heavy gage steel in accordance with OSHA requirements.

C. Belt Guards
   1. Guards shall totally enclose the belts and sheaves. Guards shall be fabricated of galvanized expanded metal sides, solid galvanized steel band and adequately sized galvanized angle iron frame.
   2. Adequate room for belt adjustments shall be provided.
   3. Tachometer holes with covers shall be provided for both sheaves.
PART 3 - EXECUTION (Not Applicable)

END OF SECTION
PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. This Section includes the following hangers and supports for HVAC system piping and equipment:

1. Steel pipe hangers and supports.
2. Thermal-hanger shield inserts.
3. Equipment supports.

B. Related Sections include the following:

1. Division 05 Section "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
2. Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment" for vibration isolation devices.
3. Division 23 Section(s) "Metal Ducts" for duct hangers and supports.

1.03 PERFORMANCE REQUIREMENTS

A. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

B. Design seismic-restraint hangers and supports for piping and equipment and obtain approval from authorities having jurisdiction.

1.04 SUBMITTALS

A. Product Data: For the following:

1. Steel pipe hangers and supports.
2. Thermal-hanger shield inserts.

B. Shop Drawings: Show fabrication and installation details and include calculations for the following:

1. Equipment supports.

C. Welding certificates.

1.05 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code--Steel."
B. Welding: Qualify procedures and personnel according to the following:

1. AWS D1.1, "Structural Welding Code--Steel."
4. AWS D1.4, "Structural Welding Code--Reinforcing Steel."
5. ASME Boiler and Pressure Vessel Code: Section IX.

PART 2 - PRODUCTS

2.01 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.

2.02 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. Manufacturers:

1. Thermo Hanger Shield, Inc.
2. Portable Pipe,
3. Hanger, Inc.
4. Channel Support Systems
5. Miro Industries

C. Galvanized, Metallic Coatings: Pregalvanized or hot dipped.

D. Nonmetallic Coatings: Plastic coating, jacket, or liner.

E. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion for support of bearing surface of piping.

2.03 THERMAL-HANGER SHIELD INSERTS

A. Description: 100-psig- minimum, compressive-strength insulation insert encased in sheet metal shield.

B. Manufacturers:

1. PHS Industries, Inc.
2. Pipe Shields, Inc.
4. Value Engineered Products, Inc.

C. Insulation-Insert Material for Cold Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate or ASTM C 552, Type II cellular glass with vapor barrier.

D. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
E. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.04 EQUIPMENT SUPPORTS

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

2.05 MISCELLANEOUS MATERIALS

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

PART 3 - EXECUTION

3.01 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 on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

E. Use padded hangers for piping that is subject to scratching.

F. 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.
2. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.

G. 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. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.

H. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.
I. Comply with MFMA-102 for metal framing system selections and applications that are not specified in piping system Sections.

3.02 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 properly support piping from building structure.

B. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.

C. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.


E. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

F. Install lateral bracing with pipe hangers and supports to prevent swaying.

G. Load Distribution: Install hangers and supports so piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

H. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.1 (for power piping) and ASME B31.9 (for building services piping) are not exceeded.

I. Insulated Piping: Comply with the following:

1. Attach clamps and spacers to piping.
   a. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
   b. Do not exceed pipe stress limits according to ASME B31.1 for power piping and ASME B31.9 for building services piping.

2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining Insulation.

3. Shield Dimensions for Pipe: Not less than the following:
   a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.

4. Insert Material: Length at least as long as protective shield.

5. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.03 EQUIPMENT SUPPORTS

A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.

B. Provide lateral bracing, to prevent swaying, for equipment supports.
3.04 METAL FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.

B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

C. Field Welding: Comply with AWS D1.1 procedures for shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work, and 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. Finish welds at exposed connections so no roughness shows after finishing and contours of welded surfaces match adjacent contours.

3.05 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.

3.06 PAINTING

A. Touch Up: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
   1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.

B. Touch Up: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 09 painting Sections.

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION
SECTION 23 05 48
VIBRATION AND SEISMIC CONTROLS FOR HVAC EQUIPMENT

PART 1 - GENERAL

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

1.02 SUMMARY
A. This Section includes the following:
   1. Isolation pads.
   2. Isolation mounts.
   3. Restrained elastomeric isolation mounts.
   4. Housed spring mounts.
   5. Elastomeric hangers.
   7. Spring hangers with vertical-limit stops.
   8. Seismic snubbers.
   9. Steel and inertia, vibration isolation equipment bases.

1.03 DEFINITIONS

1.04 PERFORMANCE REQUIREMENTS
A. Provide vibration isolation on motor driven equipment where indicated on the drawings.
B. Provide minimum static deflection of isolators for equipment as indicated on the drawings.
C. Seismic-Restraint Loading:
   1. As defined in the IBC.
   2. As specified by Structural documents for this project.

1.05 SUBMITTALS
A. Product Data: For the following:
   1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
   2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of seismic-restraint component used.
      a. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by an agency acceptable to authorities having jurisdiction.
      b. Annotate to indicate application of each product submitted and compliance with requirements.
   3. Interlocking Snubbers: Include ratings for horizontal, vertical, and combined loads.
B. Delegated-Design Submittal: For vibration isolation and seismic-restraint details indicated to
comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer licensed in the State of Nevada responsible for their preparation.

1. Design Calculations: Calculate static and dynamic loading due to equipment weight and operation, seismic forces required to select vibration isolators, seismic restraints, and for designing vibration isolation bases.
   
   a. Coordinate design calculations with wind load calculations required for equipment mounted outdoors. Comply with requirements in other Division 23 Sections for equipment mounted outdoors.

2. Riser Supports: Include riser diagrams and calculations showing anticipated expansion and contraction at each support point, initial and final loads on building structure, spring deflection changes, and seismic loads. Include certification that riser system has been examined for excessive stress and that none will exist.

3. Vibration Isolation Base Details: Detail overall dimensions, including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails, base weights, equipment static loads, power transmission, component misalignment, and cantilever loads.

4. Seismic-Restraint Details:
   
   a. Design Analysis: To support selection and arrangement of seismic restraints. Include calculations of combined tensile and shear loads.
   
   b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events. Indicate association with vibration isolation devices.
   
   c. Coordinate seismic-restraint and vibration isolation details with wind-restraint details required for equipment mounted outdoors. Comply with requirements in other Division 23 Sections for equipment mounted outdoors.
   
   d. Pre-approval and Evaluation Documentation: By an agency acceptable to authorities having jurisdiction, showing maximum ratings of restraint items and the basis for approval (tests or calculations).

C. Coordination Drawings: Show coordination of seismic bracing for HVAC piping and equipment with other systems and equipment in the vicinity, including other supports and seismic restraints.

D. Welding certificates.

E. Operation and Maintenance Data: For air-mounting systems to include in operation and maintenance manuals.

F. Manufacturer’s field reports.

G. Project Record Documents: Record actual locations of hangers including attachment points.

1.06 QUALITY CONTROL

A. Comply with seismic-restraint requirements in the IBC.

B. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
C. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage pre-approval by an agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If pre-approved ratings are not available, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer.

PART 2 - PRODUCTS

2.01 VIBRATION ISOLATORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Amber/Booth Company, Inc.
2. I.S.A.T (International Seismic Application Technology).
5. M.W. Sausse/Vibrex

B. Pads: Arranged in single or multiple layers of sufficient stiffness for uniform loading over pad area, molded with a non-slip pattern and galvanized-steel baseplates, and factory cut to sizes that match requirements of supported equipment.

1. Resilient Material: Oil- and water-resistant neoprene or hermetically sealed compressed fiberglass.

C. Mounts: Double-deflection type, with molded, oil-resistant rubber, hermetically sealed compressed fiberglass, or neoprene isolator elements with factory-drilled, encapsulated top plate for bolting to equipment and with baseplate for bolting to structure. Color-code or otherwise identify to indicate capacity range.

1. Materials: Cast-ductile-iron or welded steel housing containing two separate and opposing, oil-resistant rubber or neoprene elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.
2. Neoprene: Shock-absorbing materials compounded according to the standard for bridge-bearing neoprene as defined by AASHTO.

D. Restrained Mounts: All-directional mountings with seismic restraint.

1. Materials: Cast-ductile-iron or welded steel housing containing two separate and opposing, oil-resistant rubber or neoprene elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.
2. Neoprene: Shock-absorbing materials compounded according to the standard for bridge-bearing neoprene as defined by AASHTO.

E. Restrained Spring Isolators: Freestanding, steel, open-spring isolators with seismic or limit-stop restraint.

1. Housing: Steel with resilient vertical-limit stops to prevent spring extension due to weight being removed; factory-drilled baseplate bonded to 1/4-inch- (6-mm-) thick, neoprene or rubber isolator pad attached to baseplate underside; and adjustable equipment mounting and leveling bolt that acts as blocking during installation.
2. Restraint: Seismic or limit stop as required for equipment and authorities having jurisdiction.
3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

F. Housed Spring Mounts: Housed spring isolator with integral seismic snubbers.
   1. Housing: Ductile-iron or steel housing to provide all-directional seismic restraint.
   2. Base: Factory drilled for bolting to structure.
   3. Snubbers: Vertically adjustable to allow a maximum of 1/4-inch (6-mm) travel up or down before contacting a resilient collar.

G. Elastomeric Hangers: Single or double-deflection type, fitted with molded, oil-resistant elastomeric isolator elements bonded to steel housings with threaded connections for hanger rods. Color-code or otherwise identify to indicate capacity range.

H. Spring Hangers: Combination coil-spring and elastomeric-insert hanger with spring and insert in compression.
   1. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
   2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
   3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
   4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
   5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
   6. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.
   7. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.

I. Spring Hangers with Vertical-Limit Stop: Combination coil-spring and elastomeric-insert hanger with spring and insert in compression and with a vertical-limit stop.
   1. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
   2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
   3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
   4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
   5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
   6. Elastomeric Element: Molded, oil-resistant rubber or neoprene.
   7. Adjustable Vertical Stop: Steel washer with neoprene washer "up-stop" on lower threaded rod.
   8. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.
2.02 VIBRATION ISOLATION EQUIPMENT BASES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Amber/Booth Company, Inc.
3. Mason Industries.
4. M.W. Sausse

B. Steel Base: Factory-fabricated, welded, structural-steel bases and rails.

1. Design Requirements: Lowest possible mounting height with not less than 1-inch (25-mm) clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails.
   a. Include supports for suction and discharge elbows for pumps.
2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A 36/A 36M. Bases shall have shape to accommodate supported equipment.
3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.


1. Design Requirements: Lowest possible mounting height with not less than 1-inch (25-mm) clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails.
   a. Include supports for suction and discharge elbows for pumps.
2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A 36/A 36M. Bases shall have shape to accommodate supported equipment.
3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.
4. Fabrication: Fabricate steel templates to hold equipment anchor-bolt sleeves and anchors in place during placement of concrete. Obtain anchor-bolt templates from supported equipment manufacturer.

2.03 SEISMIC-RESTRAINT DEVICES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Amber/Booth Company, Inc.
2. Hilti, Inc.
5. TOLCO Incorporated; a brand of NIBCO INC.
6. Unistrut; Tyco International, Ltd.80.

B. General Requirements for Restraint Components: Rated strengths, features, and applications shall be as defined in reports by an agency acceptable to authorities having jurisdiction.

1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they will be subjected.
C. Snubbers: Factory fabricated using welded structural-steel shapes and plates, anchor bolts, and replaceable resilient isolation washers and bushings.

1. Anchor bolts for attaching to concrete shall be seismic-rated, drill-in, and stud-wedge or female-wedge type.
2. Resilient Isolation Washers and Bushings: Oil- and water-resistant neoprene.
3. Maximum 1/4-inch (6-mm) air gap, and minimum 1/4-inch- (6-mm-) thick resilient cushion.

D. Channel Support System: MFMA-3, shop- or field-fabricated support assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end and other matching components and with corrosion-resistant coating; and rated in tension, compression, and torsion forces.

E. Restraint Cables: ASTM A 492 stainless-steel cables with end connections made of steel assemblies with thimbles, brackets, swivel, and bolts designed for restraining cable service; and with a minimum of two clamping bolts for cable engagement.

F. Hanger Rod Stiffener: Reinforcing steel angle clamped to hanger rod.

G. Bushings for Floor-Mounted Equipment Anchor Bolts: Neoprene bushings designed for rigid equipment mountings, and matched to type and size of anchor bolts and studs.

H. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings, and matched to type and size of attachment devices used.

I. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.

J. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488. Minimum length of eight times diameter.

K. Adhesive Anchor Bolts: Drilled-in and capsule anchor system containing polyvinyl or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

2.04 FACTORY FINISHES

A. Finish: Manufacturer’s standard paint applied to factory-assembled and -tested equipment before shipping.

1. Powder coating on springs and housings.
2. All hardware shall be galvanized. Hot-dip galvanized metal components for exterior use.
3. Baked enamel or powder coat for metal components on isolators for interior use.
4. Color-code or otherwise mark vibration isolation and seismic-control devices to indicate capacity range.
PART 3 - EXECUTION

3.01 EXAMINATION
A. Examine areas and equipment to receive vibration isolation and seismic-control devices for compliance with requirements for installation tolerances and other conditions affecting performance.
B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.
C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 APPLICATIONS
A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application by an agency acceptable to authorities having jurisdiction.
B. Hanger Rod Stiffeners: Install hanger rod stiffeners where required to prevent buckling of hanger rods due to seismic forces.
C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static and seismic loads within specified loading limits.

3.03 VIBRATION-CONTROL AND SEISMIC-RESTRAINT DEVICE INSTALLATION
A. Comply with requirements in Division 7 Section "Roof Accessories" for installation of roof curbs, equipment supports, and roof penetrations.
B. Equipment Restraints:
   1. Install seismic snubbers on HVAC equipment mounted on vibration isolators. Locate snubbers as close as possible to vibration isolators and bolt to equipment base and supporting structure.
   2. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch (3.2 mm).
   3. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction providing required submittals for component.
C. Piping Restraints:
   1. Comply with requirements in MSS SP-127.
   2. Space lateral supports a maximum of 40 feet (12 m) o.c., and longitudinal supports a maximum of 80 feet (24 m) o.c.
   3. Brace a change of direction longer than 12 feet (3.7 m).
D. Install cables so they do not bend across edges of adjacent equipment or building structure.
E. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction providing required submittals for component.
F. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.
G. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.
H. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.

I. Drilled-in Anchors:

1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid pre-stressed tendons, electrical and telecommunications conduit, and gas lines.

2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.

3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.

4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.

5. Set anchors to manufacturer’s recommended torque, using a torque wrench.

6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.04 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

A. Install flexible connections in piping where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where the connections terminate with connection to equipment that is anchored to a different structural element from the one supporting the connections as they approach equipment.

3.05 ADJUSTING

A. Adjust isolators after piping system is at operating weight.

B. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.

C. Adjust active height of spring isolators.

D. Adjust restraints to permit free movement of equipment within normal mode of operation.

3.06 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner’s maintenance personnel to adjust, operate, and maintain air-mounting systems. Refer to Division 1 Section "Demonstration and Training."

3.07 OWNER’S FIELD VERIFICATION

A. Provide services of testing agency to take noise measurement per Owner’s request for two (2) eight (8) hour days (non-concurrent) as scheduled with Owner’s designated representative. Use meters meeting requirements of ASA 47 (ANSI S1.4).

END OF SECTION
PART 1 - GENERAL

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

1.02 SUMMARY
A. Section Includes:
   1. Equipment labels.
   2. Warning signs and labels.
   3. Pipe labels.
   4. Duct labels.
   5. Stencils.
   6. Warning tags.

1.03 SUBMITTALS
A. Product Data: For each type of product indicated.
B. Samples: For color, letter style, and graphic representation required for each identification material and device.
C. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.

1.04 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

2.01 Manufacture
A. Manufacturers:
   1. Brady Corporation,
   2. Brimar Industries, Inc
   3. Marking Services, Inc (MSI)
   4. Panduit Corporation,
   5. Seton Identification Products
2.02 EQUIPMENT LABELS

A. Plastic Labels for Equipment:
   1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
   4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
   5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
   6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
   7. Fasteners: Stainless-steel rivets or self-tapping screws.

B. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified.

C. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.03 WARNING SIGNS AND LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.

B. Letter Color: Red.

C. Background Color: White.

D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

G. Fasteners: Stainless-steel rivets or self-tapping screws.

H. Label Content: Include caution and warning information, plus emergency notification instructions.

2.04 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 high.

2.05 DUCT LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.

B. Letter Color: Yellow.

C. Background Color: White.

D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

G. Fasteners: Stainless-steel rivets or self-tapping screws.

H. Duct Label Contents: Include identification of duct service using same designations or abbreviations as used on Drawings, duct size, and an arrow indicating flow direction.

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

2.06 STENCILS

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

   2. Stencil Paint: Exterior, gloss, acrylic enamel black unless otherwise indicated. Paint may be in pressurized spray-can form.
   3. Identification Paint: Exterior, acrylic enamel in colors according to ASME A13.1 unless otherwise indicated.

2.07 WARNING TAGS

A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.

   1. Size: Approximately 4 by 7 inches.
   2. Fasteners: Brass grommet and wire.
   3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."

PART 3 - EXECUTION

3.01 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.

3.02 EQUIPMENT LABEL INSTALLATION

A. Install or permanently fasten labels on each major item of mechanical equipment.

B. Locate equipment labels where accessible and visible.

3.03 PIPE LABEL INSTALLATION

A. Piping Color-Coding: Painting of piping is specified in Division 09 Section "Interior Painting."

B. Stenciled Pipe Label Option: Stenciled labels may be provided instead of manufactured pipe labels, at Installer's option. Install stenciled pipe labels with painted, color-coded bands or rectangles, complying with ASME A13.1, on each piping system.

1. Identification Paint: Use for contrasting background.

C. 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.

D. Provide red ceiling tacks ¾” Diameter to locate valves or dampers above T-bar type panel ceilings. Locate in corner of panel closest to equipment.

E. Room temperature sensors shall have engraved nameplates on wall adjacent to temperature sensor that identify the room number, zone number and the HVAC unit number that serves that room.

3.04 DUCT LABEL INSTALLATION

A. Install plastic-laminated duct labels with permanent adhesive on air ducts in the following color codes:

1. Blue: For cold-air supply ducts.
2. Yellow: For hot-air supply ducts.
4. ASME A13.1 Colors and Designs: For hazardous material exhaust.

B. Stenciled Duct Label Option: Stenciled labels, showing service and flow direction, may be provided instead of plastic-laminated duct labels, at Installer's option, if lettering larger than 1 inch high is needed for proper identification because of distance from normal location of required identification.

C. Locate labels near points where ducts enter into concealed spaces and at maximum intervals of 50 feet in each space where ducts are exposed or concealed by removable ceiling system.

3.05 WARNING-TAG INSTALLATION

A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION
PART 1 - GENERAL

1.01 SUMMARY

A. Drawings, all addendums, General and Special Conditions of the Contract, Divisions 00 and 01 Specification Sections, apply to this Section.

B. Testing, Adjusting, and Balancing HVAC systems will be performed by a firm contracted separately by the Owner.

C. This Section includes the TABA and Contractor requirements for the testing, adjusting, and balancing of HVAC systems to produce design objectives, including the following:

1. Balancing airflow within distribution systems, including sub mains, branches, and terminals, to indicated quantities according to specified tolerances.
2. Adjusting total HVAC systems to provide indicated quantities.
5. Reporting results of the activities and procedures specified in this Section.
6. Balancing of domestic hot and tempered water return systems.

1.02 RELATED SECTIONS INCLUDE THE FOLLOWING:

A. Document AIA A201 – General Conditions: Inspections, tests, and approvals required by public authorities.

B. Document AIA A201 – General Conditions

C. Section 01 40 00 – Quality Control

D. Section 01 43 26 – Testing Laboratory/Agency Services

E. Section 01 75 00 – Starting of Systems

F. Section 01 75 10 – System Demonstration

G. Section 01 31 30 – Testing, Adjusting, and Balancing

H. Individual Sections: Qualification of testing organization; specific services required. Where there is any conflict of services or directions between Sections regarding the Testing and Balancing of Systems, contact the Architect immediately.

1.03 DEFINITIONS

A. Adjust: To regulate fluid flow rate and air patterns at the terminal equipment, such as to reduce fan speed or adjust a damper.

B. Balance: To proportion flows within the distribution system, including sub mains, branches, and terminals, according to design quantities.
C. Draft: A current of air, when referring to localized effect caused by one or more factors of high
  Air velocity, low ambient temperature, or direction of airflow, whereby more heat is withdrawn from a person's skin than is normally dissipated.

D. System Effect: A phenomenon that can create undesired

E. or unpredicted conditions that cause reduced capacities in all or part of a system.

F. System Effect Factors: Allowances used to calculate a reduction of the performance ratings of a fan when installed under conditions different from those presented when the fan was performance tested.

G. Terminal: A point where the controlled medium, such as fluid or energy, enters or leaves the distribution system.

H. Test: A procedure to determine quantitative performance of a system or equipment.

I. Testing, Adjusting, and Balancing Agent: The entity responsible for performing and reporting the testing, adjusting, and balancing procedures.


L. SMACNA: Sheet Metal and Air Conditioning Contractors' National Association.

1.04 SUBMITTALS

A. Draft Reports: prior to commencing work, submit a detailed agenda of balancing procedures for this project. Include a draft report utilizing proper and relevant report forms appropriate to the procedures. The forms shall be essentially completed with design criteria and approved performance data of the equipment approved for use. This shall be representative of the information to be included in the final report. Accompanying this agenda/draft report shall be a complete set of approved performance submittal data on equipment relevant to the HVAC systems, etc. Also, submit the AABC National Project Performance Guarantee, or the acceptable equivalent thereof.

B. Test Reports: Prior to the final acceptance of the project, submit for approval and for inclusion into the operating and maintenance manuals. Provide the report in six copies, letter size, spiral-type (3-ring for larger reports) permanent binder, with index page, tabs, with cover identification. The report shall also include a significant General Comments section identifying unusual or incomplete final conditions that could not be remedied fully or satisfactorily. This shall also summarize such significant data that may appear on individual test data sheets. Included in the report shall be reduced scale drawings with air outlets and equipment identified to correspond to the data sheets but also the final as-built, contract drawings with respect to mark numbers, room numbers and other significant physical I.D., etc. Also show final locations of thermostats, sensing elements and duct traverses. The report shall provide evidence that all reasonable efforts on the part of the TABA and the related trades shall have been performed sufficiently to remedy any remaining deficiencies.

The report shall include an appendix with copies of all Site Inspection Reports (or equivalent thereof) issued by the TABA and the responses by any and all parties, relevant to the
Inspection Reports. In addition, shall there have been RFI’s & Change Orders affecting the TAB work, they shall be included.

C. Copies of the approved performance curves, charts, etc., on all fans, pumps, chillers, towers, boilers, etc. shall be included in a separate section or appendix of the TAB report.

It is the responsibility of the Architect and Consulting Engineer to provide “approved” copies of the appropriate submittal/performance data of the equipment involved in the installation. They shall also provide copies of the appropriate drawings and specifications, addenda, change borders, etc., required by the TABA to perform their work.

D. Report Forms: Forms utilized shall be significantly similar to the forms of the AABC National Standards.

1.05 QUALIFICATION AND QUALITY CONTROL

A. All work shall be performed per the National Standards (latest edition) of the Associated Air Balance Council (AABC) and the AABC Procedures Manual; these shall be considered the minimum criteria. Agencies shall be certified by AABC and all work shall be performed under the direct field supervision of an AABC certified TBE.

B. The successful TABA shall be immediately provided with the necessary contract drawings, approved submittal data, etc., required to enable their critique of the contract drawings, addenda and specifications with respect to determining the “balance-ability” of the systems. This report shall be given to the Owner, Architect and Engineer. The TABA shall expedite this important aspect of TAB services.

1.06 GENERAL SCOPE OF WORK

A. Testing, Adjusting and Balancing of the heating, ventilating and air conditioning (HVAC) systems.

B. All work shall be performed per the National Standards (latest edition) of the Associated Air Balance Council (AABC) and shall be considered the minimum criteria. These Standards are to be used and applied on the appropriate scope of the systems utilized and installed in and on this project. The TABA shall be totally familiar with these Standards and further detailed directions will not be provided unless specifically stated herein.

C. Test & Balance Agencies (TABA) shall be certified by the AABC, and all work shall be performed under the direct field supervision of an AABC certified TBE. All TABA firms shall have a permanent office in So. Nevada, locally manned with certified personnel and a Test & Balance Engineer. The TABA shall have been a member agency in good standing with their association for a minimum of three (3) years.

1.07 PROJECT CONDITIONS

A. Full Owner Occupancy: The Owner will occupy the site and existing building during the entire testing, adjusting, and balancing period. Cooperate with the Owner during testing, adjusting, and balancing operations to minimize conflicts with the Owner's operations.
B. Partial Owner Occupancy: The Owner may occupy completed areas of the building before Substantial Completion. Cooperate with the Owner during testing, adjusting, and balancing operations to minimize conflicts with the Owner's operations.

1.08 COORDINATION

A. Contractor and the Contractor’s representatives shall coordinate the systems and equipment, HVAC controls installers, and other mechanics to operate HVAC systems and equipment to support and assist testing, adjusting, and balancing activities.

B. Perform testing, adjusting, and balancing after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

C. Commissioning Agency will coordinate with TABA.

1.09 RESPONSIBILITY OF CONTRACTOR

A. Should the TABA be unable to perform his work or be required to redo his work because HVAC System(s) (elements, components or subsystems) are not ready or are improperly installed, any additional costs, herein related and approved by the owner, shall be back charged to the Contractor.

B. Contractor and all Sub-Contractors shall cooperate fully with the TABA to efficiently complete the systems and their balancing.

C. Other than their instrumentation, gauges, etc., the TABA shall not provide nor install any devices or components. It is the responsibility of the Contractor to ensure the necessary assistance and coordination is provided which shall include (but not limited to):

1. Calibration of all controls (includes providing of instrumentation and software necessary to the operation of same, i.e. computers, etc.), providing and installing of drives, dampers, filters, access, test holes, gauges and taps (properly located), sealing of holes and insulation, removal and replacement of ceiling and/or tiles, water systems cleaned and flushed, duct leakage and pressure testing, proper motor starters and heaters installed, volume, fire and smoke/fire dampers, diffusers, grilles. All duct-mounted dampers shall be placed and locked in a full open position and clearly “flagged” for ease of location. The ceiling tile shall be clearly and permanently ID’d, for everyone’s knowledge of access. Hard ceilings shall be provided with permanent access. Where required the contractor(s) shall provide the necessary and adequate lifts and scaffolds.

2. All systems shall be checked, tested and started prior to turning them over to the TABA, and the report of same, in writing, provided to the TABA, as well as the owner. Contractor shall have a competent technician or tradesmen available during the testing and balancing of the systems. There shall be an HVAC technician, fully familiar with the systems, on site full time during the work of the TABA.

D. Examine system and equipment installations to verify that they are complete and that testing, cleaning, adjusting, and commissioning specified in individual Specification Sections have been performed.

E. Examine equipment for installation and for properly operating safety interlocks and controls.
F. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary to allow adequate performance of procedures. After testing and balancing, close probe holes and patch insulation with new materials identical to those removed. Restore vapor barrier and finish according to the insulation Specifications for this Project.

G. Examine automatic temperature system components to verify the following:

1. Dampers, valves, and other controlled devices operate by the intended controller.
2. Dampers and valves are in the position indicated by the controller.
3. Integrity of valves and dampers for free and full operation and for tightness of fully closed and fully open positions. This includes dampers in multi-zone units, mixing boxes, and variable-air-volume terminals.
4. Automatic modulating and shutoff valves, including 2-way valves and 3-way mixing and diverting valves, are properly connected.
5. Thermostats and humidists are located to avoid adverse effects of sunlight, drafts, and cold walls.
6. Sensors are located to sense only the intended conditions.
7. Sequence of operation for control modes is according to the Contract Documents.
8. Controller set points are set at design values. Observe and record system reactions to changes in conditions. Record default set points if different from design values.
9. Interlocked systems are operating.
10. Changeover from heating to cooling mode occurs according to design values.

1.10 WARRANTY

A. General Warranty.

B. Provide one-year full warranty from date of Substantial Completion.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine Contract Documents to become familiar with project requirements and to discover conditions in systems' designs that may preclude proper testing, adjusting, and balancing of systems and equipment.

1. Contract Documents are defined in the General and Supplementary Conditions of the Contract.
2. Verify that balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are required by the Contract Documents. Verify that quantities and locations of these balancing devices are accessible and appropriate for effective balancing and for efficient system and equipment operation.

B. Examine approved submittal data of HVAC systems and equipment.

C. Examine project record documents described in Division 1 Section "Project Record Documents."
D. Examine system and equipment test reports.

E. Examine HVAC system and equipment installations to verify that indicated balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are properly installed, and their locations are accessible and appropriate for effective balancing and for efficient system and equipment operation.

F. Examine systems for functional deficiencies that cannot be corrected by adjusting and balancing, and Report all deficiencies to UNLV Project Manager.

G. Examine air-handling equipment to ensure clean filters have been installed, bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.

H. Examine terminal units, such as variable-air-volume boxes and mixing boxes, to verify that they are accessible and their controls are connected and functioning.

I. Report deficiencies discovered before and during performance of testing, adjusting, and balancing procedures to UNLV Project Manager.

3.02 PREPARATION

A. Prepare a testing, adjusting, and balancing plan that includes strategies and step-by-step procedures:

1. Before commencing work, as best as can be done, verify that systems are complete, operable and ready to balance. The TABA shall not begin their work until they (and the Owner) have received, in writing, from the installing contractors and the commissioning agency, that all of the systems have been completed, checked, tested and started and are completely ready for the TABA to begin their work.

B. This project will be accomplished in phases and the TABA shall visit the site and review the Work during systems installations for each phase. A written report (Site Inspection Report) of these inspections shall be sent to the Owner, Engineer and Contractor.

C. The TABA shall provide daily Site Inspection Reports during performance of the work. Reports shall list any defects, deficiencies or abnormal conditions observed in the systems, which may prevent systems balance, or compromise the proper operation of the systems. Reports shall be sent via fax or Email, by the following workday, to the Owner, Engineer and Contractor. Additionally, the prime Contractor shall provide a three-ring binder, on site, wherein copies of these reports/inspections shall be placed for the use of the contractors, inspectors or others.

Each of the above-notified parties shall document acceptance and receipt of these Reports by signing same, and returning that document to the owner or his representative and the TABA.

D. Recorded data shall represent actually measured or observed conditions and appropriate ambient conditions.

E. The intent and goal of testing and balancing is to have a completed system(s) functioning per design and has no deficiencies. The fullest cooperation between the TABA, Commissioning Agency and the Contractor and his trades is essential.
3.03 GENERAL TESTING AND BALANCING PROCEDURES

A. Perform testing and balancing procedures on each system according to the procedures contained in AABC national standards and this Section.

B. The TABA shall permanently mark settings of valves, dampers and other adjustment devices. Set and lock memory stops and mark them. Mark equipment settings with paint or other suitable, permanent identification material, including damper-control positions, valve indicators, fan-speed-control levers, and similar controls and devices, to show final settings.

3.04 FINAL REPORT

A. General: Typewritten, or computer printout in letter-quality font, on standard bond paper, in 3-ring binder (6copies), tabulated and divided into sections by tested and balanced systems.

B. Include a certification sheet in front of binder signed and sealed by the certified testing and balancing Engineer.

C. Include a list of the instruments used for procedures, along with proof of calibration.

D. Final Report Contents: In addition to the certified field report data, include the following:

1. Pump curves.
2. Fan curves.
3. Manufacturers' test data.
4. Field test reports prepared by system and equipment installers.
5. Other information relative to equipment performance, but do not include approved Shop Drawings and Product Data.
6. All sight inspection and deficiency reports done by TABA.
7. Domestic hot and tempered water return systems final reading.

E. General Report Data: In addition to the form titles and entries, include the following data in the final report, as applicable:

1. Title page.
2. Name and address of testing, adjusting, and balancing Agent.
3. Project name.
4. Project location.
5. Architect's name and address.
6. Engineer's name, address, and approval stamp.
7. Contractor's name and address.
9. Signature of testing, adjusting, and balancing Agent who certifies the report.

END OF SECTION
SECTION 23 07 00
HVAC INSULATION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:

1. Insulation Materials:
   a. Cellular glass.
   b. Flexible elastomeric.
   c. Mineral fiber.
   d. Polyisocyanurate.
2. Insulating cements.
3. Adhesives.
5. Lagging adhesives.
7. Factory-applied jackets.
8. Field-applied jackets.
10. Securements.
11. Corner angles.

B. Related Sections:

1. Division 22 Section "Plumbing Insulation."
2. Division 23 Section "Metal Ducts" for duct liners.

1.03 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 insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
3. Detail removable insulation at piping specialties, equipment connections, and access panels.
4. Detail application of field-applied jackets.
5. Detail application at linkages of control devices.
6. 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.
F. Acoustical duct liner.

1.04 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

B. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing and inspecting agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.05 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.

1.06 COORDINATION

A. Coordinate size and location of supports, hangers, and insulation shields specified in Division 23 Section “Hangers and Supports for HVAC Piping and Equipment.”

B. Coordinate clearance requirements with piping Installer for piping insulation application, duct installer for duct insulation application, and equipment Installer for equipment insulation application. Before preparing piping and ductwork 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.

1.07 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

2.01 INSULATION MATERIALS


B. Comply with requirements in Part 3 schedule articles for where insulating materials shall be applied.

C. Products shall not contain asbestos, lead, mercury, or mercury compounds.

D. 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.

E. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

F. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

G. Thickness for foam having K-factor of 0.165 may be required from that indicated for mineral fiber insulation having K-factor of 0.24 provided the equivalent thermal resistance is maintained.

H. Cellular Glass: Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Products: Subject to compliance with requirements, provide one of the following:
   a. Certain Teed Corp.
   b. Owen Corning

2. Block Insulation: ASTM C 552, Type I.

3. Special-Shaped Insulation: ASTM C 552, Type III.

4. Board Insulation: ASTM C 552, Type IV.

5. Preformed Pipe Insulation without Jacket: Comply with ASTM C 552, Type II, Class 1.


7. Factory fabricate shapes according to ASTM C 450 and ASTM C 585.

I. 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.

J. Mineral-Fiber Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB. For duct and plenum applications, provide insulation without factory-applied jacket. For equipment applications, provide insulation without factory-applied jacket.

1. Products: Subject to compliance with requirements, provide one of the following:
   a. CertainTeed Corp.
   b. Johns Manville.
   c. Knauf Insulation.
   d. Owens Corning.
K. Mineral-Fiber, Preformed Pipe Insulation:

1. Products: Subject to compliance with requirements, provide one of the following:
   a. Fibrex Insulations Inc.; Coreplus 1200.
   b. Johns Manville; Micro-Lok.
   c. Knauf Insulation; 1000 Pipe Insulation.
   d. Owens Corning; Fiberglas Pipe Insulation.

2. Type I, 850 deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ-SSL. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

3. Type II, 1200 deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type II, Grade A, with factory-applied ASJ-SSL. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

L. Mineral-Fiber, Pipe and Tank Insulation: Mineral or glass fibers bonded with a thermosetting resin. Semirigid board material with factory-applied FSK jacket complying with ASTM C 1393, Type II or Type IIIA Category 2, or with properties similar to ASTM C 612, Type IB. Nominal density is 2.5 lb/cu. ft. or more. Thermal conductivity (k-value) at 100 deg is 0.29 Btu x in./h x sq. ft. x deg F or less. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Products: Subject to compliance with requirements, provide one of the following:
   a. CertainTeed Corp.; CrimpWrap.
   b. Johns Manville; MicroFlex.
   c. Knauf Insulation; Pipe and Tank Insulation.
   d. Owens Corning; Fiberglas Pipe and Tank Insulation.

M. Polyisocyanurate: Unfaced, preformed, rigid cellular polyisocyanurate material intended for use as thermal insulation.

1. Products: Subject to compliance with requirements, provide one of the following:
   a. Dow Chemical Company (The); Trymer.
   b. HiTherm

2. Comply with ASTM C 591, Type I or Type IV, except thermal conductivity (k-value) shall not exceed 0.165 Btu x in./h x sq. ft. x deg F at 75 deg F after 180 days of aging.

3. Flame-spread index shall be 25 or less and smoke-developed index shall be 50 or less for thickness up to 1-1/2 inches as tested by ASTM E 84.

4. Fabricate shapes according to ASTM C 450 and ASTM C 585.

   a. Pipe Applications: ASJ-SSL.
   b. Equipment Applications: ASJ-SSL.

2.02 INSULATING CEMENTS


1. Products: Subject to compliance with requirements, provide one of the following:
   a. Insulco, Division of MFS, Inc.; Triple I.
B. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449/C 449M.

1. Products: Subject to compliance with requirements, provide one of the following
   a. Insulco, Division of MFS, Inc.; SmoothKote.
   c. Rock Wool Manufacturing Company; Delta One Shot.

2.03 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. Cellular-Glass and Polyisocyanurate Adhesive: Solvent-based resin adhesive, with a service temperature range of minus 75 to plus 300 deg F.

1. Products: Subject to compliance with requirements, provide one of the following
   a. Childers Products, Division of ITW; CP-96.

C. 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. Childers Products
   b. Ductmate Industries
   c. Foster Products Corporation, H. B. Fuller Company; 85-75.

D. 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. Ductmate Industries
   d. Design Polymenics


1. Products: Subject to compliance with requirements, provide one of the following
   a. Childers Products, Division of ITW; CP-82.
   c. Ductmate Industries
   d. Design Polymenics

F. 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.
   e. Speedline Corporation; Speedline Vinyl Adhesive.
2.04 MASTICS

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

B. Vapor-Barrier Mastic: Water based; suitable for indoor and outdoor use on below ambient services.

1. Products: Subject to compliance with requirements, provide one of the following
   a. Childers Products, Division of ITW; CP-35.
   b. Foster Products Corporation, H. B. Fuller Company; 30-90.
   c. ITW TACC, Division of Illinois Tool Works; CB-50.
   d. Marathon Industries, Inc.; 590.
   e. Mon-Eco Industries, Inc.; 55-40.
   f. Vimasco Corporation; 749.

2. Water-Vapor Permeance: ASTM E 96, Procedure B, 0.013 perm at 43-mil dry film thickness.

3. Service Temperature Range: Minus 20 to plus 180 deg F.


2.05 LAGGING ADHESIVES

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

1. Products: Subject to compliance with requirements, provide one of the following
   a. Childers Products, Division of ITW; CP-52.
   b. Foster Products Corporation, H. B. Fuller Company; 81-42.
   c. Design Polymenics
   d. Ductmate Industries

2. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over duct, equipment, and pipe insulation.

3. Service Temperature Range: Minus 50 to plus 180 deg F.


2.06 SEALANTS

A. Joint Sealants:

1. Joint Sealants for Cellular-Glass and Polyisocyanurate Products: Subject to compliance with requirements, provide one of the following
   a. Childers Products, Division of ITW; CP-76.
   b. Foster Products Corporation, H. B. Fuller Company; 30-45.
   c. Ductmate Industries

2. Materials shall be compatible with insulation materials, jackets, and substrates.

3. Permanently flexible, elastomeric sealant.

4. Service Temperature Range: Minus 100 to plus 300 deg F.

5. Color: White or gray.

B. FSK and Metal Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, provide one of the following
   a. Childers Products, Division of ITW; CP-76-8.
b. Foster Products Corporation, H. B. Fuller Company; 95-44.
c. Marathon Industries, Inc.; 405.
d. Mon-Eco Industries, Inc.; 44-05.
e. Vimasco Corporation; 750.

2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: Aluminum.

C. 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. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.

2.07 FACTORY-APPLIED JACKETS

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

1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.
4. FSP Jacket: Aluminum-foil, fiberglass-reinforced scrim with polyethylene backing; complying with ASTM C 1136, Type II.
5. PVDC Jacket for Indoor Applications: 4-mil-thick, white PVDC biaxially oriented barrier film with a permeance at 0.02 perms when tested according to ASTM E 96 and with a flame-spread index of 5 and a smoke-developed index of 20 when tested according to ASTM E 84.
   a. Products: Subject to compliance with requirements, provide one of the following:
      1) Dow Chemical Company (The); Saran 540 Vapor Retarder Film and Saran 560 Vapor Retarder Film.

2.08 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.

C. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C;0.03-inch thick; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.

1. Products: Subject to compliance with requirements, provide one of the following:
   a. Johns Manville; Zeston.
   c. Proto PVC Corporation; LoSmoke.
   d. Speedline Corporation; SmokeSafe.

2. Adhesive: As recommended by jacket material manufacturer.
3. Color: White
4. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.
   a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.
5. Factory-fabricated tank heads and tank side panels.

2.09 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.
   3. Thickness: 11.5 mil.
   5. Elongation: 2 percent.
   6. Tensile Strength: 40 lbf/inch in width.
   7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
      b. Compac Corp.; 110 and 111.
      c. Ideal Tape Co., Inc., an American Biltrite Company; 491 AWF FSK.
      d. Venture Tape; 1525 CW, 1528 CW, and 1528 CW/SQ.
   2. Width: 3 inches.
   3. Thickness: 6.5 mils.
   5. Elongation: 2 percent.
   6. Tensile Strength: 40 lbf/inch in width.
   7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive. Suitable for indoor and outdoor applications.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. 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.
   3. Thickness: 6 mils.
   5. Elongation: 500 percent.
   6. Tensile Strength: 18 lbf/inch in width.

D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
      b. Compac Corp.; 120.
c. Ideal Tape Co., Inc., an American Biltrite Company; 488 AWF.
d. Venture Tape; 3520 CW.
2. Width: 2 inches.
3. Thickness: 3.7 mils.
5. Elongation: 5 percent.
6. Tensile Strength: 34 lbf/inch in width.

2.10 SECUREMENTS

A. Bands:
1. Products: Subject to compliance with requirements, provide one of the following
   a. Childers Products; Bands.
   b. PABCO Metals Corporation; Bands.
   c. RPR Products, Inc.; Bands.
2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304 0.015 inch thick, 3/4 inch wide with wing or closed seal.
3. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 3/4 inch wide with wing or closed seal.

B. Insulation Pins and Hangers:
1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.135-inch- diameter shank, length to suit depth of insulation indicated.
   a. Products: Subject to compliance with requirements, provide one of the following:
      1) AGM Industries, Inc.; CWP-1.
      2) GEMCO; CD.
      3) Midwest Fasteners, Inc.; CD.
      4) Nelson Stud Welding; TPA, TPC, and TPS.
2. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.135-inch- diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
   a. Products: Subject to compliance with requirements, provide one of the following:
      1) AGM Industries, Inc.; CWP-1.
      2) GEMCO; Cupped Head Weld Pin.
      3) Midwest Fasteners, Inc.; Cupped Head.
      4) Nelson Stud Welding; CHP.
3. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
   a. Products: Subject to compliance with requirements, provide one of the following:
      1) AGM Industries, Inc.; Tactoo Insul-Hangers, Series T.
      2) GEMCO; Perforated Base.
      3) Midwest Fasteners, Inc.; Spindle.
   b. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
   c. Spindle: Stainless steel, fully annealed, 0.106-inch- diameter shank, length to suit depth of insulation indicated.
   d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
4. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick, galvanized-steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
   a. Products: Subject to compliance with requirements, provide one of the following:
      1) AGM Industries, Inc.; RC-150.
      2) GEMCO; R-150.
      3) Midwest Fasteners, Inc.; WA-150.
      4) Nelson Stud Welding; Speed Clips.
   b. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.

C. Staples: Outward-clinching insulation staples, nominal 3/4-inch- wide, stainless steel or Monel.

D. Wire: 0.062-inch soft-annealed, stainless steel.

   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      b. Childers Products.
      c. PABCO Metals Corporation.
      d. RPR Products, Inc.

2.11 CORNER ANGLES

A. Aluminum Corner Angles: 0.040 inch thick, minimum 1 by 1 inch aluminum according to ASTM B 209 Alloy 3003, 3005, 3105 or 5005; Temper H-14.

B. Stainless-Steel Corner Angles: 0.024 inch thick, minimum 1 by 1 inch stainless steel according to ASTM A 167 or ASTM A 240/A 240M, Type 304 or 316.
3.03 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment, ducts and fittings, 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, duct system, 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-wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches 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 ends adjacent to duct and 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 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.

3.04 PENETRATIONS

A. Insulation installation at Roof Penetrations: Install insulation continuously through roof penetrations.
   1. Seal penetrations with flashing sealant.
   2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
   3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
   4. Seal jacket to roof flashing with flashing sealant.

B. Insulation installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.

C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
   1. Seal penetrations with flashing sealant.
   2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
   3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
   4. Seal jacket to wall flashing with flashing sealant.

D. Insulation installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

E. Insulation installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions. Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches.
1. Comply with requirements in Division 07 Section "Thermal and Moisture Protection" firestopping and fire-resistant joint sealers.

F. Insulation Installation at Floor Penetrations:

1. Duct: Install insulation continuously through floor penetrations that are not fire rated. For penetrations through fire-rated assemblies, terminate insulation at fire damper sleeves and externally insulate damper sleeve beyond floor to match adjacent duct insulation. Overlap damper sleeve and duct insulation at least 2 inches.

2. Pipe: Install insulation continuously through floor penetrations.

3. Seal penetrations through fire-rated assemblies. Comply with requirements in Division 07 Section "Thermal and Moisture Protection".

3.05 GENERAL PIPE INSULATION INSTALLATION

A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:

1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity, unless otherwise indicated.

2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.

3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.

4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.

5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below ambient services, provide a design that maintains vapor barrier.

6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.

7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below ambient services and a breather mastic for above ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.

8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.

9. Stencil or label the outside insulation jacket of each union with the word "UNION." Match size and color of pipe labels.
C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes, vessels, and equipment. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

D. Install removable insulation covers at locations indicated. Installation shall conform to the following:

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

3.06 CELLULAR-GLASS INSULATION INSTALLATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above ambient services, secure laps with outward clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets on below ambient services, do not staple longitudinal tabs 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 preformed sections of same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
2. When preformed sections of insulation are not available, install mitered sections of cellular-glass insulation. Secure insulation materials with wire or bands.

C. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of cellular-glass insulation to valve body.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
3.07 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 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.

C. 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.

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

C. Insulation Installation on Valves and Pipe Specialties:
   1. Install preformed sections of same material as straight segments of pipe insulation when available.
   2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
   3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
   4. Install insulation to flanges as specified for flange insulation application.
D. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.

1. Apply adhesives according to manufacturer’s recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
   a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
   b. On duct sides with dimensions larger than 18 inches, place pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
   c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
   d. Do not overcompress insulation during installation.
   e. Impale insulation over pins and attach speed washers.
   f. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from 1 edge and 1 end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
   a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
   b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to 2 times the insulation thickness but not less than 3 inches.

5. Overlap unfaced blankets a minimum of 2 inches on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches o.c.
6. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
7. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch-wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

3.09 POLYISOCYANURATE INSULATION INSTALLATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of insulation to pipe with tape or bands and tighten without deforming insulation materials. Orient longitudinal joints between half sections in 3 and 9 o’clock positions on the pipe.
2. For insulation with factory-applied jackets with vapor barriers, do not staple longitudinal tabs but secure tabs with additional adhesive or tape as recommended by insulation material manufacturer and seal with vapor-barrier mastic.
3. All insulation shall be tightly butted and free of voids and gaps at all joints. Vapor barrier must be continuous. Before installing jacket material, install vapor-barrier system.

B. Insulation Installation on Fittings and Elbows:

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

C. Insulation Installation on Valves and Pipe Specialties:

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

3.10 FIELD-APPLIED JACKET INSTALLATION

A. Where FSK jackets are indicated, install as follows:

1. Draw jacket material smooth and tight.
2. Install lap or joint strips with same material as jacket.
3. Secure jacket to insulation with manufacturer's recommended adhesive.
4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch wide joint strips at end joints.
5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

B. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturer's recommended adhesive.

1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

C. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

D. Where PVDC jackets are indicated, install as follows:

1. Apply three separate wraps of filament tape per insulation section to secure pipe insulation to pipe prior to installation of PVDC jacket.
2. Wrap factory-presized jackets around individual pipe insulation sections with one end overlapping the previously installed sheet. Install presized jacket with an approximate overlap at butt joint of 2 inches over the previous section. Adhere lap seal using adhesive or SSL, and then apply 1-1/4 circumferences of appropriate PVDC tape around overlapped butt joint.
3. Continuous jacket can be spiral wrapped around a length of pipe insulation. Apply adhesive or PVDC tape at overlapped spiral edge. When electing to use adhesives, refer to manufacturer's written instructions for application of adhesives along this spiral edge to maintain a permanent bond.
4. Jacket can be wrapped in cigarette fashion along length of roll for insulation systems with an outer circumference of 33-1/2 inches or less. The 33-1/2-inch-circumference limit allows for 2-inch overlap seal. Using the length of roll allows for longer sections of jacket to be installed at one time. Use adhesive on the lap seal. Visually inspect lap seal for "fishmouthing," and use PVDC tape along lap seal to secure joint.
5. Repair holes or tears in PVDC jacket by placing PVDC tape over the hole or tear and wrapping a minimum of 1-1/4 circumferences to avoid damage to tape edges.

3.11 FINISHES

A. Duct, Equipment, and Pipe Insulation with ASJ or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Division 09 painting Sections.

   1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.


B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

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

3.12 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. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:

   1. Drainage piping located in crawl spaces.
   2. Underground piping.
   3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

<table>
<thead>
<tr>
<th>TABLE 23 07 00-A</th>
</tr>
</thead>
<tbody>
<tr>
<td>PIPE INSULATION SCHEDULE</td>
</tr>
<tr>
<td>INSULATION THICKNESS FOR NOMINAL PIPE SIZES</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SYSTEM</th>
<th>TEMP. RANGE</th>
<th>TEMP. LESS TO 2</th>
<th>TEMP. LESS TO 4</th>
<th>TEMP. LESS TO 6</th>
<th>JACKET</th>
</tr>
</thead>
<tbody>
<tr>
<td>Condensate Drain</td>
<td>Any</td>
<td>0.5</td>
<td>0.5</td>
<td>0.5</td>
<td>--</td>
</tr>
</tbody>
</table>

NOTE: All insulation exposed to weather shall be provided with aluminum covering.

3.13 INDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. If more than one material is listed, selection from materials listed is Contractor's option.

C. Ducts and Plenums, Concealed:

   1. None.
D. Piping, Exposed (Including Mechanical Rooms):
   1. PVC: 0.03 inches thick.
   2. Aluminum, Smooth: 0.016 inch.

NOTE: All insulation exposed to weather and exposed to view in mechanical rooms and laboratories shall be provided with elastomeric polymer-based vapor barrier and weatherproof coating.

### TABLE 23 07 00-C
**DUCT INSULATION SCHEDULE**

<table>
<thead>
<tr>
<th>SYSTEM</th>
<th>LOCATION</th>
<th>INSULATION</th>
<th>JACKET</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply Air</td>
<td>Concealed/Exterior</td>
<td>Glass Fiber</td>
<td>All Service</td>
</tr>
<tr>
<td>Heating &amp; Cooling</td>
<td></td>
<td>2 Inch</td>
<td>Flexible</td>
</tr>
<tr>
<td>Supply Air</td>
<td>Exposed Cooled &amp;</td>
<td>Glass Fiber</td>
<td>Flexible Coating</td>
</tr>
<tr>
<td>Heating &amp; Cooling</td>
<td>Heated Space</td>
<td>1-1/2 Inch</td>
<td>Per 2.1</td>
</tr>
<tr>
<td>Return Air</td>
<td>Concealed In</td>
<td>Glass Fiber</td>
<td>All Service</td>
</tr>
<tr>
<td>Flexible</td>
<td>Uncooled Or</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Unheated Space</td>
<td>1-1/2 Inch</td>
<td></td>
</tr>
<tr>
<td>Return Air</td>
<td>Concealed Or</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>Exposed Cooled And</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heated Space</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Return Air</td>
<td>Exposed In</td>
<td>Glass Fiber</td>
<td>Per 2.1</td>
</tr>
<tr>
<td>Uncooled Or</td>
<td>Flexible</td>
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</tr>
<tr>
<td>Unheated Space</td>
<td></td>
<td>1-1/2 Inch</td>
<td></td>
</tr>
<tr>
<td>Coating As Insulation,</td>
<td>Or Mechanical</td>
<td>Glass Fiber</td>
<td>Flexible</td>
</tr>
<tr>
<td></td>
<td>Rooms</td>
<td>1-1/2 Inch</td>
<td>Per 2.1</td>
</tr>
<tr>
<td>Outside Air</td>
<td>All</td>
<td>Glass Fiber</td>
<td>Flexible Coating</td>
</tr>
<tr>
<td></td>
<td>2 Inch</td>
<td></td>
<td>Per 2.1</td>
</tr>
</tbody>
</table>

NOTE: All insulation exposed to weather and exposed to view in mechanical rooms and laboratories shall be provided with elastomeric polymer-based vapor barrier and weatherproof coating.

### TABLE 23 07 00-D
**EQUIPMENT INSULATION SCHEDULE**

<table>
<thead>
<tr>
<th>Cooled Equipment</th>
<th>Insulation</th>
<th>Finish Cover</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air Conditioning</td>
<td>Glass Fiber-Coated</td>
<td>Glass Cloth With</td>
</tr>
<tr>
<td>Equipment Housings, Interior</td>
<td>Semi-Rigid Board</td>
<td>Vapor Barrier</td>
</tr>
<tr>
<td>Insulation, 1 Inch</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

NOTE: All insulation exposed to weather and exposed to view in mechanical rooms and laboratories shall be provided with elastomeric polymer-based vapor barrier and weatherproof coating.

END OF SECTION
SECTION 23 21 14
CONDENSATE DRAIN PIPING

PART 1 - GENERAL

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

1.02 SUMMARY
A. This Section includes pipe and fitting materials, joining methods, special-duty valves, and specialties for the following:
   1. Condensate-drain piping.

1.03 PERFORMANCE REQUIREMENTS
A. Hydronic piping components and installation shall be capable of withstanding the following minimum working pressure and temperature:
   1. Condensate-Drain Piping: 150 deg F.

PART 2 – PRODUCTS (All piping and accessories shall be manufactured in the U.S.A.)

2.01 COPPER TUBE AND FITTINGS
A. Drawn-Temper Copper Tubing: ASTM B 88, Type L.
B. Annealed-Temper Copper Tubing: ASTM B 88, Type K.
C. Wrought-Copper Fittings: ASME B16.22.
   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:
      a. Anvil International, Inc.
      b. S. P. Fittings; a division of Star Pipe Products.
      c. Victaulic Company of America.
D. Wrought-Copper Unions: ASME B16.22.

2.02 JOINING MATERIALS
A. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
B. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for joining copper with copper; or BAg-1, silver alloy for joining copper with bronze or steel.

2.03 DIELECTRIC FITTINGS
A. Description: Combination fitting of copper-alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.
B. Insulating Material: Suitable for system fluid, pressure, and temperature.

C. Dielectric Unions:
   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:
      b. Central Plastics Company.
      d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
      e. Zurn Plumbing Products Group; AquaSpec Commercial Products Division.
   2. Factory-fabricated union assembly, for 250-psig minimum working pressure at 180 deg F.

D. Dielectric Couplings:
   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:
      a. Calpico, Inc.
      b. Lochinvar Corporation.
   2. Galvanized-steel coupling with inert and noncorrosive thermoplastic lining; threaded ends: and 300-psig minimum working pressure at 225 deg F.

E. Dielectric Nipples:
   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:
      a. Perfection Corporation; a subsidiary of American Meter Company.
      b. Precision Plumbing Products, Inc.
      c. Sioux Chief Manufacturing Company, Inc.
      d. Victaulic Company of America.

PART 3 – EXECUTION

3.01 PIPING APPLICATIONS
   A. Condensate-Drain Piping: Type L drawn-temper copper tubing, wrought-copper fittings, and soldered joints.

3.02 PIPING INSTALLATIONS
   A. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
   B. 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.
   C. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
   D. Install piping at indicated slopes.
   E. Install piping free of sags and bends.
   F. Install fittings for changes in direction and branch connections.
   G. Install piping to allow application of insulation.
H. Install drains, consisting of a tee fitting, NPS 3/4 ball valve, and short NPS 3/4 threaded nipple with cap and chain, at low points in piping system mains and elsewhere as required for system drainage.

I. Install piping at a uniform grade of 0.2 percent upward in direction of flow.

J. Reduce pipe sizes using eccentric reducer fitting installed with level side down.

K. Mechanically formed (pulled) tee fittings in main pipe, are not acceptable.

L. Install unions in piping, NPS 2 and smaller, adjacent to valves, at final connections of equipment, and elsewhere as indicated.

M. Identify piping as specified in Division 23 Section "Identification for HVAC Piping and Equipment."

3.03 HANGERS AND SUPPORTS

A. Hanger, support, and anchor devices are specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment." Comply with the following requirements for maximum spacing of supports.

B. Seismic restraints are specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."

C. Install the following pipe attachments:
   1. Adjustable steel clevis hangers for individual horizontal piping less than 20 feet long.
   2. Provide copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.

D. Install hangers for drawn-temper copper piping with the following maximum spacing and minimum rod sizes:
   1. NPS ¾; Maximum span, 5 feet; minimum rod size, 1/4 inch
   2. NPS 1: Maximum span, 6 feet; minimum rod size, 1/4 inch
   3. NPS 1-1/2: Maximum span, 8 feet; minimum rod size, 3/8 inch
   4. NPS 2: Maximum span, 8 feet; minimum rod size, 3/8 inch
   5. NPS 2-1/2: Maximum span, 9 feet; minimum rod size, 3/8 inch
   6. NPS 3: Maximum span, 10 feet; minimum rod size, 3/8 inch.

E. Support vertical runs at roof, at each floor, and at 10-foot intervals between floors.

3.04 PIPE JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 23 Sections specifying piping systems.

B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.

F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

END OF SECTION
PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Piping.
B. Refrigerant.
C. Moisture and liquid indicators.
D. Filter-dryers.
E. Flexible connections.

1.02 RELATED SECTIONS

A. Section 09 90 00 – Painting.
B. Division 23 – HVAC Insulation.
C. Division 28 – Equipment Wiring Systems: Electrical characteristics and wiring connections.

1.03 REFERENCES

A. ARI 495 – Refrigerant Liquid Receivers.
B. ARI 710 – Liquid Line Dryers.
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.
S. AWS A5.8 – Brazing Filler Metal.
T. AWS D1.1 – Structural Welding Code, Steel.
U. MSS SP58 – Pipe Hangers and Supports – Materials, Design and Manufacturer.
V. MSS SP69 – Pipe Hangers and Supports – Selection and Application.
W. MSS SP89 – Pipe Hangers and Supports – Fabrication and Installation Practices.
X. UL 429 – Electrically Operated Valves.

1.04 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 jeopardize. Provide necessary joining fittings. Ensure flanges, union and couplings for servicing are consistently provided.
B. Provide pipe hangers and supports in accordance with MSS SP69 unless indicated otherwise.
C. 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.
D. Permanent Filter-Dryers:
   1. Use in low temperature systems.
   2. Use in systems utilizing hermetic compressors.
   3. Use filter-dryers for each solenoid valve.
E. Flexible Connectors: Utilize at or near compressors or other vibrating/rotating equipment where piping configuration does not absorb vibration.

1.05 SUBMITTALS

A. Shop Drawings: Indicate schematic layout of system, including equipment, critical dimensions and sizes.
B. Product Data: Provide general assembly of specialties, including manufacturer's catalogue information. Provide manufacturers catalog data including load capacity.
C. Design Data: Submit design data indicating pipe sizing. Indicate load carrying capacity of trapeze, multiple pipe, and riser support hangers.
D. Test Reports: Indicate results of leak test, acid test.
E. Manufacturer’s Installations: Indicate support, connection requirements and isolation for servicing.
F. Submit welder’s certification of compliance with ASME SEC 9.
1.06 PROJECT RECORD DOCUMENTS
A. Record exact locations of equipment and refrigeration accessories on record drawings.

1.07 OPERATION AND MAINTENANCE DATA
A. Maintenance Data: Include instructions for changing cartridges, assembly views, and spare part lists.

1.08 QUALIFICATIONS
A. Installer: Company specializing in performing the work of this section with minimum 3 years experience.

1.09 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. Welder’s Certification: In accordance with ASME SEC 9.
D. Products Requiring Electrical Connection: Listed and classified by UL, as Suitable for the purpose indicated.

1.10 DELIVERY, STORAGE AND HANDLING
A. Deliver and store piping and specialties in shipping containers with labeling in place.
B. Protect piping and specialties from entry of contaminating material by leaving end caps and plugs in place until installation.
C. Dehydrate and charge components such as piping and receivers, seal prior to shipment, until connected into system.

1.11 MAINTENANCE MATERIALS
A. Provide two filter-dryer cartridges of each type.

PART 2 – PRODUCT

2.01 PIPING
A. Copper Tubing: ASTM B280, Type ACR hard drawn
   2. Joints: Braze, AWS A5.8 BCup silver/phosphorus/copper alloy with melting range 1190 to 1480 degrees F.
B. Pipe Supports and Anchors:
   1. Conform to MSS SP69.
   2. Hangers for Pipe Sizes ½ to 1-1/2 Inch: Malleable iron, adjustable swivel, split ring.
   3. Multiple or Trapeze Hangers: Steel channels with welded spacers and hangers rods.
   4. Wall Support for Pipe Sizes to 3 Inches: Cast iron hook.
5. Vertical Support: Steel riser clamp, unistrut wall anchor.
6. Floor Support: Steel clamp, unistrut, expansion anchor.
7. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.
8. Hanger Rods: Mild steel threaded both ends, threaded one end or continuous threaded.
9. Inserts: Malleable iron case of galvanized 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.

2.01 MOISTURE AND LIQUID INDICATORS

A. Indicators: Single port type, UL listed, with copper or brass body, flared or solder ends, sight glass, color coded paper moisture indicator and plastic cap; for maximum working pressure of 500 psig, and maximum temperature of 200 degrees F.

2.02 FLEXIBLE CONNECTORS

A. Corrugated stainless steel hose with single layer of stainless steel exterior braiding, minimum 9 inches long with copper tube ends; for maximum working pressure 400 psig.

PART 3 - EXECUTION

3.01 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.

3.02 INSTALLATION

A. Install refrigeration specialties in accordance with manufacturer’s instructions.
B. Route piping in orderly manner, with plumbing parallel to building structure and maintain gradient.
C. Install piping to conserve building space and not interfere with use of space.
D. Group piping whenever practical at common elevations and locations. Slope piping one percent in direction of oil return.
E. Install piping to allow for expansion and contraction without stressing pipe, joints or connected equipment.
F. Inserts:
   1. Provide inserts for placement in concrete formwork.
   2. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
   3. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over inches.
   4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
   5. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut flush with top of slab.
E. Install piping to allow for expansion and contraction without stressing pipe, joints or connected equipment.

F. Inserts:
   1. Provide inserts for placement in concrete formwork.
   2. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
   3. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches.
   4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
   5. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut flush with top of slab.

G. Pipe Hangers and Supports:
   1. Install in accordance with MSS SP89.
   2. Support horizontal piping as scheduled.
   3. Install hangers to provide minimum ½ inch space between finished covering and adjacent work.
   4. Place hangers within 12 inches of each horizontal elbow.
   5. Support vertical piping at every floor. Support riser piping independently or connected HORIZONTAL PIPING.
   6. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
   7. Provide copper plated hangers and supports for copper piping.

H. Arrange piping to return oil to compressor. Provide traps and loops in piping, and provide double as risers required. Slope horizontal piping 0.40 percent in direction of flow.

I. Provide clearance for installation of insulation and access to valves and fittings.

J. Provide access to concealed valves and fittings.

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 Section 09 90 00.

N. Insulate piping; refer to Division 23.

O. Provide access to concealed valves and fittings.

P. Flood piping system with nitrogen when brazing.

Q. Where pipe support members are welded to structural building frame, brush clean and apply one coat of zinc rich primer to welding.

R. Provide access to concealed valves and fittings.

S. Flood piping system with nitrogen when brazing.

T. Where pipe support members are welded to structural building frame, brush clean and apply one coat of zinc rich primer to welding.

U. Prepare unfinished pipe, fittings, supports and accessories ready for finish painting. Refer to Section 09 90 00.
V. Insulate piping; refer to Division 23.

W. Follow ASHRAE 15 procedures for charging and purging of systems and for disposal of refrigerant.

X. Provide replaceable cartridge filter-dryers, with isolation valves and valved bypass.

Y. Locate expansion valve sensing bulb immediately downstream of evaporator on suction line.

Z. Provide external equalizer piping on expansion valves with refrigerant distributor connected to evaporator.

AA. Install flexible connectors at right angles to axial movement of compressor, parallel to crankshaft.

BB. Fully charge completed system with refrigerant after testing.

CC. Provide electrical connection to solenoid valves. Refer to Division 26.

3.03 FIELD QUALITY CONTROL

A. Test refrigeration system in accordance with ASME B31.5.

END OF SECTION
SECTION 23 31 13
METAL DUCTS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:

1. Single-wall rectangular ducts and fittings.
2. Single-wall round ducts and fittings.
4. Duct liner.
5. Sealants and gaskets.
6. Hangers and supports.
7. Seismic-restraint devices.
8. Medium Pressure Ductwork

B. Related Sections:

1. Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.
2. Division 23 Section "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

1.03 PERFORMANCE REQUIREMENTS

A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and performance requirements and design criteria indicated.

1. SMACNA + 2.0" w.g. static pressure class and 2500 FPM maximum velocity.
   a. Relief air ductwork.
   b. Outside air ductwork.
   c. Supply air ductwork from VAV terminals to air devices.
2. SMACNA - 2.0" w.g. static pressure class and 2500 FPM maximum velocity.
   a. Return air ductwork.
   b. Outside air ductwork.

B. Structural Performance: Duct hangers and supports and seismic restraints shall withstand the effects of gravity and seismic loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and ASCE 7.

1.04 SUBMITTALS

A. Product Data: For each type of the following products:

1. Liners and adhesives.
2. Sealants and gaskets.
4. Duct Construction Standards

B. Shop Drawings:

1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
2. Factory- and shop-fabricated ducts and fittings.
3. Duct layout indicating sizes, configuration, liner material, and static-pressure classes.
4. Elevation of top and bottom of ducts.
5. Dimensions of main duct runs from building grid lines.
6. Fittings.
7. Reinforcement and spacing.
8. Seam and joint construction.
9. Penetrations through fire-rated and other partitions.
10. Equipment installation based on equipment being used on Project.
11. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.
12. Hangers and supports, including methods for duct and building attachment, seismic restraints, and vibration isolation.

C. Delegated-Design Submittal:

1. Sheet metal thicknesses.
2. Joint and seam construction and sealing.
3. Reinforcement details and spacing.
4. Materials, fabrication, assembly, and spacing of hangers and supports.
5. Design Calculations: Calculations for selecting hangers and supports and seismic restraints.

D. Coordination Drawings: Plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Duct installation in congested spaces, indicating coordination with general construction, building components, and other building services. Indicate proposed changes to duct layout.
2. Suspended ceiling components.
3. Structural members to which duct will be attached.
4. Size and location of initial access modules for acoustical tile.
5. Penetrations of smoke barriers and fire-rated construction.
6. Items penetrating finished ceiling including the following:
   a. Lighting fixtures.
   b. Air outlets and inlets.
   c. Speakers.
   d. Sprinklers.
   e. Access panels.
   f. Perimeter moldings.

E. Welding certificates.

F. Field quality-control reports.

1.05 QUALITY ASSURANCE

B. Welding Qualifications: Qualify procedures and personnel according to the following:


PART 2 - PRODUCTS

2.01 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.

B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 1-4, "Transverse (Girth) Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 1-5, "Longitudinal Seams – Rectangular Ducts," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 2, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.02 SINGLE-WALL ROUND DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   Single Wall Round Duct:
   a. ASI
   b. SEMCO
   c. United McGill

2. Grooved Mechanical Joint Fittings and Couplings:
   a. Anvil Gruvlok
   b. Grinnell
   c. Shurjoint Piping Products, Inc.
   d. Victaulic Company

B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Transverse Joints - Round Duct," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

1. Transverse Joints in Ducts Larger Than 60 Inches in Diameter: Flanged.

C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal andFlexible," Figure 3-1, "Seams - Round Duct and Fittings," for static-pressure class, applicable sealing requirements, materials involved, duct-support
1. Fabricate round ducts larger than 90 inches in diameter with butt-welded longitudinal seams.
2. Fabricate flat-oval ducts larger than 72 inches in width (major dimension) with butt-welded longitudinal seams.

D. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "90 Degree Tees and Laterals," and Figure 3-5, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.03 SHEET METAL MATERIALS

A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
   1. Galvanized Coating Designation: G60.
   2. Finishes for Surfaces Exposed to View: Mill phosphatized.

C. Reinforcement Shapes and Plates: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
   1. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.

D. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.04 MEDIUM PRESSURE DUCTS

A. Fabricate and support in accordance with SMACNA Medium Pressure Duct Construction Standards and ASHRAE handbooks, except as indicated. Provide duct material, gages, reinforcing, and sealing for operating pressures indicated.

B. Construct T's, bends, and elbows with radius of not less than 1-1/2 times width of duct on centerline. Where not possible and where rectangular elbows are used, provide air foil turning vanes. Where acoustical lining is required, provide turning vanes of perforated metal with glass fiber insulation. Weld in place.

C. Transform duct sizes gradually, not exceeding 15 degrees divergence and 30 degrees convergence.

D. Fabricate continuously welded medium pressure round and oval duct fittings two gages heavier than duct gages indicated in SMACNA Standard. Joints shall be minimum 4 inch cemented slip joint, brazed or electric welded. Prime coat welded joints.

E. Provide standard 45degree lateral wye takeoffs unless otherwise indicated where 90 degree conical tee connections may be used.
2.05 SEAMS AND JOINTS

A. Longitudinal seams shall be Pittsburgh, or equal (no known equal) lock with 3/8 inch minimum pocket.

B. Round Ductwork: Transverse joints in low pressure round ducts to be beaded sleeve joint secured with sheet metal screws equally spaced on 6 inch centers maximum with a minimum of 3 screws per joint. Round duct elbows shall be stamped or segmented; adjustable elbows are not acceptable. Seal joints with sealant.

C. Rectangular Ductwork: Construct all seams and joints in rectangular ductwork in accordance with SMACNA "HVAC Duct Construction Standards,". Seal all transverse joints with duct sealant.

D. Seal each duct transverse joint and longitudinal seam with a duct sealant. Use hardcast DT tape with RTA adhesives or equal (no known equal), for exterior ductwork.

2.06 FITTINGS FOR MEDIUM PRESURE DUCTS

A. Elbows: All elbows shall have an inside radius not less than the width of the ducts in the direction of the curve. Where space conditions do not permit a full radius elbow, changes in direction shall be made using mitered elbows with multiple double thickness turning vanes.

1. Construct radius elbows in accordance with the "HVAC Duct Construction Standards,". Short radius elbows are not allowed.

2. Construct vaned elbows of double vanes in accordance with the "HVAC Duct Construction Standards,". Single vane elbow shall not be used.

B. Construct transitions and offsets in accordance with the "HVAC Duct Construction Standards,".

1. Transitions: Maintain full duct cross section areas through transitions. Angle between centerline and side of diverging transition shall be no greater than 15 degrees in lieu of 20 degrees shown in the "Low Pressure Duct Manual." Angle between centerline and side of converging transition shall be no greater than 30 degrees.

2. Offsets: Construct with inside radii not less than the width of the duct in the direction of the curbs. Mitered elbows as specified under Subparagraph, "Elbows," herein may be used where space is restricted.

C. Collar taps for air outlet connections on exposed ductwork to be made with joint connection folded over inside of main duct and without exposed flanges. Outlet collar to be of same dimension as outside dimension of air outlet frame.

D. Make branch connections in accordance with SMACNA and as otherwise indicated on the Drawings.

E. Outlet Frames: Where ducts terminate at grilles, registers or diffusers, furnish with angle or channel iron frames with mitered welded corners and with provisions for attaching said grilles, registers, or diffusers.

F. Access Doors: Hinged, airtight, access doors shall be provided where required for access to control elements or for inspection. Size doors for maintenance of concealed items. Construct access doors in accordance with "HVAC Duct Construction Standards,". Furnish hinged doors except where space does not allow the door to swing open furnish removable doors. Insulate access doors where ducts are insulated with same insulation as on ductwork or housing.

G. Make connections between ductwork and outlets with flexible duct material herein specified. (Unless otherwise specified on drawings).
2.07 DUCT LINER

A. Fibrous-Glass Duct Liner: Comply with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. CertainTeed Corporation; Insulation Group.
   b. Johns Manville.
   c. Knauf Insulation.
   d. Owens Corning.

2. Maximum Thermal Conductivity:
   a. Type I, Flexible: 0.27 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
   b. Type II, Rigid: 0.23 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.

3. Thickness:
   a. 1/2 inch—VAV box internal insulation/lining.
   b. 1 inch—First 10 feet from VAV box discharge and first 15 feet from exhaust fan inlet, or as indicated on plans.
   c. 2 inch—First 20 feet from air handling unit supply, return, outside air and relief air connections and first 20 feet from return/relief air fan inlet and outlet connections, or as indicated on plans.

4. Metal Liner: Ductwork provided with internal sound lining at connections to air handling units or fans shall have a perforated galvanized metal inner liner covering the sound liner.

5. Water-Based Liner Adhesive: Comply with NFPA 90A or NFPA 90B and with ASTM C 916.

6. Antimicrobial Erosion-Resistant Coating: Apply to the surface of the liner that will form the interior surface of the duct to act as a moisture repellent and erosion-resistant coating. Antimicrobial compound shall be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.

B. Insulation Pins and Washers:

1. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch-diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.

2. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick galvanized steel; with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.

C. Shop Application of Duct Liner: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-19, "Flexible Duct Liner Installation."

1. Adhere a single layer of indicated thickness of duct liner with at least 90 percent adhesive coverage at liner contact surface area. Attaining indicated thickness with multiple layers of duct liner is prohibited.

2. Apply adhesive to transverse edges of liner facing upstream that do not receive metal nosing.

3. Butt transverse joints without gaps, and coat joint with adhesive.

4. Fold and compress liner in corners of rectangular ducts or cut and fit to ensure butted-edge overlapping.

5. Do not apply liner in rectangular ducts with longitudinal joints, except at corners of ducts, unless duct size and dimensions of standard liner make longitudinal joints necessary.

6. Apply adhesive coating on longitudinal seams in ducts with air velocity of 2500 fpm.

7. Secure liner with mechanical fasteners 4 inches from corners and at intervals not exceeding 12 inches transversely; at 3 inches from transverse joints and at intervals not exceeding 18 inches longitudinally.

8. Secure transversely oriented liner edges facing the airstream with metal nosings that have
either channel or "Z" profiles or are integrally formed from duct wall. Fabricate edge facings at the following locations:

a. Fan discharges.
b. Intervals of lined duct preceding unlined duct.
c. Upstream edges of transverse joints in ducts where air velocities are higher than 2500 fpm or where indicated.

9. Secure insulation between perforated sheet metal inner duct of same thickness as specified for outer shell. Use mechanical fasteners that maintain inner duct at uniform distance from outer shell without compressing insulation.

a. Sheet Metal Inner Duct Perforations: 3/32-inch diameter, with an overall open area of 23 percent.

10. Terminate inner ducts with buildouts attached to fire-damper sleeves, dampers, turning vane assemblies, or other devices. Fabricated buildouts (metal hat sections) or other buildout means are optional; when used, secure buildouts to duct walls with bolts, screws, rivets, or welds.

2.08 SEALANT AND GASKETS

A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.

B. Two-Part Tape Sealing System:

1. Tape: Woven cotton fiber impregnated with mineral gypsum and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.
2. Tape Width: 3 inches.
5. Mold and mildew resistant.
6. Maximum Static-Pressure Class: 10-inch wg. positive and negative.
7. Service: Indoor and outdoor.
8. Service Temperature: Minus 40 to plus 200 deg F.
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum.

C. Water-Based Joint and Seam Sealant:

1. Application Method: Brush on.
2. Solids Content: Minimum 65 percent.
5. Mold and mildew resistant.
6. VOC: Maximum 75 g/L (less water).
7. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
8. Service: Indoor or outdoor.
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

D. Flanged Joint Sealant: Comply with ASTM C 920.

2. Type: S.
3. Grade: NS.
5. Use: O.

E. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.
F. Round Duct Joint O-Ring Seals:

1. Seal shall provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg and shall be rated for 10-inch wg static-pressure class, positive or negative.
2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.
3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

2.09 HANGERS AND SUPPORTS

A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.

B. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 4-1, "Rectangular Duct Hangers Minimum Size," and Table 4-2, "Minimum Hanger Sizes for Round Duct."

C. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.

D. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.

E. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

F. Trapeze and Riser Supports:

2.10 SEISMIC-RESTRAINT DEVICES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Cooper B-Line, Inc.; a division of Cooper Industries.
   2. Ductmate Industries, Inc.
   3. Hilti Corp.
   5. Mason Industries.
   6. TOLCO; a brand of NIBCO INC.
   7. Unistrut Corporation; Tyco International, Ltd.

B. General Requirements for Restraint Components: Rated strengths, features, and applications shall be as defined in reports by an agency acceptable to authorities having jurisdiction.

1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they will be subjected.

C. Channel Support System: Shop- or field-fabricate support assembly made of slotted steel channels rated in tension, compression, and torsion forces and with accessories for attachment to braced component at one end and to building structure at the other end. Include matching components and corrosion-resistant coating.

D. Restraint Cables: ASTM A 603, galvanized steel cables with end connections made of cadmium-plated steel assemblies with brackets, swivel, and bolts designed for restraining cable service; and with an automatic-locking and clamping device or double-cable clips.

E. Hanger Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections to hanger rod.
F. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

PART 3 - EXECUTION

3.01 DUCT INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.

B. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.

C. Install round in maximum practical lengths.

D. Install ducts with fewest possible joints.

E. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.

F. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.

G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

H. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.

I. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.

J. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches.

K. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Division 23 Section "Air Duct Accessories" for fire and smoke dampers.

L. Protect duct interiors from moisture construction debris and dust, and other foreign materials. Comply with SMACNA's "Duct Cleanliness for New Construction Guidelines."

M. Provide openings in ductwork where required to accommodate thermometers and controllers. Provide pilot 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. (Unless otherwise specified on drawings).

N. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.

O. Adhere to Drawings: Run and shape of ducts offsets during progress of work may be varied, if required to meet structural or other interferences, as approved.
P. Install ductwork in adherence to ceiling height shown on Drawings. Establish necessary space requirements so as to maintain required clearances around all equipment.

Q. Reinforce all ducts to prevent buckling, breathing, vibrations or noise, such reinforcing shall be as recommended in the reference specified herein.

3.02 SEAM AND JOINT SEALING

A. Seal duct seams and joints for duct static-pressure and leakage classes specified in "Performance Requirements" Article, according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 1-2, "Standard Duct Sealing Requirements," unless otherwise indicated.

3.03 HANGER AND SUPPORT INSTALLATION

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Hangers and Supports."

B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
   1. Where practical, install concrete inserts before placing concrete.
   2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
   3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
   4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.
   5. Do not use powder-actuated concrete fasteners for seismic restraints.

C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 4-1, "Rectangular Duct Hangers Minimum Size," and Table 4-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.

D. Hangers Exposed to View: Threaded rod and angle or channel supports.

E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet.

F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.04 SEISMIC-RESTRAINT-DEVICE INSTALLATION

A. Install ducts with hangers and braces designed to support the duct and to restrain against seismic forces required by applicable building codes. Comply with ASCE 7.
   1. Space lateral supports a maximum of 40 feet o.c., and longitudinal supports a maximum of 80 feet o.c.
   2. Brace a change of direction longer than 12 feet.

B. Select seismic-restraint devices with capacities adequate to carry present and future static and seismic loads.

C. Install cables so they do not bend across edges of adjacent equipment or building structure.
D. Install cable restraints on ducts that are suspended with vibration isolators.

E. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction.

F. Attachment to Structure: If specific attachment is not indicated, anchor bracing and restraints to structure, to flanges of beams, to upper truss chords of bar joists, or to concrete members.

G. Drilling for and Setting Anchors:
   1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcement or embedded items during drilling. Notify the Architect if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
   2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
   3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
   4. Set anchors to manufacturer’s recommended torque, using a torque wrench.
   5. Install zinc-coated steel anchors for interior applications and stainless-steel anchors for applications exposed to weather.

3.05 CONNECTIONS

A. Make connections to equipment with flexible connectors complying with Division 23 Section "Air Duct Accessories."

B. Comply with SMACNA’s "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.06 PAINTING

A. Paint interior of metal ducts that are visible through registers and grilles and that do not have duct liner. Apply one coat of flat, black, latex paint over a compatible galvanized-steel primer. Paint materials and application requirements are specified in Division 09 painting Sections.

3.07 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Leakage Tests:
   1. Comply with SMACNA’s "HVAC Air Duct Leakage Test Manual."
   2. Test the following systems:
      a. Supply air.
   3. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
   4. Test for leaks before insulation application.
   5. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If static-pressure classes are not indicated, test entire system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure. Give seven days’ advance notice for testing.
   6. Make adjustments of the mechanical equipment in accordance with the Plans and
Specifications as necessary, so the air balance testing agency which will be contracted by the Owner can complete its work. If it is found that any portion of the Work has not been installed as specified for accomplishing the testing and balancing as called for in the Specifications, the Work shall be redone at no additional cost.

7. Test Equipment: Use equipment arranged as recommended by the testing and balancing agency specified in Section 23 05 93.

8. Field Test Procedures

a. Seal all openings in duct section to be tested.

b. Connect test apparatus to test section of duct, using a flexible duct connection or hose.

c. Close damper or blower suction side to prevent excessive build up of pressure.

d. Start blower and gradually open damper on suction side of blower.

e. Build up pressure in duct test section to 4 inches WG.

f. Record indicated pressure or instrument that is connected to section of duct under test.

g. Maintain this pressure for ten minutes and check for audible leaks. Mark location of each leak.

h. Reduce pressure to 0 inch WG and repair all visual and audible leaks.

i. Upon completion of repairs, build up pressure to design operating pressure, and read leakage pressure on instrument connected across test apparatus orifice.

j. Leakage C.F.M. to be read by consulting chart calibrated with orifice diameter. If no leakage exists, zero pressure differential shall be indicated. Leakage C.F.M. shall not exceed 3%. Repeat procedure as indicated above until leakage rate is met.

9. Engage the testing agency specified in Section 23 05 93, to verify the leakage tests of all ducts and submit a certification attesting to the results obtained.

10. Tested sections of ductwork to be visually marked by agency with certification sticker and initials of field test inspector. Tests shall be made before duct sections are concealed.

C. Duct System Cleanliness Tests:

1. Visually inspect duct system to ensure that no visible contaminants are present.

2. Test sections of metal duct system, chosen randomly by Owner, for cleanliness according to "Vacuum Test" in NADCA ACR, "Assessment, Cleaning and Restoration of HVAC Systems."

   a. Acceptable Cleanliness Level: Net weight of debris collected on the filter media shall not exceed 0.75 mg/100 sq. cm.

D. Duct system will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

F. Adjustment and cleaning.

1. Balancing and Adjusting: Make adjustments of the mechanical equipment in accordance with the Plans and Specifications as necessary, so the air balance testing can complete its work. If it is found that any portion of the Work has not been installed as specified for accomplishing the testing and balancing as called for in the Specifications, the Work shall be redone at no additional cost.
3.08 DUCT SCHEDULE

A. Fabricate ducts with galvanized sheet steel.

B. Intermediate Reinforcement:

C. Liner:
   1. 1/2 inch-VAV box internal insulation/lining.
   2. 1 inch-First 10 feet from VAV box discharge and first 15 feet from exhaust fan inlet, or as indicated on plans.
   3. 2 inch-First 20 feet from rooftop air handling unit supply, return, outside air and relief air connections and first 20 feet from return/relief air fan inlet and outlet connections, or as indicated on plans

D. Elbow Configuration:
   1. Rectangular Duct: Comply with SMACNA’s "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Elbows."
      a. Velocity 1000 fpm or Lower:
         1) Radius Type RE 1 with minimum 0.5 radius-to-diameter ratio.
         2) Mitered Type RE 4 with turning vanes.
      b. Velocity 1000 to 1500 fpm:
         1) Radius Type RE 1 with minimum 1.0 radius-to-diameter ratio.
         2) Mitered Type RE 2 with vanes complying with SMACNA’s "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-3, "Vanes and Vane Runners," and Figure 2-4, "Vane Support in Elbows."
      c. Velocity 1500 fpm or Higher:
         1) Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
         2) Mitered Type RE 2 with vanes complying with SMACNA’s "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-3, "Vanes and Vane Runners," and Figure 2-4, "Vane Support in Elbows."
   2. Round Duct: Comply with SMACNA’s "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-3, "Round Duct Elbows."
      a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA’s "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.
         1) Velocity 1000 fpm or Lower: 0.5 radius-to-diameter ratio and three segments for 90-degree elbow.
         2) Velocity 1000 to 1500 fpm: 1.0 radius-to-diameter ratio and four segments for 90-degree elbow.
         3) Velocity 1500 fpm or Higher: 1.5 radius-to-diameter ratio and five segments for 90-degree elbow.
            a. Round Elbows, 12 Inches and Smaller in Diameter: Stamped or pleated.
b. Round Elbows, 14 Inches and Larger in Diameter: Standing seam or Welded.

E. Branch Configuration:

1. Rectangular Duct: Comply with SMACNA’s "HVAC Duct Construction Standards – Metal and Flexible," Figure 2-6, "Branch Connections."
   a. Rectangular Main to Rectangular Branch: 45-degree entry.
   b. Rectangular Main to Round Branch: 45 degree entry with transition to round.

2. Round: Comply with SMACNA’s "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "90 Degree Tees and Laterals," and Figure 3-5, "Conical Tees."
   a. Velocity 1000 fpm or Lower: 45 degree lateral
   b. Velocity 1000 to 1500 fpm: 45 degree lateral.
   c. Velocity 1500 fpm or Higher: 45-degree lateral.

END OF SECTION
SECTION 23 33 00
AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:

1. Backdraft and pressure relief dampers.
2. Barometric relief dampers.
4. Control dampers.
5. Fire dampers.
6. Combination fire and smoke dampers.
7. Flange connectors.
8. Duct silencers.
10. Remote damper operators.
11. Duct-mounted access doors.
12. Flexible connectors.
13. Duct accessory hardware.

B. Related Sections:

1. Division 28 Section for duct-mounted fire and smoke detectors.

1.03 SUBMITTALS

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

1. For duct silencers, include pressure drop and dynamic insertion loss data. Include breakout noise calculations for high transmission loss casings.

B. Shop Drawings: For duct accessories. Include plans, elevations, sections, details and attachments to other work.

1. Detail duct accessories fabrication and installation in ducts and other construction. Include dimensions, weights, loads, and required clearances; and method of field assembly into duct systems and other construction. Include the following:

a. Special fittings.
c. Control damper installations.
d. Fire-damper, smoke-damper, combination fire- and smoke-damper, ceiling, and corridor damper installations, including sleeves; and duct-mounted access doors and remote damper operators.
e. Duct security bars.
f. Wiring Diagrams: For power, signal, and control wiring.
C. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which ceiling-mounted access panels and access doors required for access to duct accessories are shown and coordinated with each other, using input from Installers of the items involved.

D. Source quality-control reports.

E. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.

1.04 QUALITY ASSURANCE


B. Comply with AMCA 500-D testing for damper rating.

1.05 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fusible Links: Furnish quantity equal to 10 percent of amount installed.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.

1. Galvanized Coating Designation: G60.

2. Exposed-Surface Finish: Mill phosphatized.

C. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304, and having a No. 2 finish for concealed ducts.

D. Aluminum Sheets: Comply with ASTM B 209, Alloy 3003, Temper H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.

E. Extruded Aluminum: Comply with ASTM B 221, Alloy 6063, Temper T6.

F. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.

G. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.02 BACKDRAFT AND PRESSURE RELIEF DAMPERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
2. Nailor Industries Inc.
3. Ruskin Company.
4. Potorff

B. Description: Gravity balanced.


D. Maximum System Pressure: 2-inch wg.

E. Frame: 0.052-inch thick, galvanized sheet steel, with welded corners and mounting flange.

F. Blades: Multiple single-piece blades, center-pivoted, maximum 6-inch width, 0.025-inch thick, roll-formed aluminum with sealed edges.

G. Blade Action: Parallel.

H. Blade Seals: Extruded vinyl, mechanically locked or Neoprene, mechanically locked.

I. Blade Axles:
   1. Material: Galvanized steel.
   2. Diameter: 0.20 inch.

J. Tie Bars and Brackets: Aluminum.

K. Return Spring: Adjustable tension.

L. Bearings: Steel ball or synthetic pivot bushings.

M. Accessories:
   1. Adjustment device to permit setting for varying differential static pressure.
   2. Counterweights and spring-assist kits for vertical airflow installations.
   3. Electric actuators.
   4. Chain pulls.
   5. Front of rear screens.
   6. 90-degree stops.

N. Sleeve: Minimum 20-gage thickness.

2.03 BAROMETRIC RELIEF DAMPERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   2. Nailor Industries Inc.
   3. Ruskin Company.
   4. SEMCO Incorporated.

B. Suitable for horizontal or vertical mounting.

D. Maximum System Pressure: 2-inch wg.

E. Frame: 0.064-inch- thick, galvanized sheet steel, with welded corners and mounting flange.

F. Blades:
   1. Multiple, 0.025-inch- thick, roll-formed aluminum.
   3. Action: Parallel.
   5. Eccentrically pivoted.

G. Blade Seals: Vinyl or Neoprene.

H. Blade Axles: Galvanized steel.

I. Tie Bars and Brackets:
   1. Material: Aluminum.
   2. Rattle free with 90-degree stop.

J. Return Spring: Adjustable tension.

K. Bearings: Bronze.

L. Accessories:
   1. Flange on intake.
   2. Adjustment device to permit setting for varying differential static pressures.

2.04 MANUAL VOLUME DAMPERS

A. Standard, Steel, Manual Volume Dampers:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Flexmaster U.S.A., Inc.
      b. McGill AirFlow LLC.
      c. METALAIRE, Inc.
      d. Nailor Industries Inc.
      e. Ruskin Company.
   2. Standard leakage rating.
   3. Suitable for horizontal or vertical applications.
   4. Frames:
      a. Hat-shaped, galvanized-steel channels, 0.064-inch minimum thickness.
      b. Mitered and welded corners.
      c. Flanges for attaching to walls and flangeless frames for installing in ducts.
   5. Blades:
      a. Multiple or single blade.
      b. Parallel- or opposed-blade design.
      c. Stiffen damper blades for stability.
d. Galvanized-steel, 0.064 inch thick.

7. Bearings:
   a. Oil-impregnated bronze.
   b. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.

8. Tie Bars and Brackets: Galvanized steel.

B. Standard, Aluminum, Manual Volume Dampers:
1. Manufacturers: Subject to compliance with requirements:
   a. Flexmaster U.S.A., Inc.
   b. McGill AirFlow LLC.
   c. METALAIRE, Inc.
   d. Nailor Industries Inc.
   e. Ruskin Company.
2. Standard leakage rating, with linkage outside airstream.
3. Suitable for horizontal or vertical applications.
4. Frames: Hat-shaped, 0.10-inch thick, aluminum sheet channels; frames with flanges for attaching to walls and flangeless frames for installing in ducts.
5. Blades:
   a. Multiple or single blade.
   b. Parallel- or opposed-blade design.
   c. Stiffen damper blades for stability.
   d. Roll-Formed Aluminum Blades: 0.10-inch thick aluminum sheet.
   e. Extruded-Aluminum Blades: 0.050-inch thick extruded aluminum.
7. Bearings:
   a. Oil-impregnated bronze.
   b. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
8. Tie Bars and Brackets: Aluminum.

2.05 CONTROL DAMPERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Air Balance
   2. Nailor
   3. Pottorff
   4. Ruskin

B. Low-leakage rating and bearing AMCA’s Certified Ratings Seal for both air performance and air leakage.

C. Frames:
   1. Hat shaped.
   2. Galvanized-steel channels, 0.064 inch thick.
   3. Mitered and welded corners.
D. Blades:
   1. Multiple blade with maximum blade width of 8 inches.
   2. Opposed-blade design.
   4. 0.064 inch thick.

E. Blade Axles: 1/2-inch- diameter; galvanized steel blade-linkage hardware of zinc-plated steel and brass; ends sealed against blade bearings.
   1. Operating Temperature Range: From minus 40 to plus 200 deg F.

F. Bearings:
   1. Oil-impregnated bronze.
   2. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
   3. Thrust bearings at each end of every blade.

2.06 FIRE DAMPERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Arrow United Industries.
   2. Greenheck Fan Corporation.
   3. Nailor Industries Inc.
   4. Ruskin Company.

B. Type: Static and dynamic; rated and labeled according to UL 555 by an NRTL.

C. Closing rating in ducts up to 4-inch wg static pressure class and minimum 4000-fpm velocity.

D. Fire Rating: 1-1/2 to 3 hours.

E. Frame: Curtain type with blades outside airstream fabricated with roll-formed, 0.034-inch thick galvanized steel; with mitered and interlocking corners.

F. Mounting Sleeve: Factory- or field-installed, galvanized sheet steel.
   1. Minimum Thickness: 0.052 or 0.138 inch thick, as indicated, and of length to suit application.
   2. Exception: Omit sleeve where damper-frame width permits direct attachment of perimeter mounting angles on each side of wall or floor; thickness of damper frame must comply with sleeve requirements.

G. Mounting Orientation: Vertical or horizontal as indicated.

H. Blades: Roll-formed, interlocking, 0.034-inch- thick, galvanized sheet steel. In place of interlocking blades, use full-length, 0.034-inch- thick, galvanized-steel blade connectors.

I. Horizontal Dampers: Include blade lock and stainless-steel closure spring.

2.07 COMBINATION FIRE AND SMOKE DAMPERS

A. Manufacturers: Subject to compliance with requirements:

2. Nailor Industries Inc.
3. Ruskin Company.

B. Type: Static and dynamic; rated and labeled according to UL 555 and UL 555S by an NRTL.

C. Closing rating in ducts up to 4-inch wg static pressure class and minimum 4000-fpm velocity.

D. Fire Rating: 1-1/2 and 3 hours.

E. Frame: Curtain type with blades outside airstream fabricated with roll-formed, 0.034-inch-thick galvanized steel; with mitered and interlocking corners.

F. Heat-Responsive Device: Electric resettable link and switch package, factory installed, rated.

G. Smoke Detector: Integral, factory wired for single-point connection.

H. Frame: Curtain type with blades inside airstream fabricated with roll-formed, 0.034-inch-thick galvanized steel; with mitered and interlocking corners.

I. Blades: Roll-formed, horizontal, interlocking, 0.034-inch-thick, galvanized sheet steel. In place of interlocking blades, use full-length, 0.034-inch-thick, galvanized-steel blade connectors.

J. Leakage: Class II.

K. Rated pressure and velocity to exceed design airflow conditions.

L. Mounting Sleeve: Factory-installed, 0.052-inch-thick, galvanized sheet steel; length to suit wall or floor application.

M. Master control panel for use in dynamic smoke-management systems.

N. Damper Motors: two-position action.

O. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Division 23 Section "Common Motor Requirements for HVAC Equipment."

1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
2. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in
3. Permanent-Split-Capacitor or Shaded-Pole Motors: With oil-immersed and sealed gear trains.
4. Spring-Return Motors: Equip with an integral spiral-spring mechanism where indicated. Enclose entire spring mechanism in a removable housing designed for service or adjustments. Size for running torque rating of 150 in. x lbf and breakaway torque rating of 150 in. x lbf.
5. Outdoor Motors and Motors in Outdoor-Air Intakes: Equip with O-ring gaskets designed to make motors weatherproof. Equip motors with internal heaters to permit normal operation at minus 40 deg F.
6. Nonspring-Return Motors: For dampers larger than 25 sq. ft., size motor for running torque rating of 150 in. x lbf and breakaway torque rating of 300 in. x lbf.
7. Electrical Connection: 115 V, single phase, 60 Hz.

P. Accessories:

1. Auxiliary switches for position indication.
2. Test and reset switches, damper mounted.

2.08 FLANGE CONNECTORS

A. Manufacturers: Subject to compliance with requirements:

1. Ductmate Industries, Inc.
2. Nexus PDQ
3. Ward Ind.

B. Description: roll-formed, factory-fabricated, slide-on transverse flange connectors, gaskets, and components.

C. Material: Galvanized steel.

D. Gage and Shape: Match connecting ductwork.

2.09 DUCT SILENCERS

A. Manufacturers: Subject to compliance with requirements:

B. General Requirements:

1. Factory fabricated.
2. Fire-Performance Characteristics: Adhesives, sealants, packing materials, and accessory materials shall have flame-spread index not exceeding 25 and smoke-developed index not exceeding 50 when tested according to ASTM E 84.

C. Shape:

1. Rectangular straight with splitters or baffles.
2. Round straight with center bodies or pods.
3. Rectangular elbow with splitters or baffles.
4. Round elbow with center bodies or pods.
5. Rectangular transitional with splitters or baffles.

D. Rectangular Silencer Outer Casing: ASTM A 653/A 653M, G90, galvanized sheet steel, 0.034 inch thick.


1. Sheet Metal Thickness for Units up to 24 Inches in Diameter: 0.034 inch thick.
2. Sheet Metal Thickness for Units 26 through 40 Inches in Diameter: 0.040 inch thick.
3. Sheet Metal Thickness for Units 42 through 52 Inches in Diameter: 0.052 inch thick.
4. Sheet Metal Thickness for Units 54 through 60 Inches in Diameter: 0.064 inch thick.

F. Inner Casing and Baffles: ASTM A 653/A 653M, G60 galvanized sheet metal, 0.034 inch thick, and with 1/8-inch- diameter perforations.

G. Connection Sizes: Match connecting ductwork unless otherwise indicated.

H. Principal Sound-Absorbing Mechanism:
1. Controlled impedance membranes and broadly tuned resonators without absorptive media.
2. Film-lined type with fill material.
   a. Fill Material: Inert and vermin-proof fibrous material, packed under not less than 5 percent compression
   b. Erosion Barrier: Polymer bag enclosing fill, and heat sealed before assembly.
3. Lining: Mylar.

I. Fabricate silencers to form rigid units that will not pulsate, vibrate, rattle, or otherwise react to system pressure variations. Do not use mechanical fasteners for unit assemblies.
   1. Flange connections.
   2. Suspended Units: Factory-installed suspension hooks or lugs attached to frame in quantities and spaced to prevent deflection or distortion.
   3. Reinforcement: Cross or trapeze angles for rigid suspension.

J. Capacities and Characteristics: Refer to the drawings.

2.10 TURNING VANES

A. Manufacturers: Subject to compliance with requirements:
   1. Ductmate Industries, Inc.
   2. Duro Dyne Inc.
   3. METALAIRE, Inc.
   4. SEMCO Incorporated.

B. Turning Vanes for Metal Ducts: Curved blades of galvanized sheet steel; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.

C. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards – Metal and Flexible"; Figures 2-3, "Vanes and Vane Runners," and 2-4, "Vane Support in Elbows."

D. Vane Construction: Single wall for ducts up to 24 inches wide and double wall for larger dimensions.

2.11 REMOTE DAMPER OPERATORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Potterff; a division of PCI Industries, Inc.
   2. Ventfabrics, Inc.
   3. Young Regulator Company.

B. Description: Cable system designed for remote manual damper adjustment.

C. Tubing: Brass.

D. Cable: Stainless steel.

E. Wall-Box Mounting: Recessed, 3/4 inches deep.
F. Wall-Box Cover-Plate Material: Steel.

2.12 DUCT-MOUNTED ACCESS DOORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Ductmate Industries, Inc.
2. Flame Gard, Inc.
3. 3M.


1. Door:
   a. Double wall, rectangular.
   b. Galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class.
   c. Vision panel.
   d. Hinges and Latches: 1-by-1-inch butt or piano hinge and cam latches.
   e. Fabricate doors airtight and suitable for duct pressure class.

2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.

3. Number of Hinges and Locks:
   a. Access Doors Less Than 12 Inches Square: No hinges and two sash locks.
   b. Access Doors up to 18 Inches Square: Two hinges and two sash locks.
   c. Access Doors up to 24 by 48 Inches: Three hinges and two compression latches.
   d. Access Doors Larger Than 24 by 48 Inches: Four hinges and two compression latches with outside and inside handles.

2.13 FLEXIBLE CONNECTORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Ductmate Industries, Inc.
2. Duro Dyne Inc.
3. Ventfabrics, Inc.

B. Materials: Flame-retardant or noncombustible fabrics.

C. Coatings and Adhesives: Comply with UL 181, Class 1.

D. Metal-Edged Connectors: Factory fabricated with a fabric strip 3-1/2 inches wide attached to 2 strips of 2-3/4-inch wide, 0.028-inch thick, galvanized sheet steel or 0.032-inch thick aluminum sheets. Provide metal compatible with connected ducts.

1. Minimum Weight: 26 oz./sq. yd.
2. Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
3. Service Temperature: Minus 40 to plus 200 deg F.


1. Minimum Weight: 24 oz./sq. yd.
2. Tensile Strength: 530 lbf/inch in the warp and 440 lbf/inch in the filling.
3. Service Temperature: Minus 50 to plus 250 deg F.

G. Thrust Limits: Combination coil spring and elastomeric insert with spring and insert in compression, and with a load stop. Include rod and angle-iron brackets for attaching to fan discharge and duct.

1. Frame: Steel, fabricated for connection to threaded rods and to allow for a maximum of 30 degrees of angular rod misalignment without binding or reducing isolation efficiency.
2. Outdoor Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
6. Elastomeric Element: Molded, oil-resistant rubber or neoprene.
7. Coil Spring: Factory set and field adjustable for a maximum of 1/4-inch movement at start and stop.

2.14 DUCT ACCESSORY HARDWARE

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Ductmate Industries, Inc.
2. Nexus PDQ
4. Ward Industries

B. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct-insulation thickness.

C. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.

B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.

C. Install backdraft dampers at inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan unless otherwise indicated.
D. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.

1. Coordinate subparagraphs below with Division 23 Section "Metal Ducts." Install steel volume dampers in steel ducts.
2. Install aluminum volume dampers in aluminum ducts.

E. Set dampers to fully open position before testing, adjusting, and balancing.

F. Install test holes at fan inlets and outlets and elsewhere as indicated.

G. Install fire and smoke dampers according to UL listing.

H. Connect ducts to duct silencers rigidly.

I. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:

1. On both sides of duct coils.
2. Adjacent to and close enough to fire or smoke dampers.
3. Elsewhere as indicated.

J. Install access doors with swing against duct static pressure.

K. Access Door Sizes:

1. One-Hand or Inspection Access: 8 by 5 inches.
2. Two-Hand Access: 12 by 6 inches.

L. Label access doors according to Division 23 Section "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.

M. Install flexible connectors to connect ducts to equipment.

N. For fans developing static pressures of 5-inch wg and more, cover flexible connectors with loaded vinyl sheet held in place with metal straps.

O. Connect terminal units to supply ducts directly or with maximum 12-inch lengths of flexible duct. Do not use flexible ducts to change directions.

P. Connect diffusers to low-pressure ducts directly or with maximum 60-inch lengths of flexible duct clamped or strapped in place.

Q. Install duct test holes where required for testing and balancing purposes.

1. Cut or drill temporary test holes in ducts as required. Cap with threaded metal caps.
2. Permanent test holes shall be factory fabricated, airtight flanged fittings with screw cap. Provide extended neck fittings to clear insulation.
R. Install thrust limits at centerline of thrust, symmetrical on both sides of equipment. Attach thrust limits at centerline of thrust and adjust to a maximum of 1/4-inch movement during start and stop of fans.

3.02 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Operate dampers to verify full range of movement.
2. Inspect locations of access doors and verify that purpose of access door can be performed.
3. Operate fire, smoke, and combination fire and smoke dampers to verify full range of movement and verify that proper heat-response device is installed.
4. Inspect turning vanes for proper and secure installation.
5. Operate remote damper operators to verify full range of movement of operator and damper.

END OF SECTION
PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

B. Related Sections:
   1. Section 23 05 00 Common Work Results for HVAC
   2. Section 23 07 00 HVAC Insulation.
   3. Section 23 31 13 Metal Ducts.
   4. Section 23 33 00 Air Duct Accessories.

1.02 SUMMARY

A. This Section includes cleaning of the following existing duct systems:
   1. Supply system.
   2. Return system.
   3. Exhaust system.

1.03 DEFINITIONS

A. ASCS: Air system cleaning specialist.


C. SMACNA: Sheet Metal and Air Conditioning Contractors' National Association.

D. MSDS: Material Safety Data Sheets.

E. OSHA: Occupational Safety and Health Administration.

F. EPA: Environmental Protection Agency

1.04 SUBMITTALS

A. Manufacturer Certificates: Signed by manufacturers certifying that products comply with requirements.

B. MSDS: Submittal of EPA approved cleaning and sanitizing products.

C. Qualification Data: For ASCS.

D. Access Doors

E. Field quality-control test reports.

1.05 QUALITY CONTROL

A. ASCS Qualifications: A certified member of NADCA
   1. Certification: Employ an ASCS certified by NADCA on a full-time basis
   2. Supervisor Qualifications: Certified as an ASCS by NADCA
   3. Experience: Submit records of experience in the field of HVAC systems cleaning.
   4. Equipment, Materials, and Labor: Have equipment, materials, and labor required to perform specified services.
B. Comply with current published standards of NADCA.

PART 2 - PRODUCTS

2.01 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. See Section 23 33 00 “Air Duct Accessories” for approved manufacturers listings.

2.02 SHEET METAL MATERIALS

A. Comply with SMACNA’s “HVAC Duct Construction Standards - Metal and Flexible” for acceptable materials, material thicknesses, and duct construction methods, unless otherwise indicated.

B. Galvanized-Steel Sheet: Lock-forming quality; complying with ASTM A 653/A 653M and having G60 coating designation; ducts shall have mill-phosphatized finish for surfaces exposed to view.

C. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.

D. Tie Rods: Galvanized steel, 1/4-inch (6-mm) minimum diameter for lengths 36 inches (900 mm) or less; 3/8-inch (10-mm) minimum diameter for lengths longer than 36 inches (900 mm).

2.03 DUCT-MOUNTING ACCESS DOORS

A. General Description: Fabricate doors airtight and suitable for duct pressure class. No sheet metal patches shall be allowed.

B. Rectangular Duct Door: Refer to Section 23 33 00 "Air Duct Accessories" for manufacturers of duct mounted access doors.

2.04 FLEXIBLE CONNECTORS

A. General Description: Fabricate flexible connectors of manufactured products suitable for the duct pressure class.

B. Products shall be as listed in Section 23 33 00 “Air Duct Accessories.

2.05 DUCT ACCESSORY HARDWARE

A. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.
PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine systems to determine appropriate methods, tools, and equipment required for performance of work.

B. Prepare written report listing conditions detrimental to performance of work.

C. Proceed with work only after unsatisfactory conditions have been corrected.

3.02 CLEANING

A. Engage a qualified ASCS to clean the following systems:
   1. Supply system.
   2. Return system.
   3. Exhaust system.

B. Perform cleaning before air balancing or mark position of dampers and air-directional mechanical devices before cleaning.

C. Use duct-mounted access doors, as required, for physical and mechanical entry and for inspection:
   1. Install additional duct-mounting access doors to comply with duct cleaning standards. Comply with requirements in Section 23 33 00 "Air Duct Accessories" for additional duct-mounting access doors.
   2. Disconnect and reconnect flexible ducts as needed for cleaning and inspection. Replace damaged and deteriorated flexible ducts. Comply with requirements in Division 23 Section 23 33 00 "Air Duct Accessories" for flexible ducts.
   3. Disconnect and reconnect flexible connectors as needed for cleaning and inspection. Replace damaged and deteriorated flexible connectors. Comply with requirements in Division 23 Section 23 33 00 "Air Duct Accessories" for flexible connectors.
   4. Replace damaged fusible links on fire and smoke dampers. Replacement fusible links shall be same rating as those being replaced. Comply with requirements in Division 23 Section 23 33 00 "Air Duct Accessories" for fusible links.
   5. Remove and reinstall ceiling components to gain access for duct cleaning. Clean ceiling components after they have been removed and replaced.

D. Mark position of dampers and air-directional mechanical devices before cleaning, and restore to their marked position on completion.

E. Particulate Collection and Odor Control:
   1. Where venting vacuuming system inside building, use HEPA filtration with 99.97 percent collection efficiency for 0.3-micron size (or greater) particles.
   2. When venting vacuuming system outside building, use filtration to contain debris removed from the HVAC system and locate exhaust down wind and away from air intakes and other points of entry into building.

F. Clean the following metal-duct system components by removing visible surface contaminants and deposits:
   1. Air outlets and inlets (registers, grilles, and diffusers).
   2. Supply, return, and exhaust fans including fan housings, plenums (except ceiling supply and return plenums), scrolls, blades or vanes, shafts, baffles, dampers, and drive assemblies.
   3. Air-handling-unit internal surfaces and components including mixing box, coil section.
5. Return-air ducts, dampers, and actuators, except in ceiling plenums and mechanical room.
7. Dedicated exhaust and ventilation components.

G. Mechanical Cleaning Methodology:
1. Clean metal-duct systems using mechanical cleaning methods that extract contaminants from within duct systems and remove contaminants from building.
2. Use vacuum-collection devices that are operated continuously during cleaning. Connect vacuum device to downstream end of ducts so areas being cleaned are under negative pressure.
3. Use mechanical agitation to dislodge debris adhered to interior duct surfaces without damaging integrity of metal ducts or duct liner.
4. Clean fibrous-glass duct liner with HEPA vacuuming equipment, and do not permit duct liner to get wet. Replace fibrous-glass duct liner that is damaged, deteriorated, or delaminated or that has friable material, mold, or fungus growth.
5. Clean coils and coil drain pans according to NADCA 1992. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.
6. Provide operative drainage system for washdown procedures.
7. Biocidal Agents and Coatings: Apply biocidal agents if fungus is present; use according to manufacturer’s written instructions after removal of surface deposits and debris.

H. Cleanliness Verification:
1. Verify cleanliness after mechanical cleaning and before application of treatment, including biocidal agents and protective coatings.
2. Visually inspect metal-duct systems for contaminants.
3. Where contaminants are discovered, reclean and reinspect duct systems.

3.03 DUCT ACCESSORIES INSTALLATION

A. Install duct accessories according to applicable details in SMACNA’s "HVAC Duct Construction Standards--Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts, and Section 23 33 00 "Air Duct Accessories" of this specification.

B. Provide duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.

C. Install duct-mounting access doors where access doors do not currently exist to allow for the cleaning of ducts, accessories, and terminal units as follows:
1. On both sides of duct coils.
2. Downstream from volume dampers, turning vanes, and equipment.
3. Adjacent to fire or smoke dampers; reset or install new fusible links.
4. Before and after each change in direction, at maximum 50-foot spacing.
5. On sides of ducts where adequate clearance is available.

D. Install the following sizes for duct-mounting, rectangular access doors:
1. One-Hand or Inspection Access: 8 by 5 inches.
2. Two-Hand Access: 12 by 6 inches.
E. Install the following sizes for duct-mounting, round access doors:

1. One-Hand or Inspection Access: 8 inches in diameter.
3. Head and Hand Access: 12 inches in diameter.

F. Install the following sizes for duct-mounting, pressure relief access doors:

1. One-Hand or Inspection Access: 7 inches in diameter.

3.04 CONNECTIONS

A. Reconnect ducts to fans and air-handling units with existing flexible connectors after cleaning ducts and flexible connectors. Replace existing damaged and deteriorated flexible connectors.

B. For fans developing static pressures of 5-inch wg and higher, cover replacement flexible connectors with loaded vinyl sheet held in place with metal straps.

3.05 FIELD QUALITY CONTROL

A. Gravimetric Analysis: Sections of metal-duct system, chosen randomly by Owner, may be tested for cleanliness according to NADCA vacuum test gravimetric analysis.

1. If analysis determines that levels of debris are equal to or lower than suitable levels, system shall have passed cleanliness verification.
2. If analysis determines that levels of debris exceed suitable levels, system cleanliness verification will have failed and metal-duct system shall be re-cleaned and re-verified.

B. Verification of Coil Cleaning: Cleaning shall restore coil pressure drop to within 10 percent of pressure drop measured when coil was first installed. If original pressure drop is not known, coil will be considered clean only if it is free of foreign matter and chemical residue, based on thorough visual inspection.

C. Report results of tests in writing.

END OF SECTION
PART 1 - GENERAL

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

1.02 SUMMARY
A. This Section includes the following:
   1. Airfoil centrifugal fans.
   2. Backward-inclined centrifugal fans

1.03 PERFORMANCE REQUIREMENTS
A. Project Altitude: Base fan performance ratings on 2160 ft. sea level.
B. Operating Limits: Classify according to AMCA 99.

1.04 SUBMITTALS
A. Product Data: Include rated capacities, furnished specialties, and accessories for each type of product indicated and include the following:
   1. Certified fan performance curves with system operating conditions indicated.
   2. Certified fan sound-power ratings.
   3. Motor ratings and electrical characteristics, plus motor and electrical accessories.
   4. Material thickness and finishes, including color charts.
   5. Dampers, including housings, linkages, and operators.
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.
   2. Design Calculations: Calculate requirements for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.
   3. Vibration Isolation Base Details: Detail fabrication, including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails, and base weights.
C. Coordination Drawings: Show fan room layout and relationships between components and adjacent structural and mechanical elements. Show support locations, type of support, and weight on each support. Indicate and certify field measurements.
D. Field quality-control test reports.
E. Operation and Maintenance Data: For centrifugal fans to include in emergency, operation, and maintenance manuals.
1.05 QUALITY ASSURANCE
   
   A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
   
   B. AMCA Compliance: Products shall comply with performance requirements and shall be licensed to use the AMCA-Certified Ratings Seal.
   
   C. NEMA Compliance: Motors and electrical accessories shall comply with NEMA 1.

1.06 DELIVERY, STORAGE, AND HANDLING
   
   A. Deliver fans as factory-assembled units, to the extent allowable by shipping limitations, with protective crating and covering.
   
   B. Disassemble and reassemble units, as required for moving to the final location, according to manufacturer's written instructions.
   
   C. Lift and support units with manufacturer's designated lifting or supporting points.

1.07 COORDINATION
   
   A. Coordinate size and location of structural-steel support members.
   
   B. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.
   
   C. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07 Section “Thermal and Moisture Protection”.

1.08 EXTRA MATERIALS
   
   A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
      1. Belts: One set(s) for each belt-driven unit.

1.09 MAINTENANCE AND EMERGENCY SERVICE
   
   A. Provide regular maintenance for the contract period from start up of the equipment through completion of the 12 month warranty period. Maintenance service for equipment shall be provided based on the manufacturer's recommendations, but at least every two months.
   
   B. Regular maintenance shall include a minimum of six filter replacement and a minimum of one drive belt replacement.
   
   C. Provide 24-hour emergency service for breakdowns and malfunctions. An emergency number shall be provided to the owner. A call back response shall be within four (4) hours of the phone call.
   
   D. Submit reports of maintenance and emergency services to include descriptions of malfunctions and repairs or replacements made.
PART 2 - PRODUCTS

2.01 AIRFOIL CENTRIFUGAL FANS

A. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:

1. Greenheck.
2. Loren Cook Company.
3. Trane

B. Description: Factory-fabricated, -assembled, -tested, and -finished, belt-driven centrifugal fans consisting of housing, wheel, fan shaft, bearings, motor and disconnect switch, drive assembly, and support structure.

C. Housings: Formed panels to make curved-scroll housings with shaped cutoff, with doors or panels to allow access to internal parts and components.

1. Panel Bracing: Steel angle- or channel-iron member supports for mounting and supporting fan scroll, wheel, motor, and accessories.
2. Horizontally split, bolted-flange housing.
3. Spun inlet cone with flange.
4. Outlet flange.

D. Airfoil Wheels: Single-width-single-inlet and double-width-double-inlet construction with curved inlet flange; heavy backplate hollow die-formed, airfoil-shaped blades continuously welded at tip flange and backplate and cast-iron or cast-steel hub riveted to backplate and fastened to shaft with set screws and special coating.

E. Shafts: Statically and dynamically balanced and selected for continuous operation at maximum rated fan speed and motor horsepower, with final alignment and belt adjustment made after installation.

1. Turned, ground, and polished hot-rolled steel with keyway. Ship with protective coating of lubricating oil.
2. Designed to operate at no more than 70 percent of first critical speed at top of fan's speed range.


1. Ball-Bearing Rating Life: ABMA 9, L10 at 120,000 hours.
2. Roller-Bearing Rating Life: ABMA 11, L10 at 120,000 hours.


1. Ball-Bearing Rating Life: ABMA 9, L10 at 120,000 hours.
2. Roller-Bearing Rating Life: ABMA 11, L10 at 120,000 hours.

H. Grease-Lubricated Shaft Bearings: Self-aligning, pillow-block-type, ball or roller bearings with adapter mount and two-piece, cast-iron housing.

1. Ball-Bearing Rating Life: ABMA 9, L10 at 120,000 hours.
2. Roller-Bearing Rating Life: ABMA 11, L10 at 120,000 hours.
I. Belt Drives: Factory mounted, with final alignment and belt adjustment made after installation.

1. Service Factor Based on Fan Motor Size: 1.5.
2. Fan Pulleys: Cast iron or cast steel with split, tapered bushing; dynamically balanced at factory.
3. Motor Pulleys: Adjustable pitch for use with motors through [5] hp; fixed pitch for use with larger motors. Select pulley so pitch adjustment is at the middle of adjustment range at fan design conditions.
4. Belts: Oil resistant, nonsparking, and nonstatic; matched sets for multiple belt drives.
5. Belt Guards: Fabricate to comply with OSHA and SMACNA requirements of diamond-mesh wire screen welded to steel angle frame or equivalent, prime coated. Secure to fan or fan supports without short circuiting vibration isolation. Include provisions for adjustment of belt tension, lubrication, and use of tachometer with guard in place.

J. Accessories:

1. Scroll Access Doors: Shaped to conform to scroll, with quick-opening latches and gaskets.
2. Cleanout Door: Quick-opening, latch-type gasketed door allowing access to fan scroll, of same material as housing.
3. Scroll Drain Connection: NPS 1 steel pipe coupling welded to low point of fan scroll.
4. Companion Flanges: Rolled flanges for duct connections of same material as housing.
5. Variable Inlet Vanes: With blades supported at both ends with two permanently lubricated bearings of same material as housing. Variable mechanism terminating in single control lever with control shaft for double-width fans.
6. Discharge Dampers: Assembly with opposed blades constructed of two plates formed around and to shaft, channel frame, and sealed ball bearings; with blades linked outside of airstream to single control lever of same material as housing.
7. Inlet Screens: Grid screen of same material as housing.
8. Shaft Cooler: Metal disk between bearings and fan wheel, designed to dissipate heat from shaft.
10. Shaft Seals: Airtight seals installed around shaft on drive side of single-width fans.

K. Motors: Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."

L. Capacities And Characteristics: Refer to the Drawings

2.02 BACKWARD-INCLINED CENTRIFUGAL FANS

A. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:

1. Greenheck.
2. Loren Cook Company.

B. Description: Factory-fabricated, -assembled, -tested, and -finished, belt-driven centrifugal fans consisting of housing, wheel, fan shaft, bearings, motor and disconnect switch, drive assembly, and support structure.

C. Housings: Formed panels to make curved-scroll housings with shaped cutoff; with doors or panels to allow access to internal parts and components.
1. Panel Bracing: Steel angle- or channel-iron member supports for mounting and supporting fan scroll, wheel, motor, and accessories.
2. Horizontally split, bolted-flange housing.
3. Spun inlet cone with flange.
4. Outlet flange.

D. Backward-Inclined Wheels: Single-width-single-inlet and double-width-double-inlet construction with curved inlet flange, backplate, backward-inclined blades welded or riveted to flange and backplate; cast-iron or cast-steel hub riveted to backplate and fastened to shaft with set screws.

E. Shafts: Statically and dynamically balanced and selected for continuous operation at maximum rated fan speed and motor horsepower, with final alignment and belt adjustment made after installation.
1. Turned, ground, and polished hot-rolled steel with keyway. Ship with a protective coating of lubricating oil.
2. Designed to operate at no more than 70 percent of first critical speed at top of fan's speed range.

1. Ball-Bearing Rating Life: ABMA 9, L10 at 120,000 hours.
2. Roller-Bearing Rating Life: ABMA 11, L10 at 120,000 hours.

1. Ball-Bearing Rating Life: ABMA 9, L10 at 120,000 hours.
2. Roller-Bearing Rating Life: ABMA 11, L10 at 120,000 hours.

H. Grease-Lubricated Shaft Bearings: Self-aligning, pillow-block-type, ball or roller bearings with adapter mount and two-piece, cast-iron housing.
1. Ball-Bearing Rating Life: ABMA 9, L10 at 120,000 hours.
2. Roller-Bearing Rating Life: ABMA 11, L10 at 120,000 hours.

I. Belt Drives: Factory mounted, with final alignment and belt adjustment made after installation.
1. Service Factor Based on Fan Motor Size: 1.5.
2. Fan Pulleys: Cast iron or cast steel with split, tapered bushing; dynamically balanced at factory.
3. Motor Pulleys: Adjustable pitch for use with motors through 5 hp; fixed pitch for use with larger motors. Select pulley so pitch adjustment is at the middle of adjustment range at fan design conditions.
4. Belts: Oil resistant, nonsparking, and nonstatic; matched sets for multiple belt drives.
5. Belt Guards: Fabricate to comply with OSHA and SMACNA requirements of diamond-mesh wire screen welded to steel angle frame or equivalent, prime coated. Secure to fan or fan supports without short circuiting vibration isolation. Include provisions for adjustment of belt tension, lubrication, and use of tachometer with guard in place.

J. Accessories:
1. Scroll Access Doors: Shaped to conform to scroll, with quick-opening latches and gaskets.
2. Cleanout Door: Quick-opening, latch-type gasketed door allowing access to fan scroll, of same material as housing.
3. Scroll Drain Connection: NPS 1 steel pipe coupling welded to low point of fan scroll.
4. Companion Flanges: Rolled flanges for duct connections of same material as housing.
5. Variable Inlet Vanes: With blades supported at both ends with two permanently lubricated bearings of same material as housing. Variable mechanism terminating in single control lever with control shaft for double-width fans.

6. Discharge Dampers: Assembly with opposed blades constructed of two plates formed around and to shaft, channel frame, and sealed ball bearings; with blades linked outside of airstream to single control lever of same material as housing.

7. Inlet Screens: Grid screen of same material as housing.

8. Shaft Cooler: Metal disk between bearings and fan wheel, designed to dissipate heat from shaft.


10. Shaft Seals: Airtight seals installed around shaft on drive side of single-width fans.


K. Motors: Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."

1. Enclosure Type: Totally enclosed, fan cooled.

L. Capacities And Characteristics: Refer to the Drawings

2.03 SOURCE QUALITY CONTROL

A. Sound-Power Level Ratings: Comply with AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Factory test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Label fans with the AMCA-Certified Ratings Seal.

B. Fan Performance Ratings: Establish flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests and ratings according to AMCA 210, "Laboratory Methods of Testing Fans for Rating."

PART 3 – EXECUTION

3.01 INSTALLATION

A. Install centrifugal fans level and plumb.

B. Support floor-mounting units using restrained spring isolators having a static deflection of 1 inch (25 mm). Vibration- and seismic-control devices are specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."

1. Secure vibration and seismic controls to concrete bases using anchor bolts cast in concrete base.

C. Install floor-mounting units on concrete bases. Concrete, reinforcement, and formwork requirements are specified in Division 03 Section "Cast-in-Place Concrete."

D. Install floor-mounting units on concrete bases designed to withstand, without damage to equipment, the seismic force required by authorities having jurisdiction. Concrete, reinforcement, and formwork requirements are specified in Division 03 Section "Cast-in-Place Concrete."

E. Support suspended units from structure using threaded steel rods and spring hangers with vertical-limit stops having a static deflection of 1 inch (25 mm). Vibration-control devices are specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."
F. Install units with clearances for service and maintenance.

G. Label fans according to requirements specified in Division 23 Section "Identification for HVAC Piping and Equipment."

3.02 CONNECTIONS

A. Duct installation and connection requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Division 23 Section "Air Duct Accessories."

B. Install ducts adjacent to fans to allow service and maintenance.

C. Install line-sized piping from scroll drain connection, with trap with seal equal to 1.5 times specified static pressure, to nearest floor drain.

D. Ground equipment according to Division 26.

E. Connect wiring according to Division 26.

3.03 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:

1. Verify that shipping, blocking, and bracing are removed.
2. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
3. Verify that cleaning and adjusting are complete.
4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.
5. Adjust belt tension.
6. Adjust damper linkages for proper damper operation.
7. Verify lubrication for bearings and other moving parts.
8. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.
9. Refer to Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing procedures.
10. Remove and replace malfunctioning units and retest as specified above.

B. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.04 DEMONSTRATION

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

END OF SECTION
SECTION 23 37 13
DIFFUSERS, REGISTERS, AND GRILLES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:

1. Rectangular and square ceiling diffusers.
2. Perforated diffusers.
3. Adjustable bar grilles.
4. Fixed face grilles.

B. Related Sections:

1. Division 08 Section "Openings" for fixed and adjustable louvers and wall vents, whether or not they are connected to ducts.
2. Division 23 Section "Air Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to diffusers, registers, and grilles.

1.03 SUBMITTALS

A. Product Data: For each type of product indicated, include the following:

1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
2. Diffuser, Register, and Grille Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.

B. Samples for Initial Selection: For diffusers, registers, and grilles with factory-applied color finishes.

C. Samples for Verification: For diffusers, registers, and grilles, in manufacturer's standard sizes to verify color selected.

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

1. Ceiling suspension assembly members.
2. Method of attaching hangers to building structure.
3. Size and location of initial access modules for acoustical tile.
4. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
5. Duct access panels.

E. Source quality-control reports.
PART 2 – PRODUCTS

2.01 CEILING DIFFUSERS

A. Rectangular and Square Ceiling Diffusers:
   1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
      a. Anemostat,
      b. Carnes Co.
      c. Krueger
      d. Metal-Aire
      e. Nailor Industries
      f. Price Industries
      g. Titus
      h. Tuttle & Bailey
   2. Devices shall be specifically designed for variable-air-volume flows.
   4. Finish: Baked enamel, white.

B. Perforated Diffuser:
   1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings:
      a. Anemostat,
      b. Carnes Co.
      c. Krueger
      d. Metal-Aire
      e. Nailor Industries
      f. Price Industries
      g. Titus
      h. Tuttle & Bailey
   2. Devices shall be specifically designed for variable-air-volume flows.
   3. Material: Steel backpan and pattern controllers, with steel face.
   4. Finish: Baked enamel, white.

2.02 HIGH-CAPACITY DIFFUSERS

A. Drum Louver:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Anemostat,
      b. Carnes Co.
      c. Krueger
      d. Metal-Aire
      e. Nailor Industries
      f. Price Industries
      g. Titus
      h. Tuttle & Bailey
6. Gasket between drum and border.
9. Mounting: Surface to duct.

2.03 REGISTERS AND GRILLS

A. Adjustable Bar Grill:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings:
   a. Anemostat,
   b. Carnes Co.
   c. Krueger
   d. Metal-Aire
   e. Nailor Industries
   f. Price Industries
   g. Titus
   h. Tuttle & Bailey

2. Material: Steel
3. Finish: Baked enamel, white.
4. Face Blade Arrangement: Vertical spaced 1/2 inch (13 mm) apart.
6. Rear-Blade Arrangement: Horizontal spaced 1/2 inch (13 mm)] apart.
7. Frame: 1-1/4 inches (32 mm) wide.

B. Fixed Face Grill:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
   a. Anemostat,
   b. Carnes Co.
   c. Krueger
   d. Metal-Aire
   e. Nailor Industries
   f. Price Industries
   g. Titus
   h. Tuttle & Bailey

3. Finish: Baked enamel, white.
7. Mounting: Countersunk screw.

C. Linear Bar Grill:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
   a. Anemostat,
   b. Carnes Co.
   c. Krueger
d. Metal-Aire  
e. Nailor Industries  
f. Price Industries  
g. Titus  
h. Tuttle & Bailey  

3. Finish: Baked enamel, white.  

2.04 SOURCE QUALITY CONTROL  
A. Verification of Performance: Rate diffusers, registers, and grilles according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."  

PART 3 – EXECUTION  

3.01 EXAMINATION  
A. Examine areas where diffusers and grilles are to be installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.  
B. Proceed with installation only after unsatisfactory conditions have been corrected.  

3.02 INSTALLATION  
A. Install diffusers and grilles level and plumb.  
B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practical. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.  
C. Install diffusers and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.  

3.03 ADJUSTING  
A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.  

END OF SECTION
PART 1 – GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. This Section includes factory-fabricated air-filter devices and media used to remove particulate matter from air for HVAC applications.

1.03 DEFINITIONS

A. DOP: Diocyl phthalate or bis-(2-ethylhexyl) phthalate.
B. HEPA: High-efficiency particulate air.
C. ULPA: Ultra low penetration air.

1.04 SUBMITTALS

A. Product Data: Include dimensions; operating characteristics; required clearances and access; rated flow capacity, including initial and final pressure drop at rated airflow; efficiency and test method; fire classification; furnished specialties; and accessories for each model indicated.

B. Shop Drawings: Include plans, elevations, sections, and details to illustrate component assemblies and attachments.

1.  Show filter rack assembly, dimensions, materials, and methods of assembly of components.
2.  Include setting drawings, templates, and requirements for installing anchor bolts and anchorages.

C. Operation and Maintenance Data: For each type of filter and rack to include in emergency, operation, and maintenance manuals.

1.05 QUALITY ASSURANCE

A. Product Options: Drawings indicate size, profiles, and dimensional requirements of air filters and are based on the specific system indicated.

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 ARI 850.

D. Comply with ASHRAE 52.1 and ASHRAE 52.2 for method of testing and rating air-filter units.

E. Comply with NFPA 70 for installing electrical components.

F. Comply with NFPA 90A and NFPA 90B.
1.06 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

1.07 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Provide one complete set of filters for each filter bank. If system includes prefilters, provide only prefilters.
2. Provide one container of red oil for inclined manometer filter gage.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Air Filters, and Filter-Holding Systems:
   a. Ecco Air
   b. Farr Co.
   c. Cambridge

2. Filter Gages:
   a. Cambridge Filter Corp..
   b. Dwyer Instruments, Inc.

2.02 EXTENDED-SURFACE, DISPOSABLE PANEL FILTERS

A. Description: Factory-fabricated, dry, extended-surface filters with holding frames.

B. Media: Fibrous material formed into deep-V-shaped pleats with anti-microbial agent and held by self-supporting wire grid.

C. Media and Media-Grid Frame: Fire-retardant, 3/4-inch particleboard with gaskets.

D. Duct-Mounting Frames: Welded, galvanized steel with gaskets and fasteners, and suitable for bolting together into built-up filter banks.

2.03 COMMODITY AND ASHRAE TYPE FILTERS - GENERAL

A. Commodity type filters are specified as "commodity-type" or "ASHRAE-type because it is intended that these filters fit within the range of filters generally covered by ASHRAE standards or manufactured by most filter manufacturers. These filters are distinguished from "specialty-type" filters because specialty filters may have some specific feature or absorption capability which is required by the Owner and is only manufactured by a single manufacturer.

B. Cartridge type filters may be substituted for bag type filters for each high efficiency filter application during the construction phasing, when air handling unit is used during the construction work. The substitution of cartridge type filters will not however relieve the Contractor from providing the Owner with new bag type high efficiency filters after completion of all construction phase work, including clean-up phase.
C. Manufacturer’s names and catalog numbers given hereafter are intended to establish type, size, performance and standard of quality.

D. Provide filter media for all air handling units, and replacement roof top air handling units, and at other locations as shown and scheduled on the drawings.

E. Provide throw-away type filter media for all packaged terminal equipment such as fan coil units, cabinet unit heaters, and fan powered terminal boxes. Refer to the drawing schedules. Filter media shall be the size required by the terminal equipment device.

2.04 ASHRAE 30 PERCENT EFFICIENCY FILTERS (MERV 11)

A. Provide 30 Percent Efficiency (MERV 11) Air Filters of the size and depth as scheduled on the drawings and as specified in other sections of this specification. Air filters shall be the pleated, disposable type. Each filter shall consist of synthetic fabric media, media support grid, and enclosing frame. The filter shall be listed as Underwriters’ Laboratories Class 2 (or Class 1).

B. The media shall have an average efficiency of 25-30% (MERV 11) when tested under ASHRAE Standard 52.1-1992 (52.2-1999).

1. For 1 inch deep filters, the effective filter media shall be not less than 1.9 square feet of media per square foot of filter face area. There shall be not less than 14 pleats per linear foot of filter face area. Initial resistance at 500 feet per minute approach velocity shall not exceed 0.45” w.g. Filter shall be rated for a final pressure drop of not less than 1.0” w.g.

2. For 2 inch deep filters, the effective filter media shall be not less than 4.4 square feet of media per square foot of filter face area. There shall be not less than 14 pleats per linear foot of filter face area. Initial resistance at 500 feet per minute approach velocity shall not exceed 0.30” w.g. Filter shall be rated for a final pressure drop of not less than 1.0” w.g.

3. For 4 inch deep filters, the effective filter media shall be not less than 6.7 square feet of media per square foot of filter face area. There shall be not less than 10 pleats per linear foot of filter face area. Initial resistance at 600 feet per minute approach velocity shall not exceed 0.35” w.g. Filter shall be rated for a final pressure drop of not less than 1.0” w.g.

C. The media support grid shall be constructed of a corrosion resistant expanded metal backing.

D. The enclosing frame shall be constructed of a rigid, heavy-duty, high wet-strength beverage board. Diagonal support members, of the same construction, shall be bonded to the air entering and air exiting side of each pleat. The inside periphery of the enclosing frame shall be bonded to the filter pack eliminating the possibility of air bypass.

E. The filter shall be identified on the enclosing frame as to manufacturer, model, and U.L. Class rating.

2.05 FILTER GAGES

A. An Air Filter Gauge for measuring the resistance to airflow through the filters shall be installed. Each housing shall include one gauge (magnehelic type) for measurement of pre-filter, final filter, and/or total filter bank resistance.

B. The air filter gauge shall be diaphragm actuated, shall have 3-7/8” diameter white dial with black figures and graduations, shall have zero adjustment, shall be furnished with
two static pressure tips, fittings for 1/4” metal or plastic tubing, and a means for mounting
the gauge. Gauge graduations shall be from 0”-3”.

C. A three-way gauge cock and fittings shall be provided to allow measurements relating to
three tap locations.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Install filter frames according to manufacturer’s written instructions.

B. Position each filter unit with clearance for normal service and maintenance. Anchor filter
holding frames to substrate.

C. Install filters in position to prevent passage of unfiltered air.

D. Install filter gage for each filter bank.

E. Install filter gage static-pressure tips upstream and downstream from filters to measure pressure
drop through filter. Mount filter gages on outside of filter housing or filter plenum in an
accessible position. Adjust and level inclined gages.

F. Coordinate filter installations with duct and air-handling unit installations.

G. Electrical wiring and connections are specified in Division 26 Sections.

H. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical
Systems."

3.02 FIELD QUALITY CONTROL

A. Manufacturer’s Field Service: Engage a factory-authorized service representative to
inspect, test, and adjust field-assembled components, filter and filter-frame installation,
and electrical wiring, and to assist in field testing. Report results in writing.

3.03 CLEANING

A. After completing system installation and testing, adjusting, and balancing air-handling and air-
distribution systems, clean filter housings and install new filter media.

END OF SECTION
SECTION 23 51 13
DRAFT CONTROL DEVICES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. This Section includes the following:

1. Barometric dampers.
2. Vent dampers.

1.03 SUBMITTALS

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

B. Shop Drawings: Show fabrication and installation details for fans and dampers. Include plans, elevations, sections, details, and attachments to other work. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, hangers and seismic restraints, and location and size of each field connection.


C. Operation and Maintenance Data: For draft control devices to include in emergency, operation, and maintenance manuals.

D. Warranty: Special warranty specified in this Section.

1.04 QUALITY ASSURANCE

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

1.05 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of vent exhaust fans barometric dampers or vent dampers that fail in materials or workmanship within specified warranty period.

   1. Failures include failure of the fan due to corrosion.
   2. Warranty Period: Two years from date of Substantial Completion.
PART 2 – PRODUCTS

2.01 BAROMETRIC DAMPERS

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

1. Babco Inc.
2. Bramec Corporation.
3. EXHAUSTO, Inc.
4. Tjernlund Products, Inc.
5. Tutco, Inc.
6. Wing Draft Inducers.


2.02 VENT DAMPERS

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

1. Effikal International Inc.
2. Field Controls L.L.C.; Venting Solutions Company (The).

B. Damper Construction: Stainless-steel damper blade, shaft, and vent pipe with metal, prelubricated bearings.

1. Electric motor sized to power damper open and closed in approximately 15 seconds in each direction. Power is off when damper is at rest.

C. Controls:

1. Control transformer.
2. Keyed wiring harness.
3. Damper end-switch to prove damper is open.
4. Interlock with boiler to permit burner operation when damper is open.
5. Hold-open switch for troubleshooting boiler controls.

2.03 MOTORS

A. Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."

2.04 CAPACITIES AND CHARACTERISTICS – Refer to the Drawings

PART 3 – EXECUTION

3.01 INSTALLATION

A. Install listed components in a manner complying with the listing.
B. Secure barometric dampers to breechings with hardware compatible with connected materials.
C. Locate barometric and motorized vent dampers as close to draft hood collar as possible.
D. Secure barometric and motorized vent dampers to appliances, breechings, or chimneys with hardware compatible with connected materials.
E. Install intake duct that is sized according to manufacturer's written instructions.

3.02 CONNECTIONS
A. Ground equipment according to Division 26.
B. Connect wiring according to Division 26.

3.03 STARTUP SERVICE
A. Engage a factory-authorized service representative to perform startup service.
   1. Complete installation and startup checks according to manufacturer's written instructions.
B. Remove and replace malfunctioning components and recheck.

3.04 ADJUSTING
A. Set field-adjustable switches and controls as indicated.

3.05 DEMONSTRATION
A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain draft control devices.

END OF SECTION
PART 1 - GENERAL

1.01 SECTION INCLUDES:
A. Split Air Conditioners.
B. Controls.

1.02 RELATED SECTIONS:
A. Section 23 05 00 – Basic Mechanical Materials and Methods
B. Section 23 05 13 – Motors.
C. Section 23 05 48 - Vibration Isolation and Seismic Controls.
D. Section 23 07 00 - Mechanical Insulation.
E. Section 23 23 00- Refrigerant Piping and Specialties
F. Division 26 - Electrical: Equipment Wiring Systems - Electrical supply to units.

1.03 SUBMITTALS:
A. Submit shop drawings and product data under provisions of Division 1.
B. Submit shop drawings and product data for manufactured and assemblies required of the project.
C. Indicate drain and electrical rough-in connection on shop drawings or product data

1.04 WARRANTY:
A. Provide a one year warranty to include coverage under provisions of Division 1.

1.05 EXTRA MATERIALS:
A. Provide one set of filters for each unit.

PART 2 - PRODUCTS

2.01 MANUFACTURERS:
A. LG
B. Mitsubishi
C. Carrier.
D. Approved Equal.

2.02 AIR CONDITIONING UNITS:
A. Description: Packaged, self-contained, factory assembled, prewired unit, consisting of cabinet, compressor, condensing coil, evaporator fan, evaporator coil, air filters, controls, and remote condenser and refrigerant kit.

2.03 CABINET:
A. Frame and Panels: Heavy gauge galvanized steel with baked enamel finish, easily removed access doors with positive latches, discharge and return grilles.
B. Insulation: Minimum 1 inch thick acoustic duct liner for lining cabinet interior.
C. Drain Pan: Galvanized steel with corrosion-resistant coating.
2.04 EVAPORATOR FAN:

A. Fan: Direct drive, width, double inlet, forward curved centrifugal fan, statically and dynamically balanced, with permanently lubricated bearings.
B. Motors: As indicated in compliance with Section 23 05 13.

2.05 COMPRESSOR:

A. Compressors shall be heavy-duty, rotary, hermetic type with reversible, positive displacement oil pump, suction and discharge line service valves, crankcase heater and inherent-solid-state thermal overload protection. Each compressor shall have its own completely independent refrigeration circuit including sight glass, filter-drier, and manual shutoff. A spruse-type high pressure relief valve. Compressor shall be isolated on neoprene impregnated fiberglass kinetic block.

2.06 EVAPORATOR COIL:

A. Direct expansion coiling coil of seamless copper to be expanded into aluminum fins. Provide each coil with an additional circuit for a minimum of 15 degrees of subcooling.

2.07 CONDENSER:

A. Fan: propeller type statically and dynamically balanced, with permanently lubricated bearings.
B. Motors: As indicated in compliance with Section 23 05 13.
C. Provide with metal coil guard.

2.08 AIR FILTERS:

A. Easily removed one inch thick disposable glass fiber panel filters.

2.09 CONTROLS:

A. Unit shall be complete with a remote wall mounted micro processor based thermostat.

2.10 REFRIGERANT PIPING:

A. Copper Tubing: ASTM B280, Type ACR hard drawn.
   2. Joints: Braze, AWS A5.8 BCuP silver/phosphorus/copper alloy with melting range 1190 to 1480 degrees F.
B. Copper Tubing to 7/8 inch OD: ASTM B88, Type K, annealed.

PART 3 - EXECUTION

3.01 INSTALLATION:

A. Install in accordance with manufacturer’s instructions.
B. Pipe condensate from drain pan to condensate drainage system.

END OF SECTION
SECTION 26 00 00

BASIC ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Basic Electrical Requirements specifically applicable to Division 16 Sections, in addition to Division 1 General Requirements.

1.2 ALTERNATES

A. Alternates quoted on Bid Forms will be reviewed and accepted or rejected at the Owner's option. Accepted Alternates will be identified in Owner-Contractor Agreement.

B. Coordinate related work and modify surrounding work as required.

1.3 REFERENCES


1.4 SUBMITTALS

A. Submit under provisions of Section 01 33 00.

B. Proposed Products List: Include Products specified in the following Sections:

1. Section 26 00 00 – Basic Electrical Requirements
2. Section 26 05 03 – Equipment Wiring Systems
3. Section 26 05 05 – Selective Demolition for Electrical
4. Section 26 05 19 – Low Voltage Electrical Power Conductors and Cables
5. Section 26 05 22 – Manufactured Wiring Assemblies
6. Section 26 05 26 – Grounding and Bonding for Electrical Systems
7. Section 26 05 08 – Seismic Restraint
8. Section 26 05 05 – Hangers and Support for Electrical Systems
9. Section 26 05 33 – Raceway and Boxes for Electrical Systems
10. Section 26 05 36 – Cable Trays for Electrical Systems
11. Section 26 05 53 – Identification for Electrical Systems
12. Section 26 05 70 – Testing
13. Section 26 24 16 - Panelboards
14. Section 26 27 16 – Electrical Cabinet and Enclosures
15. Section 26 27 26 – Wiring Devices
16. Section 26 28 19 – Enclosed Switches
17. Section 26 29 16 – Enclosed Contactors
18. Section 26 51 00 – Interior Lighting
19. Section 26 51 50 – Interior Lighting Solid State Lighting (SSL)
20. Section 28 46 21.11 – Addressable Fire Alarm Systems

C. Submit shop drawings and product data grouped to include complete submittals of related systems, products, and accessories in a single submittal.

D. Mark dimensions and values in units to match those specified.

1.5 REGULATORY REQUIREMENTS

A. Conform to Uniform Building Code.

B. Electrical: Conform to NFPA 70.
C. Electrical: Conform to local electrical ordinance.

D. Obtain permits, and request inspections from authority having jurisdiction.

### 1.6 PROJECT/SITE CONDITIONS

A. Install Work in locations shown on Drawings, unless prevented by Project conditions.

B. The drawings are diagrammatic unless indicated otherwise. The drawings reflect equipment installation and circuiting only and are not depicting exact conduit routing unless specifically noted otherwise. Home run circuits may be combined per requirements of NEC. All circuits indicated shall be run with dedicated neutral conductors.

C. Prepare drawings showing proposed rearrangement of Work to meet Project conditions, including changes to Work specified in other Sections. Obtain permission of Owner before proceeding.

D. Data presented on these drawings are as accurate as planning can determine, but field verification of all dimensions, locations, levels, etc., to suit field conditions is required. Review all architectural, structural, and civil drawings; and adjust all work to meet the requirements of conditions shown. Discrepancies between different plans, or between drawings and specifications, or regulations and codes governing the installation shall be brought to the attention of the engineer in writing before the date of bid opening. If discrepancies are not reported, the contractor shall bid the greater quantity or better quality, and appropriate adjustments will be made after contract award. Contractor shall be responsible to field measure and confirm mounting heights and location of electrical equipment with respect to roadways, structures, etc. Do not scale distances off the electrical drawings. Use actual building and site dimensions.

E. Guarantee all material furnished and all workmanship performed for a period of one year from the date of final acceptance of the work. Any defects developing within this period, traceable to material furnished as a part of this section or workmanship performed hereunder, shall be made good at no additional expense to the owner.

### 1.7 SEQUENCING AND SCHEDULING

A. Construct Work in sequence under provisions of Section 01 11 00.

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PART 2 - PRODUCTS

PART 3 - EXECUTION

END OF SECTION
SECTION 26 05 03
EQUIPMENT WIRING SYSTEMS

PART 1 - GENERAL

1.1 SECTION INCLUDES
A. Electrical connections to equipment specified under other sections.

1.2 RELATED SECTIONS
A. Section 01 11 00 - Summary of Work: Owner-furnished equipment.
B. Section 22 05 13 - Plumbing Equipment.
C. Section 26 05 19 - Building Wire and Cable.
D. Section 26 05 33 - Conduit.
E. Section 26 05 35 - Boxes.

1.3 REFERENCES
A. NEMA WD 1 - General Purpose Wiring Devices.
B. NEMA WD 6 - Wiring Device Configurations.

1.4 SUBMITTALS
A. Submit under provisions of Section 01 33 00.
B. Product Data: Provide wiring device manufacturer's catalog information showing dimensions, configurations, and construction.
C. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of Product.

1.5 REGULATORY REQUIREMENTS
A. Conform to requirements of ANSI/NFPA 70.
B. Furnish products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and shown.

1.6 COORDINATION
A. Coordinate work under provisions of Section 01 31 13.
B. Obtain and review shop drawings, product data, and manufacturer's instructions for equipment furnished under other sections.
C. Determine connection locations and requirements.

D. Sequence rough-in of electrical connections to coordinate with installation schedule for equipment.

E. Sequence electrical connections to coordinate with start-up schedule for equipment.

PART 2 - PRODUCTS

2.1 CORDS AND CAPS

A. Manufacturers:
   1. Woodhead.
   2. Hubbell.
   3. Leviton.
   4. Substitutions: Under provisions of Section 01 25 00.

B. Attachment Plug Construction: Conform to NEMA WD 1.

C. Configuration: NEMA WD 6; match receptacle configuration at outlet provided for equipment.

D. Cord Construction: ANSI/NFPA 70, Type SO multi-conductor flexible cord with identified equipment grounding conductor, suitable for use in damp locations.

E. Size: Suitable for connected load of equipment, length of cord, and rating of branch circuit overcurrent protection.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify conditions under provisions of Section 01 31 13.

B. Verify that equipment is ready for electrical connection, wiring, and energization.

3.2 ELECTRICAL CONNECTIONS

A. Make electrical connections in accordance with equipment manufacturer's instructions.

B. Make conduit connections to equipment subject to vibration using flexible conduit, maximum 36 inch length. Use liquid-tight flexible conduit with watertight connectors in damp or wet locations. Make final connections to interior lighting fixtures using flexible conduit, maximum 72 inch length.

C. Make wiring connections using wire and cable with insulation suitable for temperatures encountered in heat producing equipment.

D. Provide receptacle outlet where connection with attachment plug is indicated. Provide cord and cap where field-supplied attachment plug is indicated.

E. Provide suitable strain-relief clamps and fittings for cord connections at outlet boxes and equipment connection boxes.

F. Install disconnect switches, controllers, control stations, and control devices as indicated.

G. Modify equipment control wiring with terminal block jumpers as indicated.
H. Provide interconnecting conduit and wiring between devices and equipment where indicated.

END OF SECTION
PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Removal of existing electrical equipment, wiring, and conduit in areas to be remodeled; removal of designated construction; dismantling, cutting and alterations for completion of the Work.
2. Disposal of materials.
4. Identification of utilities.
5. Salvaged items.
6. Protection of items to remain as indicated on drawings.
7. Relocate existing equipment to accommodate construction.

B. Related Sections:

1.2 CLOSEOUT SUBMITTALS

A. Section 017000 - Execution and Closeout Requirements: Requirements for submittals.

B. Project Record Documents: Record actual locations of capped conduits and equipment abandoned in place.

C. QUALITY ASSURANCE

D. Perform Work in accordance with Public Works standard.

E. PRE-INSTALLATION MEETINGS

F. Section 013000 - Administrative Requirements: Pre-installation meeting.

G. Convene minimum one week prior to commencing work of this section.

1.3 SEQUENCING

A. Section 011000 - Summary: Requirements for sequencing.

B. Sequence work in the following order:
1. Verify all electrical equipment, wiring devices, and wiring to be removed.
2. Verify existing circuiting of equipment indicated to be removed and any equipment on common circuit that is to remain.
3. Disconnect equipment indicated to be removed from existing circuit and provide for continuity of circuit to existing equipment indicated to remain.
4. Provide protection for removed equipment and store in owner designated location.
1.4 SCHEDULING
   A. Section 013000 – Administrative Requirements: Requirements for scheduling.
   B. Schedule work to coincide with new construction and work of other trades.
   C. Perform demolition work:
      1. Between hours of 7:00am and 3:00pm.
   D. Cease operations immediately when structure appears to be in danger and notify Architect/Engineer. Do not resume operations until directed.

1.5 COORDINATION
   A. Section 013000 - Administrative Requirements: Requirements for coordination.
   B. Conduct demolition to minimize interference with adjacent and occupied building areas.
   C. Coordinate demolition work with work of other trades.
   D. Coordinate and sequence demolition so as not to cause shutdown of operation of surrounding areas.
   E. Shut-down Periods:
      1. Arrange timing of shut-down periods of in service panels with Owner. Do not shut down any utility without prior written approval.
      2. Keep shut-down period to minimum or use intermittent period as directed by Owner.
      3. Maintain life-safety systems in full operation in occupied facilities, or provide notice minimum seven days in advance.
   F. Identify salvage items in cooperation with Owner.

PART 2 - PRODUCTS

2.1 Not Used

PART 3 - EXECUTION

3.1 EXAMINATION
   A. Section 01 30 00 - Administrative Requirements: Verification of existing conditions before starting work.
   B. Verify wiring and equipment indicated to be demolished serve only abandoned facilities.
   C. Verify termination points for demolished services.

3.2 PREPARATION
   A. Erect, and maintain temporary safeguards, including warning signs, barricades for protection of the public, Owner, Contractor's employees, and existing improvements to remain.
B. Temporary egress signage and emergency lighting

3.3 DEMOLITION

A. Demolition Drawings are based on casual field observation and existing record documents. Report discrepancies to Architect / Engineer before disturbing existing installation.

B. Remove exposed abandoned conduit, including abandoned conduit above accessible ceiling finishes. Cut conduit flush with walls and floors, and patch surfaces to match existing.

C. Remove conduit, wire, boxes, and fastening devices to avoid any interference with new installation in accessible locations.

D. Disconnect electrical systems in walls, floors, and ceilings scheduled for removal.

E. Reconnect equipment being disturbed by renovation work and required for continue service to the existing circuit or nearest designated panel.

F. Disconnect or shut off service to areas where electrical work is to be removed. Remove electrical fixtures, equipment, and related switches, outlets, conduit and wiring which are not part of final project.

G. Install temporary wiring and connections to maintain existing systems in service during construction.

H. Perform work on energized equipment or circuits with experienced and trained personnel.

I. Remove, relocate, and extend existing installations to accommodate new construction.

J. Repair adjacent construction and finishes damaged during demolition and extension work.

K. Remove exposed abandoned grounding and bonding components, fasteners and supports, and electrical identification components, including components abandoned components above accessible ceiling finishes. Cut embedded support elements flush with walls and floors.

L. Clean and repair existing equipment to remain, affected by demolition work, or to be re-installed.

M. Protect and retain power to existing active equipment remaining.

N. Identify abandoned empty conduit at both ends as “abandoned”.

3.4 EXISTING PANELBOARDS

A. Ring out circuits in existing panel affected by the Work. Where additional circuits are needed, use available “spare” circuit breakers or install new breakers.

B. Identify unused circuits as spare on the updated panelboard directory.

C. Where existing circuits are indicated to be reused, use sensing measuring devices to verify circuits feeding Project area or are not in use.

D. Remove existing wire no longer in use from panel to equipment.
E. Provide new updated (Typed) directories where more than three circuits have been modified or rewired.

3.5 SALVAGE ITEMS

A. Remove and protect items indicated on drawings or scheduled in this specification section to be salvaged and turn over to Owner.

B. Items of salvageable value may be removed as work progresses. Transport salvaged items from site as they are removed.

3.6 REUSABLE ELECTRICAL EQUIPMENT

A. Carefully remove and clean equipment, materials, or fixtures which are to be reused.

B. Disconnect, remove, or relocate existing electrical material and equipment interfering with new installation.

C. Relocate existing lighting fixtures as indicated on Drawings. Clean fixtures and re-lamp. Test fixture to see if it is in good working condition before installation at new location.

3.7 CLEANING

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for cleaning.

B. Remove demolished materials as work progresses. Legally dispose.

C. Keep workplace neat on a daily basis.

3.8 PROTECTION OF FINISHED WORK

A. Section 017000 - Execution and Closeout Requirements: Requirements for protecting finished Work.

B. Do not permit traffic over unprotected floor surface.

C. SCHEDULES

D. Remove, store and protect the following materials and equipment:
   1. Light fixtures.
   2. Laboratory equipment.

E. Remove the following equipment for Owner's retention. Deliver to location designated by Owner:
   1. Lighting fixtures.

END OF SECTION
SECTION 26 05 19
LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 SECTION INCLUDES
A. Building wire and cable.
B. Wiring connectors and connections.

1.2 RELATED SECTIONS
A. Section 26 05 33 - Conduit.
B. Section 26 05 35 - Boxes.
C. Section 26 05 53 – Electrical Identification.

1.3 REFERENCES

1.4 QUALIFICATIONS
A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years documented experience.

1.5 REGULATORY REQUIREMENTS
A. Conform to requirements of ANSI/NFPA 70.
B. Furnish products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and shown.

1.6 PROJECT CONDITIONS
A. Verify that field measurements are as shown on Drawings.
B. Conductor sizes are based on AWG copper.
C. Wire and cable routing shown on Drawings is approximate unless dimensioned. Route wire and cable as required to meet Project Conditions. Include wire and cable lengths within 10 feet of length shown.
D. Where wire and cable routing is not shown, and destination only is indicated, determine exact outing and lengths required and document on “as-built” drawings at completion of project.

1.7 COORDINATION
A. Coordinate Work under provisions of Section 01 31 13.
B. Determine required separation between cable installation and other work.
C. Determine cable routing to avoid interference with work of other trades.

PART 2 - PRODUCTS

2.1 BUILDING WIRE AND CABLE

A. Description: Single conductor insulated wire.

B. Conductor: Copper.

C. Insulation Voltage Rating: 600 volts.

D. Insulation: ANSI/NFPA 70; Type THW, THHN/THWN, or XHHW insulation for feeders and branch circuits larger than 6 AWG; Type THHN/THWN insulation for feeders and branch circuits 6 AWG and smaller.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that interior of building has been protected from weather.

B. Verify that mechanical work likely to damage wire has been completed.

3.2 PREPARATION

A. Confirm that entire raceway installation has been completed and thoroughly swab raceway before installing wire.

3.3 WIRING METHODS

A. In All Power Installations:
   1. Building interior locations: Install conductors in EMT required for all exposed public spaces.
   2. Exposed exterior locations: Install conductors in Rigid Galvanized Steel (RGS) conduits.

B. Use wiring methods indicated on Drawings.

3.4 WIRE COLOR

A. General:
   1. For wire sizes 10 AWG and smaller – wire shall be colored as indicated below.
   2. For wire sizes 8 AWG and larger – identify wire with colored tape at all terminals, splices and boxes. Colors to be as indicated below.
   3. Use black, red, and blue for Phases A, B & C in 120/208 volt circuits. Use brown, orange, and yellow for Phases A, B & C in 277/480 volt circuits.

B. Neutral Conductors: White for 208Y/120V: 6 AWG and smaller. For 4 AWG and larger, identify with white tape at both ends and visible points included in all junction boxes. Where there are two or more neutrals in one conduit, each shall be individually identified with the proper circuit. For 480Y/277V: Use gray conductor for 6 AWG and smaller. For 4 AWG and larger, identify with gray tape at both ends and all visible points included in all junction boxes.
C. Branch Circuit Conductors: Three or four wire home runs shall have each phase uniquely color coded.

D. Feeder Circuit Conductors: Each phase shall be uniquely color coded.

E. Ground Conductors: Green for 6 AWG and smaller. For 4 AWG and larger, identify with green tape at both ends and all visible points included in all junction boxes.

### 3.5 INSTALLATION

A. Install products in accordance with manufacturers’ instructions.

B. Use solid conductors for feeders and branch circuits 10 AWG and smaller.

C. Use stranded conductors for control circuits (Minimum wire size is #16 AWG).

D. Use conductors not smaller than 12 AWG for power and lighting circuits.

E. Use conductors not smaller than 16 AWG for control circuits.

F. Use 10 AWG conductors for 20 ampere, 120 volt branch circuits longer than 75 feet.

G. Use 10 AWG conductors for 20 ampere, 277 volt branch circuits longer than 200 feet.

H. Pull all conductors into raceway at same time.

I. Use suitable wire pulling lubricant for building wire 4 AWG and larger.

J. Neatly train and lace wiring inside boxes, equipment, and panelboards.

K. Clean conductor surfaces before installing lugs and connectors.

L. Make splices, taps, and terminations to carry full ampacity of conductors with no perceptible temperature rise.

M. Use split bolt connectors for copper conductor splices and taps, 6 AWG and larger. Tape uninsulated conductors and connector with electrical tape to 150 percent of insulation rating of conductor.

N. Use solderless pressure connectors with insulating covers for copper conductor splices and taps, 8 AWG and smaller.

O. Use insulated spring wire connectors with plastic caps for copper conductor splices and taps, 10 AWG and smaller.

P. Do not share neutrals for lighting or receptacle circuits.

### 3.6 INTERFACE WITH OTHER PRODUCTS

A. Identify wire and cable under provisions of Section 26 05 53.

B. Identify each conductor with its circuit number or other designation indicated on Drawings.

### 3.7 FIELD QUALITY CONTROL

A. Perform field inspection and testing under provisions of Section 01 40 00.

B. Inspect wire for physical damage and proper connection.
C. Measure tightness of bolted connections and compare torque measurements with manufacturer's recommended values.

D. Verify continuity of each branch circuit conductor.

E. Verify continuity of each feeder.

END OF SECTION
PART 1 GENERAL

1.1 SUMMARY
A. Section includes prefabricated flexible cables, distribution units, and cable accessories for system of wiring using manufactured wiring assemblies.
B. Related Sections:
1. Section 26 05 33 - Raceway and Boxes for Electrical Systems: Receptacle and wall switch outlets.
2. Section 26 27 26 - Wiring Devices: Convenience receptacles and wall switches.
3. Section 26 51 00 - Interior Lighting: Fixture connector assemblies.

1.2 REFERENCES
A. National Fire Protection Association:
   1. NFPA 262 - Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces.

1.3 SUBMITTALS
A. See Division 1 for Submittal Procedures.
B. Shop Drawings: Indicate distribution box, switch box, outlet, and cable layout and branch circuit configuration.
C. Product Data: Submit catalog data for each cable type and for each fitting and accessory.

1.4 CLOSEOUT SUBMITTALS
A. See Division 1 Submittal Procedures for Execution and Closeout Requirements.
B. Project Record Documents: Record actual locations of cable assemblies and branch circuits.

1.5 QUALITY ASSURANCE
A. Provide wiring materials located in plenums with peak optical density not greater than 0.5, average optical density not greater than 0.15, and flame spread not greater than 5 feet (1.5 m) when tested in accordance with NFPA 262.
B. Perform Work in accordance with NECA’s Standard of Installation.

1.6 QUALIFICATIONS
A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

1.7 FIELD MEASUREMENTS
A. Verify field measurements prior to fabrication.
B. Drawings:
1. Drawings are diagrammatic and should not be scaled to determine exact locations. Verify all locations and requirements of equipment furnished and/or installed by others before roughing in.
2. Any costs resulting from errors or omissions caused by this Contractor not verifying the above information will be borne by this Contractor at no expense to the Owner.
3. Any discrepancies noted on the drawings shall be identified by the Contractor during bidding. Contractor shall use the more stringent requirement and cost to establish a bid price.
4. Any conflicts between drawings and drawing schedules shall be brought to the Engineer's attention prior to submission of bid. Any such conflicts discovered at a later date shall be resolved at the Owner's discretion at the expense of the Contractor.

1.8 COORDINATION

A. See Division 1 Administrative Requirements for Coordination and Project Conditions.
B. Furnish luminaire connectors to luminaire manufacturer for factory installation.

PART 2 PRODUCTS

2.1 MANUFACTURED WIRING ASSEMBLIES

A. Manufacturers:
   1. Electro/Connect Division of Emerson Electric Company.
   3. Lithonia Reloc.
   4. Substitutions: See Division 1 for Product Requirements and Substitution Procedures.

B. Product Description: Factory assembled cable assemblies with appropriate connector on each end, with lengths and circuit configurations as indicated on Drawings.

C. Convenience Receptacle Unit Assemblies: Furnish cables configured to match device type. Voltage: [120] [277] volts.

D. Luminaire Connector Assemblies: Connector suitable for mounting in luminaire body knockout. Voltage: [120] [277] volts.

2.2 DISTRIBUTION UNITS

A. Manufacturers:
   1. Electro/Connect Division of Emerson Electric Company.
   3. Lithonia Reloc.
   4. Substitutions: See Division 1 for Product Requirements and Substitution Procedures.

B. Product Description: Boxes suitable for terminating building wiring system raceways and making connections to integral receptacles; circuit configuration as indicated on Drawings.

2.3 ACCESSORIES

A. Furnish manufacturer's standard accessories, including cable extenders, distribution tees, and switching assemblies.
PART 3 EXECUTION

3.1 EXISTING WORK

A. Remove exposed abandoned cable and accessories, including abandoned components above accessible ceiling finishes.

B. Disconnect and remove abandoned cable. Remove abandoned cable when boxes being serviced are abandoned and removed.

C. Maintain access to existing distribution boxes and other installations remaining active and requiring access. Modify installation or provide access panel.

D. Extend existing cable installations using materials and methods as specified.

E. Clean and repair existing cable and accessories to remain or to be reinstalled.

3.2 INSTALLATION

A. Support cable by means of straps and clamps.

B. Support cable above suspended ceiling from structure to avoid contact with and interference with removal of ceiling panels. Do not support from ceiling suspension system.

C. Arrange cable to avoid interference with access to other Work.

D. Install each cable with 10 percent slack length.

END OF SECTION
PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Grounding electrodes and conductors.
B. Equipment grounding conductors.
C. Bonding.

1.2 RELATED SECTIONS

A. Section 03 20 00 - Concrete Reinforcement.
B. Section 03 10 00 - Concrete.

1.3 REFERENCES

A. Section 01 40 00 - Quality Control.
B. Section 01 42 19 - Reference Standards: Requirements for references and standards.
D. NFPA 70 - National Electrical Code.

1.4 GROUNDING SYSTEM DESCRIPTION

A. Metal underground water pipe if available.
B. Rod electrode.

1.5 PERFORMANCE REQUIREMENTS

A. Grounding System Resistance: 5 ohms.

1.6 SUBMITTALS FOR REVIEW

A. Section 01 33 00 - Submittals: Procedures for submittals.
B. Product Data: Provide for grounding electrodes and connections.

1.7 SUBMITTALS FOR INFORMATION

A. Section 01 33 00 - Submittals: Submittals for information.
B. Test Reports: Indicate overall resistance to ground.
C. Manufacturer’s Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include
instructions for storage, handling, protection, examination, preparation, and installation of Product.

1.8 SUBMITTALS FOR CLOSEOUT
   A. Sections 01 77 00 - Contract Closeout; 01 78 23 - Operation and Maintenance Data.
   B. Project Record Documents: Record actual locations of components and grounding electrodes.
   C. Certificate of Compliance: Indicate approval of installation by authority having jurisdiction.

1.9 QUALIFICATIONS
   A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years experience, and with service facilities within 100 miles of Project.

1.10 REGULATORY REQUIREMENTS
   A. Conform to requirements of NFPA 70.
   B. Products: Listed and classified by Underwriters Laboratories, Inc. as suitable for the purpose specified and indicated.

PART 2 - PRODUCTS

2.1 ROD ELECTRODES
   A. Material: Copper-clad steel.
   B. Diameter: 3/4 inch (19mm).
   C. Length: 10 feet (3000 mm).

2.2 MECHANICAL CONNECTORS
   A. Material: Bronze.

2.3 EXOTHERMIC CONNECTIONS
   A. Manufacturers:
      1. Erico Cadweld.
      2. Burndy.
      3. Substitutions: Refer to Section 01 60 00 - Material and Equipment.

2.4 GROUND WIRE
   A. Material: 3/0 Stranded copper.
   B. Grounding Electrode Conductor: Size to meet NFPA 70 requirements.

PART 3 - EXECUTION

3.1 EXAMINATION
A. Section 01 31 13 - Coordination and Meetings: Verification of existing conditions prior to beginning work.

B. Verify that final backfill and compaction has been completed before driving rod electrodes.

3.2 INSTALLATION

A. Section 01 40 00 - Quality Control: Manufacturer's instructions.

B. Install up to 2 additional rod electrodes as required to achieve specified resistance to ground. Notify Engineer if resistance to ground is not less than 5 ohms.

C. Install 3/0 AWG bare copper wire at minimum 30 inch depth underground from rod to rod, make exothermic connections.

D. Provide bonding to meet Regulatory Requirements.
   1. Provide bonding jumpers at all insulated couplings and valves of metallic piping.

E. Bond together metal siding not attached to grounded structure; bond to ground.

F. Provide isolated grounding conductor for circuits where indicated on plans.

G. Equipment Grounding Conductor: Provide separate, insulated conductor within each feeder and branch circuit raceway. Terminate each end on suitable lug, bus, or bushing.

H. Ground all transformers to grounding system as required by code. Increase size of equipment grounding conductor in 3.2 - G per NEC Table 250-94 or install separate concrete encased electrode. Ground rods are not permitted.

3.3 FIELD QUALITY CONTROL

A. Sections 01 40 00 - Quality Assurance; 01 75 00 - Starting of Systems: Field inspection, testing, adjusting.

B. Inspect and test in accordance with NETA ATS, except Section 4.

C. Perform inspections and tests listed in NETA ATS, Section 7.13.

END OF SECTION
SECTION 26 05 28
SEISMIC RESTRAINT

PART 1 - GENERAL

1.1 RELATED SECTIONS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions, Special Conditions, and Division-1 Specification sections, apply to work specified in this section.
   1. Section 26 05 19 – Low-Voltage Electrical Power Conductors and Cables.
   2. Section 26 05 29 – Hangers and Support for Electrical Systems.
   4. Section 26 05 36 – Cable Tray for Electrical Systems.

1.2 QUALITY ASSURANCE

A. Substitution of Materials: Refer to Division 1.

1.3 SCOPE

A. Design, furnish, and install attachment devices, anchor bolts, and seismic restraints that are required for seismic compliance for all equipment, apparatus, conduit and raceways, and other components of the specified systems required by reference codes and standards.

B. Provide seismic restraint types as described. If the item to be restrained is not listed, select appropriate restraint and submit for approval.

C. Provide seismic bracing as described in Table A for all electrical systems.

1.4 DEFINITIONS

A. "Transverse Bracing": Restraint(s) applied to limit motion perpendicular or angular to the centerline of the conduit.

B. "Longitudinal Bracing": Restraints applied to limit motion along the centerline of the conduit.

1.5 ACCEPTABLE MANUFACTURERS

A. All devices specified in this section shall be the product of a single manufacturer. Acceptable manufacturers are: AVNEC, Inc., Mason Industries, Amber Booth Company, Peabody Noise Control, Korfund Dynamics Corporation, Vibration Mountings and Equipment, or Vibration Eliminator Co. provided they meet the requirements of this specification. AVNEC Inc. Model Numbers have been used in this specification to establish quality of components. Products of the other listed manufacturers are acceptable provided their systems strictly comply with the intent, structural design, performance and deflections of the components specified.

1.6 REFERENCE CODES AND STANDARDS


C. Southern Nevada Amendments to the NEC – 2011 ed.

D. State and local codes.

1.7 DESIGN REQUIREMENTS; CERTIFICATION AND ANALYSIS

A. Seismic Restraints Requirements
1. For each seismic restraint, provide certified calculations to verify adequacy to meet the following design requirements:
   a. Ability to accommodate relative seismic displacements of supported item between points of support.
   b. Ability to accommodate the required seismic forces.
2. For each respective set of anchor bolts provide calculations to verify adequacy to meet combined seismic-induced shear and tension forces.
3. For each weldment between structure and item subject to seismic force, provide calculations to verify adequacy.
4. Calculations shall be stamped by a professional engineer, who is registered in the state, where the work is being performed, has specific experience in seismic calculations.
5. Restraints shall maintain the restrained item in a captive position without short circuiting the vibration isolation.

1.8 SUBMITTALS

A. Catalog cuts or data sheets on specific products utilized, which detail compliance with the specification. Reference “TYPE” as per “PRODUCTS” section of this specification.

B. Shop Drawings
   1. Where walls and slabs are used as seismic restraint locations, provide details of acceptable methods for restraint of equipment, conduit and other raceways shall be included, with supporting certified calculations.
   2. Provide specific details of seismic restraints and anchors; include number, size and locations for each piece of equipment.
   3. Coordination or contract drawings shall be marked-up with the specific locations and types of restraints shown for all conduit, cable tray, busducts, etc. Rod bracing and assigned load at each restraint location shall be clearly delineated. Each drawing shall be stamped and signed by the engineer doing the seismic certification.

C. Seismic Certification and Analysis
   1. Seismic restraint calculations shall be provided for all connections of equipment to the structure. All performance of products (such as: strut, cable, anchors, clips, etc.) associated with restraints shall be supported with manufacturer’s data sheets or certified calculations. Seismic calculation shall be certified by a Professional Structural or Civil Engineer registered in the State of the project.
   2. Seismic restraint calculations shall be based on the acceleration criteria required by local codes.
   3. Calculations to support seismic restraints designs shall be stamped by a professional registered engineer in the state where the work is being performed, with at least five years of seismic design experience.
   4. Table elevations refer to the structural point of attachment of the equipment support system (i.e., use floor slab for floor supported equipment and the elevation of the slab above for suspended equipment).
   5. Analysis shall indicate calculated dead loads, derived loads, and materials utilized for connections to equipment and structure. Analysis shall detail anchoring methods, bolt diameter, embedment and/or weld length.

PART 2 - PRODUCTS
2.1 GENERAL

A. Provide seismic restraints as specified herein and seismic bracing as specified herein and/or described in Table A (PART 3 - EXECUTION). If the item to be restrained is not listed in the table, manufacturer shall select appropriate restraint and submit for approval.

2.2 PAD TYPE NEOPRENE ISOLATOR

A. When bolting is required for seismic restraints, neoprene and duct washers and bushings shall be provided to prevent short circuiting.
   1. AVNEC, Inc.: Type NP.75

2.3 PAD TYPE ELASTOMER ISOLATOR

A. When bolting is required for seismic restraints, neoprene washers and bushings shall be provided to prevent short circuiting.

2.4 SEISMIC RESTRAINT TYPES

A. Type I: Shall comply with general characteristics of spring isolator Type A with the following additional features. Isolator shall incorporate snubbing restraint in all directions, and be capable of supporting equipment at fixed elevations during installation. Cast or aluminum housings, except ductile iron, are not acceptable.
   1. AVNEC, Inc.: Type RS

B. Type II: Each corner or side of equipment base shall incorporate a seismic restraint having a minimum of 5/8" thick, all directional resilient pad limit stop. Restraints shall be fabricated of plate, structural members or square metal tubing. Angle bumpers are not acceptable.
   1. AVNEC, Inc.: Type SSN

C. Type III: Multiple metal cable or steel strut type with approved fastening devices to equipment and structure. System to be field bolted to deck using two sided beam clamps or appropriately designed inserts for concrete.
   1. AVNEC, Inc.: Type SCA, SRA

D. Type IV: Double deflection neoprene isolator (min. 0.15") encased in ductile iron or steel casing.
   1. AVNEC, Inc.: Type SNCM

E. Type V: Non-isolated equipment shall be field bolted or welded (powder shots not acceptable) to the structures as required to meet seismic forces. Bolt diameter, imbedment data, and/or weld length must be shown in certified calculations as noted above.

PART 3 - EXECUTION

3.1 SEISMIC RESTRAINT INSTALLATION

A. All floor mounted equipment whether isolated or not shall be snubbed, anchored, bolted or welded to structure to comply with the requirements of these specifications. Calculations that determine that isolated equipment movement may be less than the operating clearances of snubbers (restraints) do not preclude the need for snubbers. All equipment shall be positively attached to the structure.
B. All suspended equipment and apparatus shall be two or four point independently braced with TYPE III restraints, installed taught for non-isolated equipment and slack with 1/2" cable deflection for isolated equipment. Suspending rods shall be braced as necessary to restrain against angular motion.

C. All non-isolated floor or wall mounted equipment shall use RESTRAINT TYPE III or V.

D. Where base anchoring of equipment is insufficient to resist seismic forces, restraint TYPE III shall be located above the component's center of gravity to suitably resist "G" forces specified. Vertically mounted tanks and up-blast tubular centrifugal fans, tanks, or similar equipment, may require this additional restraint.

E. A rigid piping system shall not be braced to dissimilar parts of building on two dissimilar building systems that may respond in a different mode during an earthquake. Examples: Wall and roof; solid concrete wall and a metal deck with lightweight concrete fill, busduct, cable tray, conduit, etc., crossing a building expansion joint.

3.2 INSPECTION

A. Upon completion of installation of all seismic restraint devices, a certification report prepared by the manufacturer shall be submitted in writing to the contractor indicating that all systems are installed properly and in compliance with the specifications. The report must identify those areas that require corrective measures or certify that none exists. Any field coordination type changes to the originally submitted seismic restraint designs must be clearly defined and detailed in this report.

PART 4 -

A. TABLE A

<table>
<thead>
<tr>
<th>Equipment</th>
<th>On Center Spacing</th>
<th>Within Each Change of Direction</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>(Larger of...)</td>
</tr>
<tr>
<td></td>
<td>Transverse</td>
<td>Longitudinal</td>
</tr>
</tbody>
</table>

| Duct                  | 30 Feet           | 60 Feet                         |
| Pipe                  |                   |                                 |
| Threaded, Welded, Soldered or Grooved |
| To 16"                | 40 Feet           | 80 Feet                         |
|                       | 10 Feet or 15 Diameters |
| 18" – 28"             | 30 Feet           | 60 Feet                         |
|                       | 10 Feet or 15 Diameters |
| 30"-40"               | 20 Feet           | 60 Feet                         |
|                       | 10 Feet or 15 Diameters |
| 42" & Larger          | 10 Feet           | 30 Feet                         |
|                       | 10 Feet or 15 Diameters |
| NO-Hub, Bell & Spigot, Cast Iron |
| 2.5" & Larger         | 10 Feet           | 20 Feet                         |
|                       | 4 Feet             |
| Boiler Breaching      | 30 Feet           | 60 Feet                         |
|                       | 10 Feet or 15 Diameters |
| Chimneys & Stacks     | 30 Feet           | 60 Feet                         |
|                       | 10 Feet or 15 Diameters |
| Conduit               | 40 Feet           | 80 Feet                         |
|                       | 210 Feet or 15 Diameters |
| Bus Duct              | 20 Feet           | 40 Feet                         |
|                       | 4 Feet             |
| Cable Tray            | 40 Feet           | 80 Feet                         |
|                       | 10 Feet             |

END OF SECTION
PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Conduit and equipment supports.
B. Anchors and fasteners.

1.2 REFERENCES

A. NECA - "Standard of Installation".

1.3 SUBMITTALS

A. Submit under provisions of Section 01 33 00.
B. Product Data: Provide manufacturer’s catalog data for fastening systems.
C. Manufacturer’s Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of Product.

1.4 REGULATORY REQUIREMENTS

A. Conform to requirements of ANSI/NFPA 70.
B. Furnish products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and shown.

PART 2 - PRODUCTS

2.1 PRODUCT REQUIREMENTS

A. Materials and Finishes: Provide adequate corrosion resistance.
B. Provide materials, sizes, and types of anchors, fasteners and supports to carry the loads of equipment and conduit. Consider weight of wire in conduit when selecting products.
C. Anchors and Fasteners:
   1. Concrete Structural Elements: Use precast insert system, expansion anchors and preset inserts.
   2. Steel Structural Elements: Use beam clamps and welded fasteners.
   5. Solid Masonry Walls: Use expansion anchors and preset inserts.
2.2 STEEL CHANNEL

A. Manufacturer:
   1. Unistrut
   2. B-Line.
   3. Substitutions: Under provisions of Section 01 25 00.

B. Description: Painted steel.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Provide anchors, fasteners, and supports in accordance with NECA "Standard of Installation".

C. Do not fasten supports to pipes, ducts, mechanical equipment, and conduit.

D. Obtain permission from Architect/Engineer before using spring steel clips and clamps.

E. Obtain permission from Architect/Engineer before drilling or cutting structural members.

F. Fabricate supports from structural steel or steel channel. Rigidly weld members or use hexagon head bolts to present neat appearance with adequate strength and rigidity. Use spring lock washers under all nuts.

G. Install surface-mounted cabinets and panelboards with minimum of four anchors.

H. In wet and damp locations use steel channel supports to stand cabinets and panelboards one inch (25 mm) off wall.

I. Use sheet metal channel to bridge studs above and below cabinets and panelboards recessed in hollow partitions.

END OF SECTION
SECTION 26 05 33
RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Metal conduit.
B. Flexible metal conduit.
C. Liquidtight flexible metal conduit.
D. Electrical metallic tubing.
E. Nonmetal conduit.
F. Fittings and conduit bodies.

1.2 RELATED SECTIONS

A. Section 07 84 00 - Fire Stopping.
B. Section 26 05 26 - Grounding and Bonding.
C. Section 26 05 29 - Supporting Devices.
D. Section 26 05 35 - Boxes.
E. Section 26 05 53 - Electrical Identification.

1.3 REFERENCES

A. ANSI C80.1 - Rigid Steel Conduit, Zinc Coated.
B. ANSI C80.3 - Electrical Metallic Tubing, Zinc Coated.
C. ANSI/NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and Cable Assemblies.
E. NECA "Standard of Installation."
F. NEMA RN 1 - Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit.
G. NEMA TC 2 - Electrical Plastic Tubing (EPT) and Conduit (EPC-40 and EPC-80).
H. NEMA TC 3 - PVC Fittings for Use with Rigid PVC Conduit and Tubing.

1.4 DESIGN REQUIREMENTS

A. Conduit Size: ANSI/NFPA 70. Minimum 1 inch diameter for underground installations.
1.5 PROJECT RECORD DOCUMENTS
   A. Submit under provisions of Section 01 78 39.
   B. Accurately record actual routing of conduits larger than 2 inches.

1.6 REGULATORY REQUIREMENTS
   A. Conform to requirements of ANSI/NFPA 70.
   B. Furnish products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and shown.

1.7 DELIVERY, STORAGE, AND HANDLING
   A. Deliver, store, protect, and handle Products to site under provisions of Section 01 60 00.
   B. Accept conduit on site. Inspect for damage.
   C. Protect conduit from corrosion and entrance of debris by storing above grade. Provide appropriate covering.
   D. Protect PVC conduit from sunlight.

1.8 PROJECT CONDITIONS
   A. Verify that field measurements are as shown on Drawings.
   B. Verify routing and termination locations of conduit prior to rough-in.
   C. Conduit routing is shown on Drawings in approximate locations unless dimensioned. Route as required to complete wiring system.

PART 2 - PRODUCTS

2.1 CONDUIT REQUIREMENTS
   A. Minimum Size: 1/2 inch unless otherwise specified.
   B. Underground Installations:
      1. More than Five Feet from Foundation Wall: Use PVC Schedule 40 conduit.
      2. Within Five Feet from Foundation Wall: Use PVC Schedule 40 conduit.
      3. In or Under Building Slab on Grade: Use PVC Schedule 40 conduit with PVC coated RGS elbows and risers when penetrating thru floor slabs and housekeeping pads.
      4. Minimum Size: 1 inch.
   C. Outdoor Locations: Above Grade: Use rigid steel and intermediate metal conduit.
   D. Wet and Damp Locations: Use rigid steel and electrical metallic tubing.
   E. Dry Locations:
      1. Concealed: Use electrical metallic tubing for Home runs.
      2. Exposed: Use electrical metallic tubing.

2.2 METAL CONDUIT
A. Rigid Steel Conduit: ANSI C80.1.

B. Intermediate Metal Conduit (IMC): Rigid steel.

C. Fittings and Conduit Bodies: ANSI/NEMA FB 1; all steel fittings.

2.3 PVC COATED METAL CONDUIT

A. Description: NEMA RN 1; rigid steel conduit with external PVC coating, 20 mil thick.

B. Fittings and Conduit Bodies: ANSI/NEMA FB 1; steel fittings with external PVC coating to match conduit.

2.4 FLEXIBLE METAL CONDUIT

A. Description: Interlocked steel construction.


2.5 LIQUIDTIGHT FLEXIBLE METAL CONDUIT

A. Description: Interlocked steel construction with PVC jacket.


2.6 ELECTRICAL METALLIC TUBING (EMT)

A. Description: ANSI C80.3; galvanized tubing.

B. Fittings and Conduit Bodies: ANSI/NEMA FB 1; steel, compression, or set screw type with insulated throats.

2.7 NONMETALLIC CONDUIT

A. Description: NEMA TC 2; Schedule 40 PVC.

B. Fittings and Conduit Bodies: NEMA TC 3.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install conduit in accordance with NECA "Standard of Installation."

B. Install nonmetallic conduit in accordance with manufacturer's instructions.

C. Arrange supports to prevent misalignment during wiring installation.

D. Support conduit using coated steel or malleable iron straps, lay-in adjustable hangers, clevis hangers, and split hangers.

E. Group related conduits; support using conduit rack. Construct rack using steel channel.

F. Fasten conduit supports to building structure and surfaces under provisions of Section 26 05 29.
G. Do not support conduit with wire or perforated pipe straps. Remove wire used for temporary supports.

H. Arrange conduit to maintain headroom and present neat appearance.

I. Route conduit parallel and perpendicular to walls.

J. Route conduit installed above accessible ceilings parallel and perpendicular to walls.

K. Route conduit in and under slab from point-to-point.

L. Do not cross conduits in slab.

M. Maintain adequate clearance between conduit and piping.

N. Maintain 12 inch (300 mm) clearance between conduit and surfaces with temperatures exceeding 104 degrees F (40 degrees C).

O. Cut conduit square using saw or pipe cutter; de-burr cut ends.

P. Bring conduit to shoulder of fittings; fasten securely.

Q. Join nonmetallic conduit using cement as recommended by manufacturer. Wipe nonmetallic conduit dry and clean before joining. Apply full even coat of cement to entire area inserted in fitting. Allow joint to cure for 20 minutes, minimum.

R. Use conduit hubs or sealing locknuts to fasten conduit to sheet metal boxes in damp and wet locations and to cast boxes.

S. Install no more than equivalent of three 90-degree bends between boxes. Use conduit bodies to make sharp changes in direction, as around beams. Use hydraulic one-shot bender to fabricate bends in metal conduit larger than 2 inch (50 mm) size.

T. Avoid moisture traps; provide junction box with drain fitting at low points in conduit system.

U. Provide suitable fittings to accommodate expansion and deflection where conduit crosses expansion joints.

V. Provide suitable pull string in each empty conduit except sleeves and nipples.

W. Use suitable caps to protect installed conduit against entrance of dirt and moisture.

X. Ground and bond conduit under provisions of Section 26 05 26.

Y. Identify conduit under provisions of Section 26 05 53.

Z. Use suitable insulated bushings and inserts at connections to outlets, boxes, and equipment.

AA. Do not support conduit from roof deck.

### 3.2 INTERFACE WITH OTHER PRODUCTS

A. Install conduit to preserve fire resistance rating of partitions and other elements, using materials and methods under the provisions of Section 07 84 00.
SECTION 26 05 36
CABLE TRAYS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SUMMARY

A. Section includes cable tray.

B. Related Sections:
   1. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
   2. Section 26 05 29 - Hangers and Supports for Electrical Systems.

1.2 REFERENCES

A. ASTM International:
   2. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

B. National Electrical Manufacturers Association:
   1. NEMA VE 1 - Metal Cable Tray Systems.
   2. NEMA VE 2 - Metal Cable Tray Installation Guidelines.

1.3 SUBMITTALS

A. See Division 1 for Submittal procedures.

B. Shop Drawings: Indicate tray type, dimensions, support points, and finishes.

C. Product Data: Submit fittings and accessories.

D. Manufacturer’s Installation Instructions: Submit application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, and installation of Product.

1.4 CLOSEOUT SUBMITTALS

A. See Division 1 - Execution and Closeout Requirements: Closeout procedures.

B. Project Record Documents: Record actual routing of cable tray and locations of supports.

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years documented experience.

1.6 PRE-INSTALLATION MEETINGS

A. See Division 1 Administrative Requirement: Pre-installation meeting.

B. Convene minimum one week prior to commencing work of this section.
PART 2  PRODUCTS

2.1  METAL LADDER-TYPE CABLE TRAY

A. Manufacturers:
   1. Wiremold.
   2. B-Line.
   3. T.J. Cope Inc.
   4. Substitutions: See Division 1 for Product Requirements and Substitution Procedures.

B. Product Description: NEMA VE 1, Class [20C] ladder type tray.

C. Material: Steel.

D. Finish: Galvanized to ASTM A123/A123M; minimum 1.2 oz/sq ft 355 coating thickness; galvanize after fabrication.

E. Inside Width: As indicated on Drawings.

F. Inside Depth: As indicated on Drawings.

G. Straight Section Rung Spacing: 18 inches (457 mm) on center.

H. Inside Radius of Fittings: 24 inches (610 mm)

I. Furnish manufacturer's standard clamps, hangers, brackets, splice plates, reducer plates, blind ends, barrier strips, connectors, and grounding straps.

J. Covers: Flanged, solid flush cover.

2.2  CENTER AND WALL SUPPORTED CABLE TRAY

A. Manufacturers:
   1. Wiremold Company Model Spec Mate Center Spine and Wall Mount.
   2. Substitutions: See Division 1 for Product Requirements and Substitution Procedures.

B. Product Description:
   1. The tray shall be constructed of 6063 T6 aluminum alloy and shall utilize a center spine with center lines to indicate all areas where after field cutting of tray, new holes need to be drilled or screws inserted. The standard 3” deep bottom rung tray in which the spine acts to separate the cable compartments, shall offer a full 3” wall separating each compartment. When 4” and 6” rungs are used, a divider strip should be placed on top of the spine to provide a full barrier and the threaded rod should be sleeved.

   a. The cable tray shall be constructed to form open and accessible compartments to hold the necessary cables which will also enable full viewing of same. The tray shall be center hung allowing cable lay in where applicable.

   b. The tray shall be constructed with two components, (1) the center spine and (2) the rung. The spine is a single aluminum extrusion containing two hollows. The upper or vertical hollow provides surface to mount the splice connector and hanger rod. The lower or horizontal hollow has wings extending left and right which provide extra support for the rungs.

   c. The rungs shall have a 1” cable laying surface and be placed horizontally along the spine on 6” centers. The end of the rungs shall be bent upward to a height of 6” forming a 90-degree angle, creating a cable laying area
between the spine and the vertical portion of the rung. The rung shall be designed with a center screw groove along its length to provide a direct connection for rung mounted accessories. The ends of all rungs shall be fitted with a plastic cap to prevent damage to the cable and injury to the installer. The rungs shall be field removable and replaceable, enabling the avoidance of obstructions during installation and easy restructuring of the system should future alterations become necessary. The interchangeable rungs shall offer future expansion of the tray capacity without removal of cables or the existing spine.

d. The tray must offer an open view of the cables and be free of side rails.

e. Cable tray shall be 12” (18”) wide.

3. Wall Mounted Tray:

a. The cable tray shall be constructed to form an open and accessible compartment to hold the necessary cables which will also enable full viewing of same. The tray shall be wall mounted allowing cable lay in where applicable.

b. The tray shall be constructed with two components, (1) the main support which is the spine and (2) the rungs. The spine is a single aluminum extrusion designed with a lower cavity, which has extending wings and provides 1-5/16” rung support.

c. The rungs shall have a 1” cable laying surface and be attached on 6” centers. They shall protrude from the spine on only one side. The end of the rungs shall be bent upward to a height of 6” forming a 90-degree angle, creating a cable laying area between the spine and the vertical portion of the rung. The rung shall be designed with a center screw groove along its length to provide a direct connection for rung mounted accessories. The ends of all rungs shall be fitted with a plastic cap to prevent damage to the cable and injury to the installer.

d. The tray must not have side rails and must offer an open view of the cables.

e. Cable tray shall be 12” wide.

4. A full complement of fittings for the cable tray shall be available including, but not limited to, 45 and 90 degree flat, vertical inside and outside elbows, tee and cross fittings, couplings for joining sections of the tray, hangers, end blanks, a field-installed divider and all other components necessary to make the system workable. The fittings and accessories shall be of compatible material.

2.3 WARNING SIGNS

A. Engraved Nameplates: 1/2 inch (13 mm) black letters on yellow laminated plastic nameplate, engraved with: WARNING! DO NOT USE CABLE TRAY AS WALKWAY, LADDER, OR SUPPORT. USE ONLY AS MECHANICAL SUPPORT FOR CABLES AND TUBING!

PART 3 EXECUTION

3.1 EXISTING WORK

A. Remove exposed abandoned cable tray, including abandoned cable tray above accessible ceiling finishes. Remove supports. Cut cable tray flush with walls and floors, and patch surfaces.

B. Maintain access to existing cable tray and other installations remaining active and requiring access. Modify installation or provide access panel.

C. Extend existing cable tray installations using materials and methods, existing electrical installations, or as specified.

D. Clean and repair existing cable tray to remain or to be reinstalled.
3.2 INSTALLATION

A. Install metal cable tray in accordance with NEMA VE 2.

B. Install fiberglass cable tray in accordance with NEMA FG 1.

C. Support trays and fasten to structure and finishes in accordance with Section 26 05 29. Install supports at each connection point, at end of each run, and at other points to maintain spacing between supports of 6 ft. (1.83 mm) maximum.

D. Install expansion connectors where recommended by manufacturer.

E. Install firestopping in accordance with Section 26 05 29 to sustain ratings when passing cable tray through fire-rated elements.

F. Ground and bond metal cable tray in accordance with Section 26 05 26.
   1. Provide continuity between tray components.
   2. Use anti-oxidant compound to prepare aluminum contact surfaces before assembly.
   3. Install 2 AWG bare [copper] [aluminum] equipment grounding conductor through entire length of tray; bond to each component.
   4. Make connections to tray using mechanical, compression or exothermic connectors.

G. Install warning signs at 50 feet (1500 mm) centers along cable tray, located to be visible.

H. Prior to and during installation, refer to system layout or approval drawings containing all elements of the system. Install shall comply with complete system instruction sheets.

I. All enclosures shall be mechanically continuous and connected to adjacent conduit and wiring systems.

J. Center supported tray shall be supported to structure on 6’ centers by a single half inch threaded rod which either passes through the vertical hole in the splice connector or a hole drilled vertically through the spine.

K. Wall mounted tray shall be supported on a minimum of 4’ centers by three mounting brackets that allow the spine to be temporarily held in place with snap-on covers, until they can be secured to the wall bracket with sheet metal screws.

L. Provide all required transition fittings to transition from center supported tray to wall mounted tray, so that tray is on a continuous run.

M. All connections shall be checked to make sure they are correctly tightened and to ensure that all enclosures are electrically continuous and bonded with adjacent systems in accordance with the National Electric Code for proper grounding.

N. All systems shall be installed complete. Work shall include fastening all enclosures to adjacent wiring systems to install a complete system as indicated on the electrical and/or communication drawings and in the applicable specifications.

O. Allow sufficient space surrounding tray to permit access for installing and maintaining cables.

P. Coordinate location of cable tray with mechanical ducts and piping of other trades as required.

Q. Conduits stubbed to cable tray shall be attached to tray using conduit bushing dropout fittings.
END OF SECTION
SECTION 26 05 53
IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SECTION INCLUDES
A. Nameplates and labels.
B. Wire and cable markers.

1.2 REFERENCES

1.3 REGULATORY REQUIREMENTS
A. Conform to requirements of ANSI/NFPA 70.
B. Furnish products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and shown.

PART 2 - PRODUCTS

2.1 NAMEPLATES AND LABELS
A. Nameplates: Engraved three-layer phenolic, white letters on black background. For emergency equipment, white letters on red background.
B. Locations:
   1. Each electrical distribution and control equipment enclosure.
   2. Panelboards.
   3. Transformers.
   4. Shore Stations
C. Letter Size:
   1. Use 1/2 inch letters for identifying individual equipment and loads.
   2. Use 1/4 inch letters for identifying voltage systems.
D. Labels: Embossed adhesive tape, with 3/16 inch white letters on black background. Use only for identification of individual wall switches and receptacles, control device stations.

2.2 WIRE MARKERS
A. Description: Cloth, tape, split sleeve, or tubing type wire markers.
B. Locations: Each conductor at panelboard gutters, outlet and junction boxes, and each load connection.
C. Legend:
   1. Power and Lighting Circuits: Branch circuit or feeder number indicated on drawings.
   2. Control Circuits: Control wire number indicated on shop drawings.

2.3 UNDERGROUND WARNING TAPE
A. Description: 4 inch wide plastic tape, detectable type, colored red with suitable warning legend describing buried electrical lines.

PART 3 - EXECUTION

3.1 PREPARATION

A. Degrease and clean surfaces to receive nameplates and labels.

3.2 APPLICATION

A. Install nameplate and label parallel to equipment lines.
B. Secure nameplate to equipment front using screws or rivets.
C. Secure nameplate to inside surface of door on panelboard that is recessed in finished locations.
D. Identify underground conduits using underground warning tape. Install warning tape along full length of buried conduits, directly above at 6 inches below finished grade.
E. Identify all conductors, cables, communication, and control wires with wire markers.

END OF SECTION
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

B. Division-26 sections apply to work of this section.

1.2 WORK INCLUDED

A. Extent of testing required by this section is defined to include, but is not necessarily limited to, electrical equipment and cables.

B. Component types of testing specified in this section includes the following as applied to electrical equipment:
   1. Switchgear - General.
   2. Cables - Low Voltage.

1.3 QUALITY ASSURANCE

A. All inspections and tests shall be in accordance with the following applicable codes and standards except as provided otherwise herein.
   1. National Electrical Code – NEC.
   2. National Electrical Manufacturers Association – NEMA.
   3. American Society for Testing and Materials – ASTM.
   4. Institute of Electrical and Electronic Engineers – IEEE.
   5. National Electrical Testing Association – NETA.
   6. American National Standards Institute – ANSI.
   7. State and Local Codes and Ordinances.
   8. Insulated Cable Engineers Association – ICEA.

B. Inspections and tests shall utilize the following references:
   1. Project Design Specifications.
   2. Project Design Drawings.
   3. Manufacturer’s instruction manuals applicable to each particular apparatus.

1.4 SUBMITTALS

A. Submit certified test reports, signed by Supervisor who performed work.

B. Include identification and types of instruments used, and their most recent calibration date with submission of final test report.

C. Submit biographical data on Supervisor who is to directly supervise testing, adjusting, and balancing work.

1.5 PROJECT/SITE CONDITIONS

A. Do not proceed with testing until work pertaining to the specific test has been completed. Ensure that there is no latent residual work still to be completed.
B. Do not proceed until work scheduled for testing and adjusting is clean and free from debris, dirt, and discarded building materials.

1.6 RESPONSIBILITY

A. The contractor shall perform routine installation resistance, continuity and rotation tests for all distribution and utilization equipment prior to putting electrical system into service.

B. Any system material or workmanship, which is found defective on the basis of acceptance tests, shall be corrected and documented.

C. Maintain a written record of all tests and upon completion of project, assemble and certify a final test report.

PART 2 - PRODUCTS

2.1 TEST INSTRUMENTS

A. Utilize test instruments and equipment for work required, of type, precision, and capacity as recommended in the following standards:


2. Test Instrument Traceability:
   a. The accuracy of all testing instruments shall be traceable to the National Bureau of Standards in an unbroken chain.
   b. Instruments shall be calibrated in accordance with the following frequency schedule:
      1. Field Instruments – 6 months maximum
      2. Laboratory instruments – 12 months.
      3. Leased specialty equipment – 12 months (Where accuracy is guaranteed by lesser, i.e. Doble).
   c. Dated calibration labels shall be visible on all test equipment.
   d. Records must be kept up-to-date which show date and results of all instruments calibrated or tested.
   e. An up-to-date instrument calibration instruction and procedure will be maintained for each test instrument.

PART 3 - EXECUTION

3.1 INSPECTION AND TEST PROCEDURES

A. Switchgear and Switchboard Assemblies:

1. Visual and Mechanical Inspection:
   a. Inspect for physical damage.
   b. Compare equipment nameplate information with latest single line diagram and report discrepancies.
   c. Check tightness of accessible bolted bus joints by calibrated torque wrench method. Refer to manufacturer’s instruction for proper foot pound levels. In the absence of specific instructions use NETA Standards.
   d. All doors, panels and sections shall be inspected for paint, dents, scratches and fit.

2. Electrical Tests:
   a. Insulation Resistance Test:
      1. Measure insulation resistance of each bus section phase to ground.
      2. Potential application shall be for one (1) minute. Test voltage shall be in accordance with NETA Standards or manufacturer’s recommendations.
b. Over Potential Test:
   1. Perform over potential test on each bus section phase to ground. Potential application shall be for one (1) minute. Test voltage shall be in accordance with NETA Standards or manufacturer’s recommendations.

c. Test Values:
   1. Bolt torque levels shall be in accordance with manufacturer’s recommendations.
   2. Insulation resistance test to be performed in accordance with Table A.

   Table A
   Insulation Resistance Test Voltage
   
<table>
<thead>
<tr>
<th>Voltage Rating</th>
<th>Test Voltage</th>
</tr>
</thead>
<tbody>
<tr>
<td>150 – 600V</td>
<td>1000V DC</td>
</tr>
</tbody>
</table>

   d. Values of insulation resistance less than manufacturer’s minimum of KV +1 in megohms should be investigated. Over potential test should not proceed until insulation resistance levels are raised to said minimum.

e. Over potential test voltages shall be applied in accordance with ANSI 37.20c.

3.2 CABLES – LOW VOLTAGE (600 VOLTS AND LESS)

A. Visual and Mechanical Inspection:
   1. Cables to be inspected for physical damage and proper connection in accordance with single line diagram.
   2. Cable connection shall be torque tested to manufacturer’s recommended values.

B. Electrical Tests:
   1. Perform insulation resistance test on each cable with respect to ground and adjacent cables.
   2. Perform continuity test to insure proper cable connection.

C. Test Values:
   1. Insulation resistance tests shall be performed at 1000 volts D.C. for one-half (1/2) minute.
   2. When insulation resistance must be determined with all switchboards, panelboards, fuse holders, switches, and overcurrent devices in place, the insulation resistance when tested at 500 volts D.C. shall be no less than below:

   MINIMUM INSULATION RESISTANCE
   
<table>
<thead>
<tr>
<th>Conductor or Conduit Size</th>
<th>Minimum Resistance</th>
</tr>
</thead>
<tbody>
<tr>
<td>No 14 and 12 AWG</td>
<td>1,000,000 ohms</td>
</tr>
<tr>
<td>25 ampere circuits and above</td>
<td>250,000 ohms</td>
</tr>
</tbody>
</table>

3.3 GROUNDING SYSTEMS

A. Visual and Mechanical Inspection:
   1. Inspect ground system for compliance with plans and specifications.

B. Electrical Tests:
   1. Perform all of potential test per IEEE Standard No. 81, Section 9.04 on the main grounding electrode or system.
   2. Perform the two (2) point method test per IEEE No. 81, Section 9.03 to determine the grounded resistance between the main grounding system and all major electrical equipment frames, system neutral and/or derived neutral points.
   3. Alternate Method:
a. Perform ground continuity test between main ground system and equipment frame, system neutral and/or derived neutral point. This test shall be made by passing a minimum of ten (10) amperes D.C. current between ground reference system and the ground point to be tested. Voltage drop shall be measured and resistance calculated by voltage drop method.

4. Test Values:
a. The main ground electrode system resistance to ground should be no greater than five (5) ohms for commercial or industrial systems.

3.4 MANUAL TRANSFER SWITCHES

A. Visual and Mechanical Inspection:
1. Inspect for physical damage.
2. Compare equipment nameplate information and connections with single line diagram and report and discrepancies.
3. Check switch to insure positive interlock between normal and alternate sources.
4. Check tightness of all cable connections and bus joints.
5. Perform manual transfer operation.

B. Electrical Tests:
1. Perform insulation resistance tests phase to phase and phase to ground with switch in both load distribution equipment positions.
2. Perform manual transfer between loads.

3.5 SYSTEM FUNCTION TESTS

A. General:
1. Each system specified shall be function tested to insure total system operation.
2. Upon completion of equipment tests, the system function tests shall be performed. It is the intent of system functional tests to prove the proper interaction of all sensing, processing and action devices to effect the design end product or result.
3. Implementation:
   a. Input signal or stimuli.
   b. Current Transformers.
   c. Potential Transformers.
   d. Design process.
   e. Action device.
   f. Circuit Breaker – OCB.
   g. Zone Fault Protection.

B. Prepare report of recommendation for correcting unsatisfactory electrical performances.

END OF SECTION
SECTION 26 24 16
PANELBOARDS

PART 1 - GENERAL

1.1 SECTION INCLUDES
A. Distribution panelboards.
B. Mini-Power Zone Branch circuit panelboards.

1.2 RELATED WORK
A. Section 26 05 29 – Hangers and Support for Electrical Systems.
B. Section 26 05 53 – Identification for Electrical Systems.

1.3 REFERENCES
A. NECA (National Electrical Contractors Association) "Standard of Installation."
B. NEMA AB 1 - Molded Case Circuit Breakers.
C. NEMA ICS 2 - Industrial Control Devices, Controllers, and Assemblies.
D. NEMA PB 1 - Panelboards.
E. NEMA PB 1.1 - Instructions for Safe Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less.
F. NFPA 70 - National Electrical Code.

1.4 SUBMITTALS
A. Submit under provisions of Section 01 33 00.
B. Shop Drawings: Indicate outline and support point dimensions, voltage, main bus ampacity, integrated short circuit ampere rating, circuit breaker and fusible switch arrangement and sizes.
C. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of Product.

1.5 PROJECT RECORD DOCUMENTS
A. Submit under provisions of Section 01 78 39.
B. Record actual locations of Products; indicate actual branch circuit arrangement.

1.6 OPERATION AND MAINTENANCE DATA
A. Submit under provisions of Section 01 33 00.
B. Maintenance Data: Include spare parts data listing; source and current prices of
replacement parts and supplies; and recommended maintenance procedures and intervals.

1.7 QUALITY ASSURANCE
A. Perform Work in accordance with NECA "Standard of Installation".
B. Maintain one copy of each document on site.

1.8 QUALIFICATIONS
A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

1.9 REGULATORY REQUIREMENTS
A. Conform to requirements of NFPA 70.
B. Furnish products listed and classified by UL as suitable for purpose specified and indicated.

1.10 FIELD MEASUREMENTS
A. Verify that field measurements are as indicated on shop drawings.

1.11 MAINTENANCE MATERIALS
A. Provide maintenance materials under provisions of Section 01 78 43.
B. Provide two keys for each panelboard. All panelboards shall be keyed alike.

PART 2 - PRODUCTS

2.1 MANUFACTURERS
A. Square D.
B. Eaton.
C. GE.
D. Siemens.
E. Substitutions: Under provisions of Section 01 25 00.
   1. Challenger equipment is not acceptable.

2.2 DISTRIBUTION PANELBOARDS
A. Panelboards: NEMA PB 1, circuit breaker type.
B. Service Conditions:
   1. Temperature: 120 degrees F (40 degrees C).
   2. Altitude: 2,500 feet.
C. Panelboard Bus: Copper, ratings as indicated. Provide copper ground bus in each panelboard.
D. Minimum short circuit rating: Fully rated, 10,000 amperes rms symmetrical for 240 volt panelboards; 14,000 amperes rms symmetrical for 480 volt panelboards, or as indicated on schedules.

E. Molded Case Circuit Breakers: NEMA AB 1. Provide circuit breakers with integral thermal and instantaneous magnetic trip in each pole. Provide circuit breakers UL listed as Type HACR for air conditioning equipment branch circuits. Bolt-on type circuit breakers.

F. Provide circuit breaker accessory trip units and auxiliary switches as indicated.

G. Enclosure: NEMA PB 1, Type 3R. As needed by capacity. Indicated on drawings.

H. Cabinet Front: Surface type, fastened with screw cover. Provide hinged door with flush lock. Finish in manufacturer's standard gray enamel.

I. Integral Surge Protection Device (SPD)
   1. Provide per Specification Section 26 35 53.
   2. Locations as shown on one line diagram

2.3 MINI-POWER ZONE BRANCH CIRCUIT PANELBOARDS

A. Lighting and Appliance Branch Circuit Panelboards: NEMA PB1, circuit breaker type.

B. Panelboard Bus: Copper, ratings as indicated. Provide copper ground bus in each panelboard; provide insulated ground bus where scheduled.

C. Minimum integrated short circuit rating: 10,000 amperes rms symmetrical for 240 volt panelboards.

D. Molded Case Circuit Breakers: NEMA AB 1, bolt-on type thermal magnetic trip circuit breakers, with common trip handle for all poles. Provide circuit breakers UL listed as Type SWD for lighting circuits. Provide UL Class A ground fault interrupter circuit breakers where scheduled. Do not use tandem circuit breakers. Bolt on type circuit breakers.
   1. Provide circuit breaker lock on devices for panels supplying computer loads.

E. Enclosure: NEMA PB 1, Type 3R.

F. Cabinet box: Integral, matching to transformer section.

G. Cabinet Front: Surface cabinet front with concealed trim clamps, concealed hinge, and flush lock all keyed alike. Finish in manufacturer's standard gray enamel.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install panelboards in accordance with NEMA PB 1.1.

B. Install panelboards plumb. Provide supports in accordance with Section 26 05 29.

C. Height: 6 ft to top of Mini-Power Zone enclosure.

D. Provide filler plates for unused spaces in panelboards.

E. Provide typed or neatly handwritten circuit directory for each branch circuit panelboard. Revise directory to reflect circuiting changes required to balance phase loads.

F. Provide engraved plastic nameplates under the provisions of Section 26 05 53.
3.2 FIELD QUALITY CONTROL

A. Field inspection and testing will be performed under provisions of Section 01 40 00.

B. Measure steady state load currents at each panelboard feeder; rearrange circuits in the panelboard to balance the phase loads to within 20 percent of each other. Maintain proper phasing for multi-wire branch circuits.

C. Visual and Mechanical Inspection: Inspect for physical damage, proper alignment, anchorage, and grounding. Check proper installation and tightness of connections for circuit breakers.

END OF SECTION
PART 1  GENERAL

1.1  SUMMARY

A. Section includes hinged cover enclosures, cabinets, terminal blocks, and accessories.

B. Related Sections:
1. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
2. Section 27 05 19 – Low-Voltage Electrical Power Conductors and Cables
3. Section 26 05 33 - Raceway and Boxes for Electrical Systems.

1.2  REFERENCES

A. National Electrical Manufacturers Association:
1. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
2. NEMA ICS 4 - Industrial Control and Systems: Terminal Blocks.

1.3  SUBMITTALS

A. See Division 1 Submittal for procedures.

B. Product Data: Submit manufacturer's standard data for enclosures, cabinets, and terminal blocks.

C. Manufacturer's Installation Instructions: Submit application conditions and limitations of use stipulated by product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

1.4  QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years documented experience.

1.5  EXTRA MATERIALS

A. See Division 1 - Execution and Closeout Requirements: Spare parts and maintenance products.

B. Furnish two of each key.

PART 2  PRODUCTS

2.1  HINGED COVER ENCLOSURES

A. Manufacturers:
1. Carlon Electrical Products.
2. Hubbell Wiring Devices.
5. Substitutions: See Division 1 for Product Requirements and Substitution Procedures.
B. Construction: NEMA 250, Type 4 steel enclosure.

C. Covers: Continuous hinge, held closed by hasp and staple for padlock.

D. Furnish interior metal panel for mounting terminal blocks and electrical components; finish with white enamel.

E. Enclosure Finish: Manufacturer's standard gray enamel.

2.2 CABINETS

A. Manufacturers:
   1. Carlon Electrical Products.
   2. Hubbell Wiring Devices.
   5. Substitutions: See Division 1 for Product Requirements and Substitution Procedures.

B. Boxes: Galvanized steel.

C. Box Size: 24 inches wide x 30 inches high x 6 inches deep.


E. Fronts: Steel, surface type with concealed trim clamps, door with concealed hinge, and flush lock keyed to match branch circuit panelboard. Finish with gray baked enamel.

F. Knockouts: Manufacturer's standard top and bottom.

G. Furnish metal barriers to form separate compartments wiring of different systems and voltages.

H. Furnish accessory feet for free-standing equipment.

2.3 TERMINAL BLOCKS

A. Manufacturers:
   1. Carlon Electrical Products.
   2. Hubbell Wiring Devices.
   4. Square D.
   5. Substitutions: See Division 1 for Product Requirements and Substitution Procedures.


C. Power Terminals: Unit construction type with closed back and tubular pressure screw connectors, rated 600 volts.

D. Signal and Control Terminals: Modular construction type, suitable for channel mounting, with tubular pressure screw connectors, rated 300 volts.

E. Furnish ground bus terminal block, with each connector bonded to enclosure.
2.4 PLASTIC RACEWAY

A. Manufacturers:
   1. Carlon Electrical Products.
   2. Hubbell Wiring Devices.
   4. Substitutions: See Division 1 for Product Requirements and Substitution Procedures.

B. Product Description: Plastic channel with hinged or snap-on cover.

PART 3 EXECUTION

3.1 EXISTING WORK

A. Remove abandoned cabinets and enclosures, including abandoned cabinets and enclosures above accessible ceiling finishes. Patch surfaces.

B. Maintain access to existing cabinets and enclosures and other installations remaining active and requiring access. Modify installation or provide access panel.

C. Extend existing cabinets and enclosures using materials and methods as specified.

D. Clean and repair existing cabinets and enclosures to remain or to be reinstalled.

3.2 INSTALLATION

A. Install enclosures and boxes plumb. Anchor securely to wall and structural supports at each corner in accordance with Section 26 05 29.

B. Install cabinet fronts plumb.

3.3 CLEANING

A. See Division 1 - Execution and Closeout Requirements: Final cleaning.

B. Clean electrical parts to remove conductive and harmful materials.

C. Remove dirt and debris from enclosure.

D. Clean finishes and touch up damage.

END OF SECTION
PART 1 -  GENERAL

1.1  SECTION INCLUDES

A.  Receptacles.
B.  Device plates.

1.2  RELATED SECTIONS

A.  Section 26 05 33 – Raceways and Boxes for Electrical Systems

1.3  REFERENCES

A.  NEMA WD 1 - General Purpose Wiring Devices.
B.  NEMA WD 6 - Wiring Device Configurations.

1.4  SUBMITTALS

A.  Submit under provisions of Section 01 33 00.
B.  Product Data:  Provide manufacturer's catalog information showing dimensions, colors, and configurations.
C.  Manufacturer's Instructions:
   1.  Indicate application conditions and limitations of use stipulated by product testing agency specified under regulatory requirements.
   2.  Include instructions for storage, handling, protection, examination, preparation, operation and installation of product.
D.  Warranty: Provide letter from manufacturer and contractor acknowledging warranty requirements.

1.5  QUALIFICATIONS

A.  Manufacturer:  Company specializing in manufacturing products specified in this Section with minimum three years documented experience.

1.6  REGULATORY REQUIREMENTS

A.  Conform to requirements of ANSI/NFPA 70.
B.  Furnish products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and shown.

1.7  RECEPTACLES

A.  Manufacturers:
   1.  Leviton.
   2.  Pass & Seymour.
   3.  Hubbell.
B. Description: NEMA WD 1; heavy-duty specification grade side and back wired.

C. Device Body: Brown nylon.

D. Configuration: NEMA WD 6; type as specified and indicated.

E. Convenience Receptacle: Type 5-20.

F. GFCI Receptacle: Convenience receptacle with integral ground fault circuit interrupter to meet regulatory requirements.

1.8 DEVICE PLATES

A. Device plates shall be weather-proof cast aluminum for device mounting with “in-use” cover.

1.9 EXAMINATION

A. Verify conditions under provisions of Section 01 31 13.

B. Verify outlet boxes are installed at proper height.

C. Verify branch circuit wiring installation is completed, tested, and ready for connection to wiring devices.

1.10 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install devices plumb and level.

C. Install receptacles with grounding pole on bottom.

D. Connect wiring device grounding terminal to branch circuit equipment grounding conductor.

E. Connect wiring devices by wrapping conductor around screw terminal or by using screw down clamp.

1.11 INTERFACE WITH OTHER PRODUCTS

A. Coordinate locations of outlet boxes provided under Section 26 05 35 to obtain mounting heights specified and indicated on Drawings.

B. Install convenience receptacle 48 inches above finished grade.

1.12 FIELD QUALITY CONTROL

A. Inspect each wiring device for defects.

B. Verify that each receptacle device is energized.

C. Test each receptacle device for proper polarity.

D. Test each GFCI receptacle device for proper operation.
SECTION 26 28 19
ENCLOSED SWITCHES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Fusible switches.
B. Nonfusible switches.
C. Fuses.

1.2 REFERENCES

A. NEMA KS 1 - Enclosed Switches.
B. NFPA 70 - National Electrical Code.
C. UL 198C - High-Interrupting Capacity Fuses; Current Limiting Type.
D. UL 198E - Class R Fuses.

1.3 SUBMITTALS

A. Submit under provisions of Section 01 33 00.
B. Product Data: Provide switch ratings and enclosure dimensions.
C. Manufacturer’s Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of Product.

1.4 QUALITY ASSURANCE

A. Perform Work in accordance with NECA Standard of Installation.
B. Maintain one copy of each document on site.

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing Products specified in this Section with minimum three years documented experience.

1.6 REGULATORY REQUIREMENTS

A. Conform to requirements of NFPA 70.
B. Furnish products listed and classified by UL as suitable for purpose specified and shown.

PART 2 - PRODUCTS

2.1 ENCLOSED SWITCHES
A. Fusible Switch Assemblies: NEMA KS 1, Type HD load interrupter enclosed knife switch with externally operable handle interlocked to prevent opening front cover with switch in ON position. Handle lockable in OFF position. Fuse clips: Designed to accommodate Class R fuses.

B. Nonfusible Switch Assemblies: NEMA KS 1, Type HD load interrupter enclosed knife switch with externally operable handle interlocked to prevent opening front cover with switch in ON position. Handle lockable in OFF position.

C. Enclosures: NEMA KS 1.
   1. Exterior Locations: Type 3R.

2.2 FUSES

   A. Description: Dual element, current limiting, time delay, one-time fuse, UL 198E, Class RK
   B. Interrupting Rating: 200,000 rms amperes.

PART 3 - EXECUTION

3.1 INSTALLATION

   A. Install disconnect switches where indicated.
   B. Install fuses in fusible disconnect switches. Verify size with nameplate of equipment and adjust fuse sizes to match.
   C. Provide adhesive label on inside door of each switch indicating UL fuse class and size for replacement.
   D. Provide nameplate on outside per Section 26 05 53.

END OF SECTION
PART 1  GENERAL

1.1  SUMMARY

A. Section includes enclosed contactors for lighting and general purposes.

1.2  REFERENCES

A. National Electrical Manufacturers Association:
   1. NEMA FU 1 - Low Voltage Cartridge Fuses.
   2. NEMA ICS 2 - Industrial Control and Systems: Controllers, Contactors, and Overload Relays, Rated Not More Than 2000 Volts AC or 750 Volts DC.
   3. NEMA ICS 5 - Industrial Control and Systems: Control Circuit and Pilot Devices.
   4. NEMA ICS 6 - Industrial Control and Systems: Enclosures.
   5. NEMA KS 1 - Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).

B. International Electrical Testing Association:

C. Underwriters Laboratories Inc:
   1. UL 489 - Molded Case Circuit Breakers and Molded Case Switches and Circuit-Breaker Enclosures.

1.3  SUBMITTALS

A. See Division 1 - Submittal Procedures: Submittal procedures.

B. Product Data: Submit dimensions, size, voltage ratings and current ratings.

1.4  CLOSEOUT SUBMITTALS

A. See Division 1 - Execution and Closeout Requirements: Closeout procedures.

B. Project Record Documents: Record actual locations and ratings of enclosed contactors.

C. Operation and Maintenance Data: Submit instructions for replacing and maintaining coil and contacts.

1.5  QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

PART 2  PRODUCTS

2.1  GENERAL PURPOSE CONTACTORS

A. Manufacturers:
   1. Square D.
   2. General Electric.
   3. Cutler Hammer.
4. Substitutions: See Division 1 for Product Requirements and Substitution Procedures.

B. Product Description: NEMA ICS 2, AC general purpose magnetic contactor.

C. Coil operating voltage: 120 volts, 60 Hertz.

D. Poles: To match circuit configuration and control function.

E. Product Features:
1. Cover Mounted Pilot Devices: NEMA ICS 5, heavy-duty oiltight type with Form Z contacts, rated A150.
2. Pushbutton: ON/OFF function, with shrouded configuration.
3. Selector Switch: ON/OFF/AUTOMATIC function, with rotary action.
4. Indicating Light: RED lens, transformer type, with neon lamp.
5. Auxiliary Contacts: One field convertible in addition to seal-in contact.
7. Control Power Transformers: 120 volt secondary, 100 VA minimum, in each enclosed contactor. Furnish fused primary and secondary, and bond unfused leg of secondary to enclosure.

F. Combination Contactors: Combine contactors with enclosed knife switch conforming to NEMA KS 1, with externally operable handle and fuse clips designed to accommodate NEMA FU 1, Class J fuses.

2.2 LIGHTING CONTACTORS

A. Manufacturers:
1. General Electric.
2. Square D
3. Cutler Hammer.
4. Substitutions: See Division 1 for Product Requirements and Substitution Procedures.

B. Product Description: NEMA ICS 2, magnetic lighting contactor.

C. Configuration: Electrically held.

D. Coil operating voltage: 120 volts, 60 Hertz.

E. Poles: To match circuit configuration and control function.

F. Contact Rating: Match branch circuit overcurrent protection, considering derating for continuous loads.

G. Accessories:
1. Cover Mounted Pilot Devices: NEMA ICS 5, heavy-duty oiltight type with Form Z contacts, rated A150.
2. Pushbutton: ON/OFF function, with shrouded configuration.
3. Selector Switch: ON/OFF/AUTOMATIC function, with rotary action.
4. Indicating Light: RED lens, transformer type, with led lamp.
5. Auxiliary Contacts: One field convertible in addition to seal-in contact.
7. Control Power Transformers: 120 volt secondary, 100 VA minimum, in each enclosed contactor. Furnish fused primary and secondary, and bond unfused leg of secondary to enclosure.
H. Combination Contactors: Combine contactors with enclosed knife switch conforming to NEMA KS 1, with externally operable handle and fuse clips designed to accommodate NEMA FU 1, Class J fuses.

PART 3 EXECUTION

3.1 EXISTING WORK

A. Disconnect abandoned enclosed contactors and remove abandoned enclosed contactors.

B. Maintain access to existing enclosed contactors and other installations remaining active and requiring access. Modify installation or provide access panel.

C. Clean and repair existing enclosed contactors to remain or to be reinstalled.

3.2 INSTALLATION

A. Install enclosed contactors in accordance with NECA "Standard of Installation."

B. Install enclosed contactors plumb. Provide supports in accordance with Section 26 05 29.

C. Height: 5 ft (1500 mm) to operating handle.

D. Install fuses for fusible switches. Refer to Section 26 28 13 for product requirements.

E. Install engraved plastic nameplates. Refer to Section 26 05 53 for product requirements and location.

3.3 FIELD QUALITY CONTROL

A. See Division 1 - Quality Requirements Execution and Closeout Requirements: Field inspecting, testing, adjusting, and balancing.

B. Inspect and test in accordance with NETA ATS, except Section 4.

C. Perform inspections and tests listed in NETA ATS, Section 7.16.1.

END OF SECTION
PART 1 -  GENERAL

1.1  SECTION INCLUDES

A.   Interior luminaries and accessories.
B.   Emergency lighting units.
C.   Exit signs.
D.   Ballasts.
E.   Lamps.
F.   Luminaire accessories.

1.2  RELATED SECTIONS

A.  Section 26 05 33 – Raceway and boxes for Electrical Systems.

1.3  REFERENCES

A.  ANSI C78.379 - Electric Lamps - Incandescent and High-Intensity Discharge Reflector Lamps - Classification of Beam Patterns.
B.  ANSI C82.1 - Ballasts for Fluorescent Lamps - Specifications.
C.  ANSI C82.4 - Ballasts for High-Intensity Discharge and Low Pressure Sodium Lamps (Multiple Supply Type).
F.  NEMA WD 6 - Wiring Devices-Dimensional Requirements.

1.4  SUBMITTALS

A.  Submit under provisions of Section 01 33 00.
B.  Shop Drawings: Indicate dimensions and components for each luminaire that is not a standard product of the manufacturer.
C.  Product Data: Provide dimensions, ratings, and performance data.
   1. Provide documentation indicating the understanding and implementation of 3.2 S.
D.  Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency specified under Regulatory Requirements.
E.  Manufacturer's Instructions: Include instructions for storage, handling, protection, examination, preparation, and installation of product.

1.5  PROJECT RECORD DOCUMENTS
A. Submit under provisions of Section 01 78 39.

B. Accurately record actual locations of each luminaire.

1.6 OPERATION AND MAINTENANCE DATA

A. Submit under provisions of Section 01 78 23.

B. Maintenance Data: Include replacement parts list.

C. Warranty: Provide letter from manufacturer and letter from contractor acknowledging warranty.

1.7 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years documented experience.

1. Ballast manufacturer shall have been manufacturing electronic ballast for at least 10 years.

1.8 REGULATORY REQUIREMENTS

A. Conform to requirements of ANSI/NFPA 70.

B. Conform to requirements of NFPA 101.

C. Furnish products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and shown.

PART 2 - PRODUCTS

2.1 LUMINARIES

A. Furnish products as specified in schedule.

B. Substitutions: Under provisions of Section 01 25 00.

C. Fluorescent Fixtures:

1. Description: Static Troffer type luminaire with ballast and lamps installed by luminaire manufacturer. The following fixtures have been evaluated as meeting the following specification:

   a. Lithonia.
   b. Columbia.
   c. Lightolier.
   d. Williams.
   e. Prudential.
   f. Metalux.
   g. Daybrite.
   h. Similar fixtures in the same specifications family for 2 lamp, 3 lamp, and 1 x 4 fixtures are also approved equal.

2. Material: .026 min. per UL "Code Gauge" gauge sheet steel housing with steel end plates and embossed reinforced ribs for strength and rigidity.

3. Lens and Enclosure: Prismatic acrylic lens, pattern 19. Provide gasketing between frame and luminaire housing or permanent, integral light stop to illuminate "light leak". Foam gasketing is not acceptable.

4. Photometric Control Elements: White coating, baked to form a smooth glossy durable finish electrostatically applied. Minimum reflectance to be 86%.

5. Photometric Performance: Minimum coefficient of utilization 0.65 at room cavity
ratio of 2 with ceiling-wall-floor reflectance of 70-50-20 percent and with A19 lens.
6. Socket Assembly: Bracket assembly shall be code gauge cold rolled steel held firmly in place without screws. Provide tombstone style pressure lock lampholders with plated contacts. Center of lamp to lenses shall be no closer than 2.7 inches. Lenses shall have a uniform brightness without lamp imaging.
7. Mounting: As scheduled.
9. Lamp: Two, three, or four as noted on schedule.
10. Flush Door Frame: .045 inch extruded aluminum with mitered corners, equipped with two replaceable zinc plated T-type hinges and two replaceable cam latches. Painted white to match fixture.
11. Wireway Cover: Code gauge tension secured with hinging on one side, or captioned spring cover mounting with removable chains.

2.2 EXIT SIGNS
A. Description: Exit sign fixture.
B. Housing: Painted Steel.
C. Face: Painted Steel.
D. Directional Arrows: As indicated.
E. Mounting: As indicated.
F. Lamps: Photoluminescent (Red).
G. Input Voltage: N/A.
H. Accessories: Provide wire guard for signs in Multipurpose Room, P.E. Room and Exterior.

2.3 BALLASTS
A. High Performance Fluorescent (Super T8) Electronic Ballast:
   1. General: All electronic ballasts shall meet the requirements of UL 935 and shall bear the appropriate UL label.
   2. Submittals: Provide manufacturers' data for each type of electronic ballast installed. Also provide nationally recognized independent test laboratory data verifying compliance with the specifications herein. Indicate actual lumen output of lamps with ballast.
   3. Warranty: The electronic ballasts shall be warranted against defects in material and workmanship for five years and include a $15 replacement labor allowance.
   4. Mechanical Construction: Electronic ballasts shall have the same physical dimensions, mounting arrangements and ballast to lamp socket lead lengths as those of their core and coil counterparts.
   5. Electrical Characteristics: The electronic ballast shall withstand input power line transients as defined in ANSI C62.41. The ballast shall tolerate a line voltage frequency variation of +/- 10%.
      a. Multi-Volt Ballast shall operate from a line voltage range of 108-305 volts, 50/60 HZ.
   6. The power factor shall be 98% or higher. The lamp crest factor shall measure 1.7 or less.
   7. The electronic ballast shall be Class “A” sound rated and UL Class P thermally protected.
   8. Total harmonic distortion of the input current to the electronic ballast shall not exceed 10% of the input current.
   9. The electronic ballast shall comply with FCC rules and regulations, Part 18 concerning the generation of both EMI (electromagnetic interference) and RFI (radio frequency interference).
10. Ballast system Efficacy shall not be less than 93 Lumens / Watt. Lamp lumens of the ballast system shall not be less than 71% of the rated lumens of the lamp.

11. The electronic ballast shall operate the lamp at a frequency of 42 KHZ or greater to both improve lamp efficiency and reduce the effects of lamp flicker. Lamp Flicker Index shall be less than 3%.

12. The ballast shall start and operate standard lamps at 50 degrees F. and energy savings lamps at 60 degrees F. Ballast case temperature shall not exceed 25 degrees C. rise above a 40 degrees C. ambient.

13. The ballast shall be provided with an internal fuse to protect the electrical power supply from internal component failure. The ballast shall also be short circuit protected in the event of miswiring.

14. Due to the extensive use of motion sensors, only Programmed rapid-start type ballasts will be considered. Do not use instant start type ballasts.

15. Approvals: Each ballast/lamp combination will be considered separately. Blanket approval of a manufacturer's line of ballasts will not be given.

16. Performance Evaluation: All evaluations will be based upon independent laboratory test data. All ballasts must be approved prior to individual project bidding.

17. Provide a single ballast in all 1, 2, 3, or 4 lamp fixtures that do not have multiple switching. Provide 1 - 2 lamp and 1 - 1 lamp ballast in 3 lamp multiple switched fixtures. Provide 2 - 2 lamp ballasts in 4 lamp multiple switched fixtures. Lamps and ballasts may be Tandem wired in multiple switched fixtures. Maximum run 20 ft.

18. Ballast shall allow for Independent Lamp Operation which allows for remaining lamps to maintain full light output if one or more lamps fail.

19. Ballast factors:
   a. Low - .75 Minimum
   b. Normal - .85
   c. High – 1.2

20. Ballast shall be provided with integral loads per ANSI C82.11 and manufacturer installed quick plug-in style connectors.


22. Ballast shall be manufactured in ISO 9002 Certified Facility.

B. High Intensity Discharge (HID) Ballast:
   1. Description: Pulse start metal halide ballast equal to Venture Uni-Form pulse start system.
   2. Provide ballast suitable for lamp specified.
   3. Voltage: Match luminaire voltage.

2.4 LAMPS

A. Lamps shall be as manufactured by:
   1. Sylvania – Xtreme XPS EcoLogic (FO32/841/XPS/ECO).
   2. General Electric – High Lumen ECO (F32T8/XL/SPX841/HL/ECO).
   3. Philips – Advantage ALTO (F32T8/ADV/841/ALTO).

B. Metal halide lamps shall be equal to Venture Uni-Form pulse start lamps.

C. Do not substitute other manufacturers.

D. Super T8 fluorescent lamps shall be 230ma with an initial lumen output of 3100 lumens, 85 CRI, and color temperature of 4100 Kelvins unless otherwise noted on the fixture schedule.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrate and supporting grids for luminaires.
B. Examine each luminaire to determine suitability for lamps specified.

3.2 INSTALLATION

A. Install in accordance with manufacturer’s instructions.

B. Install suspended luminaries using pendants supported from swivel hangers. Provide pendant length required to suspend luminaire at indicated height.

C. 2’ x 4’ luminaries are to be supported per one of the following methods:
   1. Independently of the ceiling grid with (4) #12 gauge wires from the fixture to the building structure. OR
   2. By the ceiling grid with a minimum of one #12 gauge support wire from the grid within 3” of each of the four corners of the fixture.

D. Locate recessed ceiling luminaries as indicated on reflected ceiling plan.

E. Install surface mounted luminaries and exit signs plumb and adjust to align with building lines and with each other. Secure to prohibit movement.

F. Install recessed luminaries to permit removal from below. Connect with flexible metal conduit from a J-Box in vicinity of fixture. Limit flex to 6’ maximum.

G. Install recessed luminaries using accessories and firestopping materials to meet regulatory requirements for fire rating.

H. Install clips to secure recessed grid-supported luminaries in place.

I. Install wall mounted luminaries, emergency lighting units and exit signs at height as indicated on Drawings.

J. Install accessories furnished with each luminaire.

K. Connect luminaries, emergency lighting units and exit signs to branch circuit outlets provided under Section 26 05 35 as indicated.

L. Make wiring connections to branch circuit using building wire with insulation suitable for temperature conditions within luminaire.

M. Bond products and metal accessories to branch circuit equipment grounding conductor.

N. Install specified lamps in each luminaire, emergency lighting unit and exit sign.

O. Do not use manufactured wiring systems.

P. Install #12 seismic support wires to luminaries as follows:
   1. 2’ x 4’ luminaire – 2 total, located at diagonal corners.
   2. Recessed cans – 1 total.

Q. Seismic support wires may be slack under normal conditions but shall not allow more than 6” deflection of the fixture if the ceiling is eliminated.

R. Ceiling mounted motion sensors and smoke detectors are to be fed with a shore flexible whip and supported by a 24” bracket bar hanger clipped to T-bar ceiling.

S. Label all fixtures with manufacture name, catalog number, lamp part number and lamp manufacture name in permanent marker pen. Use of preprinted labels is acceptable.

3.3 FIELD QUALITY CONTROL
A. Operate each luminaire after installation and connection. Inspect for proper connection and operation.

3.4 ADJUSTING

A. Adjust Work under provisions of Section 01 77 00.
B. Aim and adjust luminaries as indicated on Drawings.
C. Adjust exit sign directional arrows as indicated.
D. Relamp luminaries that have failed lamps at Substantial Completion.

3.5 CLEANING

A. Clean Work under provisions of Section 01 74 23.
B. Clean electrical parts to remove conductive and deleterious materials.
C. Remove dirt and debris from enclosure.
D. Clean photometric control surfaces as recommended by manufacturer.
E. Clean finishes and touch up damage.

3.6 DEMONSTRATION

A. Provide systems demonstration under provisions of Section 01 75 00.
B. Provide minimum of two hours demonstration of luminaire operation.

END OF SECTION
PART 1  GENERAL

1.1.  SECTION INCLUDES

A.  LED lamps
B.  LED Dimming Drivers
C.  Integral lighting controls

1.2.  RELATED DOCUMENTS (edit subparagraphs to coordinate with other sections in Specification)

A.  Section 26 27 26 – Wiring Devices

1.3.  REFERENCE STANDARDS

E.  IESNA LM-80-08 IESNA - Approved Method for Measuring Lumen Maintenance of LED Light Sources.
F.  IESNA TM-21-2011 – Projecting Long Term Lumen Maintenance of LED Light Sources.
G.  UL 1310 and 8750 – Light Emitting Diode (LED) Equipment for Use in Lighting Products.
H.  OSHA 29CFR1910.7 – Luminaires shall be listed by nationally recognized testing laboratory approved by United Stated Department of Labor, Occupational Safety and Health Administration (OSHA).
I.  ANSI C82.11 – Performance requirement for high frequency ballasts.
J.  ANSI C62.41 – Recommended practice in low power circuits.
K.  IEC 61347-1 – General and safety requirements for lamp control gear.
M.  IEC 62384 - DC or AC supplied electronic control gear for LED modules – performance requirements.
N.  IEC 61000-3-2 - Harmonic current emissions.
O.  IEC 61547 - EMC immunity requirements.
R.  Entertainment Services and Technology Association
   1.  ESTA E1.3 - Entertainment Technology - Lighting Control System - 0 to 10V Analog Control Protocol.
1.2 DEFINITIONS

**CALiPER**
DOE Commercially Available LED Product Evaluation and Reporting program for the testing and monitoring of commercially available LED Luminaires and lights.
http://www1.eere.energy.gov/buildings/ssl/m/caliper.html

**CCT**
Correlated Color Temperature: The temperature in units of kelvin of a blackbody whose chromaticity most nearly resembles that of the light source in question.

**cd**
Candela: SI Unit of luminous intensity, equal to 1 lumen per steradian (lm/sr).

**Chromaticity**
The property of color of light defined by the dominant or complementary wavelength and purity aspects of the color taken together.

**CRI**
Color Rendering Index – measure of the degree of color shift of reference objects when illuminated by the light source as compared to a reference source of comparable color temperature.

**fc**
Footcandle: Unit of illuminance, equal to 1 lm/ft².

**L80**
The extrapolated life in hours of the luminaire when the luminous output depreciates 20 percent from initial values.

**LED**
Light Emitting Diode

**METS**
Material Engineering and Testing Services of the Translab

**MacAdam**
Shape on the CIE chromaticity diagram that illustrates how much one can “stray” from the target before perceiving a difference from the target color.

**NEMA**
National Electrical Manufacturers Association

**NRTL**
Nationally Recognized Testing Laboratory

**NVLAP**
National Voluntary Laboratory Accreditation Program - A program under the US DOE to accredit independent testing laboratories to qualify.

**PF**
Power Factor - The ratio of the real power component to the total (complex) power component.

**Rated power**
Power consumption that the luminaire was designed and tested for at ambient temperature (70°F or 21°C).

**RoHS**
Compliance aims to restrict certain dangerous substances commonly used in electronic equipment, including Lead, Cadmium, Mercury and others.

**SPD**
Surge Protection Device - A subsystem or component(s) that can protect the unit against short duration voltage and current surges.

**SSL**
Solid State Lighting

**THD**
Total Harmonic Distortion - The amount of higher frequency power on the power line.

1.3 SUBMITTALS

A. See Section 013000 – Administrative Requirements, for submittal procedures

B. Shop drawings: Clearly indicate luminaire type, name of the job, and Architect. Contractor shall submit all luminaire, driver and integral controls shop drawings at one time, in one package. Re-submittals shall include all luminaire, driver and integral controls previously rejected or requiring further information. Specialty SSL, custom, or modified fixtures may be submitted as a separate package.
C. Shop Drawings: Reproductions of the contract drawings are not acceptable as shop drawings. Indicate any components for each luminaire that are not a standard product of the manufacturer.

D. Product Data: Provide dimensions, ratings and specific catalog number and identification of items and accessories and performance data.

E. Wiring Diagrams – as needed for special operation or interaction with other system(s)

F. Photometric Data: Where indicated below or for substitutions, supply complete photometric data for the fixture, including optical performance, rendered by NVLAP approved laboratory developed according to the methods of the Illuminating Engineering Society of North America. Submit electronically, in IESNA LM-63 standard format.

G. Submit photometric data for all substitute luminaries. Photometric reports are not required from specified manufacturer unless noted in 1.5.7 above.

H. Specification Sheets: If lacking sufficient detail to indicate compliance with contract documents, standard specification sheets will not be accepted. This includes, but is not limited to, luminaire type designation, manufacturer's complete catalog number, voltage, LED type, CCT, CRI, specific driver information, system efficacy, L80 life rating, and any modifications necessary to meet the requirements of the contract documents.

I. Substitutions shall include complete photometric data as outlined in paragraph 1.5.7 above, and point by point calculations for the specific conditions on the project. Samples shall be required for consideration of any substitutions and must be submitted in accordance with the terms outlined in paragraph 1.5.11 below.

J. Working Samples of all substitutions: Samples shall be 120 volt with cord and plug attached, and shall include specified LEDs and all modifications necessary to meet the requirements specified in the Contract Documents.

PART 2. PRODUCT REQUIREMENTS

2.1 MANUFACTURERS

A. Approved Manufacturers: Provide products of firms regularly engaged in the manufacture of recessed lighting fixtures and components of types and ratings required, whose products have been in satisfactory use in similar service for not less than 5 years. The manufacturer of the lighting fixtures and components shall comply with the provisions of the appropriate code and standards. All fixtures shall be pretested before shipping.

B. Conformance: Fixtures shall be manufactured in strict accordance with the Contract Drawings and Specifications.

C. Codes: Materials and installation shall be in accordance with the latest revision of the National Electrical Code and any applicable Federal, State, and local codes and regulations.

D. UL or CSA US Listing: All fixtures shall be manufactured in strict accordance with the appropriate and current requirements of the “Standards for Safety” to UL 8750 or others as they may be applicable. A listing shall be provided for each fixture type, and the appropriate label or labels shall be affixed to each fixture in a position concealing it from normal view.

E. Luminaire shall be DLC Certified (Design Lights Consortium). (Specifier: Low lumen versions of luminaires may not meet DLC, if so delete line.)

F. Specifications and scale drawings are intended to convey the salient features, function and character of the fixtures only, and do not undertake to illustrate or set forth every item or detail necessary for the work.
G. **Base Bid Manufacturers:** Are listed on fixture schedule and specification. Manufacturers listed without accompanying catalog numbers are responsible for meeting the quality standards and photometric distribution set by the specified product.

H. **Alternate Manufacturers:** Identification by means of manufacturers names and catalog numbers is to establish basic features, quality and performance standards. Any substitutions must meet or exceed these standards.

I. Luminaire shall carry the Lighting Facts label, verified based on LM-79 test reports. [www.lightingfacts.com](http://www.lightingfacts.com)

### 2.2 LUMINAIRES TYPE XX, YY – Linear Pendant

A. Each luminaire shall consist of an assembly that utilizes LEDs as the light source. In addition, a complete luminaire shall consist of a housing, LED array, and electronic driver (power supply) and integral controls as per this specification.

B. Each luminaire shall be designed to operate at an average operating temperature of 25°C.

C. The operating temperature range shall be 0°C to +25°C.

D. Each luminaire shall meet all parameters of this specification throughout the minimum operational life of 50,000 hours when operated at the average operating temperature (see 2.2.2).

E. Nominal luminaire dimensions:
   - **Type XX** – Length – 4’ (121.0cm), Width – 8 1/4” (21.0cm), Depth – 1 3/4” (4.45cm)
   - **Type YY** – Length – 8’ (242.0cm), Width – 8 1/4” (21.0cm), Depth – 1 3/4” (4.45cm)

F. Luminaire Construction:
   1. Luminaire housing to have no visible welding, screws, springs, hooks, rivets, bare LEDs, or plastic supports.
   2. The luminaire shall be a single, self-contained device, not requiring on-site assembly for installation. The power supply and circuit board for the luminaire shall be integral to the unit.
   3. Luminaires shall be fabricated from post painted cold rolled 18 GA steel and shall be a rigid structure with die cast end caps, mechanically attached with no visible fasteners. Luminaire may be mounted and wired in continuous rows.
   4. Finish: Polyester powder coat painted in white, black or painted aluminum as per specification. *(Specifier to edit for color selection or custom color with color reference number).*
   5. Luminaire lengths of 4’ or 8’ shall be joined to create a continuous run using internal joiners as shown on drawings.
   7. Lens shall be single clear diffuser with advanced optical film and shall provide LED concealment and even illumination across the diffuser.
   8. Polymeric materials (if used) of enclosures containing either the power supply or electronic components of the luminaire shall be made of UL94VO flame retardant materials. Luminaire lenses are excluded from this requirement.
   9. Suspension shall be aircraft wire with total suspension length as specified. Cable to be field adjustable.
   10. The assembly and manufacturing process for the SSL luminaire shall be designed to assure all internal components are adequately supported to withstand mechanical shock and vibration and prevent light leaks at all visible joints.

G. **LED Sources**
   1. LEDs shall be manufactured by Nichia, or Equal.
   2. Lumen Output – minimum initial delivered lumen output of the luminaire shall be as follows for the lumens exiting the luminaire in the 0-360 degree zone - as
measured by IESNA Standard LM-79-08 in an accredited lab. Exact tested lumen output shall be clearly noted on the shop drawings.

a. Type XX – 8 ¼” x 4’ – 3400 (30 watts max.) or 4800 (45 watts max.) nominal delivered lumens @ 3500K per specification

b. Type YY – 8 ¼” x 8’ – 6800 (60 watts max.) or 9600 (90 watts max.) nominal delivered lumens @ 3500K

c. Lumen output shall not decrease by more than 20% over the minimum operational life of 50,000 hours at the rated ambient operating temperature (see 2.2.2)

3. Individual LEDs shall be connected such that a catastrophic loss or the failure of one LED will not result in the loss of the all LEDs within the luminaire.

4. LED Boards shall be suitable for field maintenance and have plug-in connectors. LED boards shall be upgradable.

5. Light Color/Quality-
   a. Correlated Color Temperature (CCT) range as per specification, between 3000K, 3500K and 4000K shall be correlated to chromaticity as defined by the absolute (X, Y) coordinates on the 2-D CIE chromaticity chart. (Edit color temperature per project specification)
   b. Color shift over 6,000 hours shall be <0.007 change in u’ v’ as demonstrated in IES LM80 report.
   c. The Color Rendition Index (CRI) shall be 80 or greater.
   d. LED boards to be tested for color consistency and shall be within a space of 2.5 MacAdam ellipses on the CIE chromaticity chart.

H. Power Supply and Drive
   1. Driver: Acceptable manufacturer: eldoLED, or Equal.
   2. Ten-year expected life while operating at maximum case temperature and 90 percent non-condensing relative humidity.
   3. Driver shall be UL Recognized under the component program and shall be modular for simple field replacement. Drivers that do not meet these requirements will not be accepted.
   4. Electrical characteristics: 120 – 277 volt, UL Listed, CSA Certified, Sound Rated A+. Driver shall be > 80% efficient at full load across all input voltages. Input wires shall be 18AWG solid copper minimum.
   5. Dimming: Driver shall be suitable for full-range dimming. LED dimming shall be equal in range and quality to a commercial grade incandescent dimmer. Quality of dimming to be defined by dimming range, freedom from perceived flicker or visible stroboscopic flicker, smooth and continuous change in level (no visible steps in transitions), natural square law response to control input, inaudible in 26db environment, and stable when input voltage conditions fluctuate over what is typically experienced in a commercial environment. Demonstration of this compliance to dimming performance will be necessary for substitutions or prior approval. The luminaire shall be capable of continuous dimming without perceivable flicker over a range of 100 percent to 0.1 percent of rated lumen output with a smooth shut off function.
      a. Dimming shall be controlled by a 0-10V signal.
      b. Driver shall include ability to provide no light output when the analog control signal drops below 0.5V, or the DALI/DMX digital signal calls for light to be extinguished and shall consume 0.5 watts or less in this standby. Control deadband between .5 and .65V shall be included to allow for voltage variation of incoming signal without causing noticeable variation in fixture to fixture output.
      c. Driver shall be capable of configuring a linear or logarithmic dimming curve, allowing fine grained resolution at low light levels.
      d. Driver must be capable of 20 bit dimming resolution for white light LED driver.
      e. Drivers shall track evenly across multiple fixtures at all light levels, and shall have an input signal to output light level that allows smooth adjustment over the entire dimming range.
      (Specifier: To provide similar visual performance and illumination quality to existing fluorescent dimming solution, system should minimize flicker.)
6. Flicker: Driver and luminaire electronics shall deliver illumination that is free from objectionable flicker as measured by flicker index (ANSI/IES RP-16-10). At all points within the dimming range from 100-0.1 percent luminaire shall have:
   a. Less than 1 percent flicker index at frequencies below 120 Hz.
   b. Less than 12 percent flicker index at 120 Hz, and shall not increase at greater than 0.1 percent per Hz to a maximum of 80 percent flicker index at 800Hz.
      (Specifier: Alternative to above: choose a luminaire that shall have flicker index below 800 Hz of 5 percent or less, which is equivalent to incandescent dimming.)

7. Driver disconnect shall be provided where required to comply with codes.

8. The electronics/power supply enclosure shall be internal to the SSL luminaire and be accessible per UL requirements.

9. The surge protection which resides within the driver shall protect the luminaire from damage and failure for transient voltages and currents as defined in ANSI/IEEE C64.41 2002 for Location Category A, where failure does not mean a momentary loss of light during the transient event.

I. Electrical

1. Power Consumption: Maximum power consumption, +/- 5% when operating between 120 – 277V (or 346V) shall be as follows:
   a. Type XX – 8 ¼" x 4’ – 30 watts and 45 watts nominal
   b. Type YY - 8 ¼" x 8’ – 60 watts and 90 watts nominal

2. Operation Voltage - The luminaire shall operate from a 60 HZ ±3 HZ AC line over a voltage ranging from 120 VAC to 277 VAC. The fluctuations of line voltage of (+/- 10%) shall have no visible effect on the luminous output.

3. Power Factor: The luminaire shall have a power factor of 90% or greater at all standard operating voltages and full luminaire output.

4. THD: Total harmonic distortion (current and voltage) induced into an AC power line by a luminaire shall not exceed 20 percent at any standard input voltage and meet ANSI C82.11 maximum allowable THD requirements at full output. THD shall at no point in the dimming curve allow imbalance current to exceed full output THD.

5. Surge Suppression: The luminaire shall include surge protection to withstand high repetition noise and other interference. Withstand up to a 1,000 volt surge without impairment of performance as defined by ANSI C62.41 Category A.
   (Specifier: The following statement ensures that the electronic dimming driver will meet NEMA inrush recommendations to reduce false circuit breaker tripping due to turn on inrush)

6. In Rush Current: Meet or exceed NEMA 410 driver inrush standard of 430 Amps per 10 Amps load with a maximum of 370 Amps2 – seconds.

7. RF Interference: The luminaire and associated on-board circuitry must meet Class A emission limits referred in Federal Communications Commission (FCC) Title 47, Subpart B, Section 15 Non-Consumer requirements for EMI/RFI emissions.

8. Driver must support automatic adaptation, allowing for future luminaire upgrades and enhancements and deliver improved performance:
   a. Adjustment of forward LED voltage, supporting 3V through 60V.
   b. Adjustment of LED current from 200mA to 1.05A at the 100 percent control input point in increments of 1mA.
   c. Adjustment for operating hours to maintain constant lumens (within 5 percent) over the 50,000 hour design life of the system, and deliver up to 20 percent energy savings early in the life cycle.

9. Electrical connections between normal power and driver must be modular utilizing a snap fit connector. All electrical components must be easily accessible after installation and be replaceable without lowering the luminaire.

10. All electrical components shall be RoHS compliant.

J. Photometric Requirements

1. Luminaire performance shall be tested as described herein.
2. Luminaire performance shall be judged against the specified minimum illuminance in the specified pattern for a particular application.
3. Luminaire lighting performance shall be adjusted (depreciated) for the minimum life expectancy (Section 2.2.4).
   a. The performance shall be adjusted (depreciated) by using the LED manufacturer’s data or the data from the IESNA Standard TM-21 test report, which ever one results in a higher level of lumen depreciation.
   b. The ratio of the peak-to-zenith maximum candela ratios shall be – 1.94:1 @ 127.5 degrees.
   c. The luminaire may be determined to be compliant photometrically, if:
      1) The initial minimum illuminance level is achieved in 100% of the area of the specified lighting pattern.
      2) The measurements shall be calibrated to standard photopic calibrations.
         (Specifier: Add specific project requirements.)

K. Thermal Management
1. The thermal management (of the heat generated by the LEDs) shall be of sufficient capacity to assure proper operation of the luminaire over the expected useful life (Section 2.2.7 (c)).
2. The LED manufacturer’s maximum junction temperature for the expected life (Section 2.2.7 (c)) shall not be exceeded at the average operating ambient (Section 2.2.2).
3. The LED manufacturer’s maximum junction temperature for the catastrophic failure shall not be exceeded at the maximum operating ambient temperature (Section 2.2.3).
4. The luminaire shall have a UL or CSA rating.
5. The Driver manufacturer’s maximum case temperature shall not be exceeded at the maximum operating ambient temperature. Thermal management shall be passive by design. The use of fans or other mechanical cooling devices shall not be allowed.

L. Optics
1. Optics shall consist of high performance advanced optical film, diffuser, and metal reflector.
   Optics shall eliminate source image.

M. Digital Controls (Specifier: Edit as required for specific project requirements)
1. Each luminaire shall be equipped with one (1) digital RJ45 port and interface with other digital control equipment.
2. Connect to devices compatible with 0 to 10V Analog Control Protocol, Class 2, capable of sinking 0.6ma per driver at a low end of 0.3V. Limit the number of drivers on each 0-10V control output based on voltage drop and control capacity.
3. Digital manual wall control shall integrate with the SSL luminaire via CAT5E cable and be self-commissioning.
4. Digital occupancy sensor shall integrate with the SSL luminaire via CAT5E cable and be self-commissioning.
5. Digital photocell shall integrate with the SSL luminaire via CAT5E cable and be self-commissioning.
6. Integral Daylight Dimming or Daylighting Dimming with Occupancy Detection sensors shall be provided as per specification. Sensor shall be designed to be low profile to minimize appearance in luminaire.
7. Each luminaire shall be supplied with a unique network address. This address shall be printed on two identification labels. One label shall be permanently affixed to the luminaire and one label shall be easily removed for network control commissioning purposes. Both labels shall be in a location which is easily accessible by the installing contractor.
8. Control Input:
   a. 4-Wire (0-10V DC Voltage Controlled) Dimming Drivers:
      1) Must meet IEC 60929 Annex E for General White Lighting LED drivers
2) Must meet ESTA E1.3 for RGBW LED drivers
   b. Digital (DALI Low Voltage Controlled) Dimming Drivers:
      1) Must meet IEC 62386

N. Luminaire Identification
1. Each luminaire shall have the manufacturer's name, trademark, model number, serial number, date of manufacture (month-year), and lot number as identification permanently marked inside each unit and the outside of each packaging box.
2. The following operating characteristics shall be permanently marked inside each unit: rated voltage and rated power in Watts and Volt-Ampere.

O. Quality Assurance
1. The luminaires shall be manufactured in accordance with a manufacturer quality assurance (QA) program. The QA program shall include two types of quality assurance: (1) design quality assurance and (2) production quality assurance. The production quality assurance shall include statistically controlled routine tests to ensure minimum performance levels of the modules built to meet this specification. These tests shall include: CCT, CRI, Lumen output, and wattage. Tests shall be recorded, analyzed and maintained for future reference.
2. QA process and test results documentation shall be kept on file for a minimum period of seven years.
3. LED luminaire designs not satisfying design qualification testing and the production quality assurance testing performance requirements described below shall not be labeled, advertised, or sold as conforming to this specification.

P. Design Qualification Testing
1. Design Qualification Testing shall be performed by a National Voluntary Laboratory Accreditation Program (NVLAP) testing facility. Such testing may be performed by the manufacturer or an independent testing lab hired by the manufacturer on new luminaire designs and when a major design change has been implemented on an existing design. A major design change is defined as a design change (electrical or physical), which changes any of the performance characteristics of the luminaire, results in a different circuit configuration for the power supply, or changes the layout of the individual LEDs in the module.
2. A quantity of two units for each design shall be submitted for Design Qualification Testing.
3. Product submittals shall be accompanied by product specification sheets or other documentation that includes the designed parameters as detailed in this specification. These parameters include (but are not limited to):
   a. Maximum power in Watts.
   b. L80 in hours, when extrapolated for the worse case operating temperature (section 2.2.3). TM21 report shall be submitted to demonstrate this.
   c. Product submittals shall be accompanied by performance data that is derived in accordance with appropriate IESNA testing standards and tested in a laboratory that is NVLAP accredited for Energy Efficient Lighting Products.
4. Luminaire shall be tested per IESNA LM 79-08.

2.3 WARRANTY

A. The manufacturer shall provide a single source, 5 year limited warranty against loss of performance and defects in materials and workmanship for all components of the luminaire. Warranty is from the time of acceptance of the Luminaires. All warranty documentation shall be provided to customer prior to the first shipment.

B. Provide manufacturer’s warranty covering 5 years on drivers from date of purchase. Refer to manufacturer’s terms and conditions on the website for detailed information.
PART 3. EXECUTION

3.1 INSTALLATION

A. Install fixtures securely, in a neat and workmanlike manner, as specified in NECA 501.
B. Fixture to suspend by aircraft wire to the mounting height specified. Adjustable cable gripper shall be provided as per specification. (delete if adjustable cable gripper is not required). Luminaires shall be mounted straight and plumb. Contractor shall verify ceiling type and shall obtain all required mounting hardware for specific ceiling type.
C. Canopies shall be provided.
D. Cord Managers shall be provided to ensure the power cords and CAT5E cables can be coupled with the aircraft cables creating one line from the fixture to the ceiling.
E. Install all required hardware and mounting brackets to secure luminaires to structure per local code requirements.
F. Bond luminaires and metal accessories to branch circuit equipment grounding conductor.

3.2 FIELD QUALITY CONTROL

A. Perform field inspection, testing, and adjusting in accordance with Section 014000.
B. Operate each luminaire after installation and connection. Inspect for improper connections and operation.
C. Test and calibrate all controls associated with luminaires, i.e. integral photo cells and occupancy sensors.

3.3 CLEANING

A. Clean electrical parts to remove conductive and deleterious materials.
B. Remove dirt and debris from lens and enclosures
   1. For cleaning acrylic lenses or diffusers, use a feather duster or dry cotton cheesecloth to rid the lens/diffuser of any minor dust. For fingerprints, smudges, or other dirt present, use an ammonia-based cleaner (such as Windex) and wipe carefully with cotton cheesecloth (so as to avoid injury from any prismatic texture of the lens).
   2. Contractor shall replace the lens if Job site contamination cannot be removed using the above recommendations.
C. Clean photometric control surfaces as recommended by manufacturer.

3.4 CLOSEOUT ACTIVITIES

A. Replace any luminaire components or associated controls which are not functioning per specifications.

END OF SECTION
PART 1  
GENERAL

1.1  
PURPOSE

A. The intent of this document is to provide a standard specification that will be used for all UNLV facilities requiring cable installation. This document provides the minimum performance criteria for the components and sub-systems comprising a complete cabling system that shall accommodate UNLV’s requirements in excess of ten years.

B. Product specifications, general design considerations, and installation guidelines are provided in this written document. Quantities of telecommunications outlets, typical installation details, cable routing and outlet types for a specific UNLV facility will be provided as an attachment to a Request for Proposal. If the bid documents are in conflict, the Request for Proposal specification shall take precedence. The successful vendor shall meet or exceed all requirements for the cabling system described in this document.

C. This specification is intended to provide general design guidelines for new construction, and performance criteria for additions/renovations to existing facilities. Since all new construction will have telephone/data communication service raceways provided by an electrical subcontractor under the general contract, the specifications included in this document are intended as supplemental information to insure an acceptable, effective installation.

D. The successful contractor is required to furnish all labor, supervision, tooling, miscellaneous mounting hardware and consumables for each cabling system installed. The contractor shall maintain current status with the warranting manufacturer, including all training requirements, for the duration of the contract. The Contractor shall staff each installation crew with the appropriate number of trained personnel, in accordance with their warranty. After installation, the Contractor shall submit documentation to support a contractor installation 10-year warranty. The 10-year warranty will cover the components and labor associated with the repair/replacement of any failed link, which is a valid warranty claim, within the warranty period.

1.2  
APPLICABLE REGULATIONS

A. Related Documents – Equipment and material shall be Underwriter's Laboratories listed and labeled. The latest editions of the following standards are minimum requirements. If a conflict exists between applicable documents, then the order in the list below shall dictate the order of precedence in resolving conflicts. This order of precedence shall be maintained unless a lesser order document has been adopted as code by a local, state or federal entity, and is therefore enforceable as law by a local, state, or federal inspection agency:

1. ANSI/TIA/EIA- Transmission Performance Specifications for 4-Pair Category 6 Cabling.
2. ANSI/TIA/EIA-568-B Commercial Building Telecommunications Cabling Standard
3. ANSI/EIA/TIA-569 Commercial Building Standard for Telecommunications Pathways and Spaces
4. ANSI/EIA/TIA-606 Administration Standard for the Telecommunications Infrastructure of Commercial Building
5. ANSI/TIA/EIA-607 Commercial Building Grounding and Bonding Requirements for Telecommunications
6. National Electrical Manufacturers Association (NEMA)
7. National Electrical Code, latest revision (NEC)
8. National Fire Protection Agency (NFPA) – 70
9. Local, State and Federal Codes including Nevada Revised Statute (NRS) 278.583
10. Nevada State Public Works Board Adopted Standards
11. UL 497 Protectors
12. UL 1459 Standard for Safety for Telephone Equipment
13. UL 1863 Standard for Safety for Communications Circuit Accessories
14. UL 2024 Standard for Safety for Optical Fiber Cable Raceway
15. UL 723 Standard for Safety for Surface Burning Characteristics of Building Materials
17. TIA SP-4195
19. ANSI/EIA 310D

1.3 DESIGN REQUIREMENTS

A. Work must conform to the design requirement for each identified element.

B. Building Service - Plans for all new buildings shall include a design for extending the campus voice, data and video networks to the building. Consistent with this design, network trunks shall be extended as a part of the initial construction and equipment shall be installed to provide connection to the building. Every building, regardless of size, shall be constructed to allow for a 19-tube cable (Sumitomo part number TC19TLW or similar) to enter through individual 4" conduits from the campus underground plant from two diverse locations. Voice cables (minimum 50 pair) to enter from the campus underground plant from one location. In addition, every building shall be equipped with at least two empty 4" conduits to the campus underground plant for later use by UNLV after installation of all voice and data cables. All raceways to have 880 lb. nylon pull strings installed. All new service entrance conduits shall be a minimum 4" trade size and of sufficient number to provide 50% growth capacity, and will terminate 4" above finished floor in the MDF (main distribution frame) room inside the building.

1. Service Data: Data communication service to each building shall consist of a minimum of 24 strands of 50/125-micron multi-mode fiber and 72 strands of 9.0/125-micron single-mode fiber and terminated at two separate major distribution locations on campus as determined by UNLV Network Development and Engineering. Fiber optic cable is to be contained in its own 19-tube air-blown cable, Sumitomo part number TC19TLA or similar. If different part number is to be used, approval must be granted by UNLV Network Development and Engineering. Multi-mode fiber is to be terminated with LC style connectors, UPC Polish and single-mode fiber is to be terminated with SC style connectors, UPC Polish. Multimode and Singlemode terminated in separate rack mounted light guides. MDF to include a Tube Distribution Unit (Sumitomo part number DE12IDU or similar). If different part number is to be used, approval must be granted by UNLV Network Development and Engineering. Each light guide must be labeled with building, and IDF room number of opposing end. Patch panels to be mounted in such a manner as to allow the maximum usage of each rack. Appropriate wire management, determined by consultation with Network Development and Engineering and with regards to building design, shall be installed. A minimum of 10 ft. of fiber-optic cable will be coiled, to meet manufacturer specifications, at both termination points. Complete IDF room design, including rack layout, power requirements, cable management will be provided by UNLV Network Development and Engineering.

2. Service – Voice: Voice communication service to each building shall consist of a minimum of one 24 AWG, solid annealed copper, 50 pair twisted cable. Cable to enter building through a separate, dedicated conduit. Cable to be terminated patch panel(s) in data rack(s). One pair per RJ-45 block, terminated on blue/white-blue. Lightning protection to be provided as required per design specifications and/or applicable codes and regulations.
C. Service Entries - Elements of the service entry facilities design are to include type, size, gauge, and insulation of distribution cables. Every copper cable shall be bonded and grounded for lightning protection per NEC 800-30A at both terminations using solid-state 5-pin protectors, 50 to 100 volt range. Building entry conduit shall allow for 50% growth and have a minimum of four 4" conduits from manhole to MDF room.

D. Manholes - All manholes shall be at minimum 4' by 4' by 4' and encased in concrete. All cable is to have service loops and be raked and mounted. Each manhole will have drainage holes and be engineered so water will not accumulate. Top of manholes are to be flush with paved areas, 6" above finished grade in landscaped areas.

E. Cable Splicing – Copper cable splicing is only allowed where previously approved by UNLV Network Development and Engineering. Fiber-optic cable will only be spliced at the termination point. Fiber-optic splicing must be fusion based with two fibers optic strands of the exact make and model on each end using factory terminated connectors on pigtailed. Splicing is not acceptable outside of Tele/Data rooms. Epoxy based splices shall not be acceptable. The following cable splicing techniques and materials for copper cable shall be utilized:

1. Preparation for Splices – All copper cables shall be thoroughly cleaned and scuffed in a manner to insure a good mechanical bond when splicing. 3M Scotchcase 4435 non-conductive aluminum oxide abrasive strip, or UNLV approved equal shall be used. All cable shall be thoroughly cleaned with a non-toxic solvent, 3M Scotchcase 4414 or 4415 or UNLV approved equal.

2. Splicing Requirements
   a. No splice cases will be permitted in cable trays.
   b. All splice closures for use on underground non-pressurized systems shall be manufactured of clear, self-extinguishing, tongue and groove fitting PVC.
   c. End caps must be tapered and flexible and be capable of separate cable entries.
   d. Rigid bonding and strain relief bars must be an integral part of the finished closure.
   e. Re-enterable, polyurethane compound shall be used.
   f. All cable splices must be tagged or marked showing the cable number and pair count spliced. Markings may be placed on the splice closure or on both the in and out cables.
   g. Supports: All cable splices shall be supported by a minimum of two cable hooks. Horizontal racking for support may utilize 3M Brand RC-100 rack adapters, manhole racks, or library approved equivalent.
   h. Closures: 3M splice closures or library approved closures will be used for splicing throughout the system.
   i. Protection: All cable splices must be protected from damage at sheath openings by mechanically protecting all conductors utilizing 3M Scotchcase Pair Saver 4458 or approved equivalent.

F. Building Voice and Data Terminal Rooms – All new building structures shall have minimum one primary Data communication room in which the outside cable terminates, henceforth referred to as the Main Distribution Facility (MDF). Each building may have additional data rooms for end wiring, henceforth referred to as Intermediate Distribution Facilities (IDFs).

1. Main Distribution Facility (MDF) Specifications
   a. The MDFs shall not contain any equipment not specified by UNLV Network Development and Engineering. This includes, but is not limited to, Marlok equipment, transformers, sinks, fire or building alarm equipment. They shall be kept as clear of all other equipment.
   b. Each MDF will be provided with isolated grounds, including a 6’ vertical earth ground, and an isolated electrical panel with 200-amp service.
   c. Each MDF will have four 20 amp, 110 V.A.C. outlets, terminated with NEMA 5-20Rs and four 30 amp 208 V.A.C. outlets, terminated with
NEMA L6-30Rs. All outlets will be serviced by the emergency power system and colored orange or otherwise marked as such. All outlets will be positioned within 4 feet of the rear of the provided racks, near floor level.

d. All MDFs shall be accessible only from inside the building. No outside entrances are permitted. All doors between the outside and the MDF must be at least 36” wide and 80” high.

e. Rooms will be rectangular or square, have a minimum clearance height of eight feet without obstructions (sprinklers, etc.), be at least 14’ x 10’, and not have false floors or ceilings.

f. No exposed water or gas pipes shall enter in or run through the main terminal room or data room. No drains, ducts or clean-outs will be permitted.

g. A separate HVAC thermostat control will be installed for all MDF rooms, and shall be air conditioned with separate zone or air conditioning unit 24 hours a day, seven days a week. A positive pressure shall be maintained with a minimum of one air change per hour.

h. All MDFs shall be secured using a Marlock card swipe reader and striker, the access of which is to be managed by the Network Operations Center.

i. All MDFs shall be provisioned with at least one standard data rack, Panduit CMR4P84CN, bolted to the floor. These rack(s) shall be placed side-by-side, with vertical cable management, Panduit part# WMPVHC45E in between and on both sides. The racks must have a minimum of 36” of clearance front and back and at least 18” on both sides. OIT provided room drawings must be followed.

j. Ladder rack shall be provided and installed sufficient to secure the equipment rack to the adjacent wall(s) as determined at installation and to provide support for incoming cables.

k. A minimum of two walls must be covered by backboards as defined in Part II.

l. Floor loading shall be designed to support a minimum of 1000 pounds of equipment per data rack provided.

m. All other elements of room to be designed and provisioned per ANSI/EIA/TIA 569 or better.

2. Intermediate Distribution Facilities (IDFs)

a. The IDFs shall not contain any equipment not specified by UNLV Network Development and Engineering. This includes, but is not limited to, Marlok equipment, transformers, sinks, fire or building alarm equipment. They shall be kept as clear of all other equipment.

b. Each IDF will be provided with isolated grounds, including a 6’ vertical earth ground.

c. Each IDF will have four 20 amp, 110 V.A.C. outlets, terminated with NEMA 5-20Rs and two 30 amp 208 V.A.C. outlets, terminated with NEMA L6-30Rs. All outlets will be serviced by the emergency power system and colored orange or otherwise marked as such. All outlets will be positioned within 4 feet of the rear of the provided racks, near floor level.

d. All IDFs shall be accessible only from inside the building. No outside entrances are permitted. All doors between the outside and the IDF must be at least 36” wide and 80” high.

e. Rooms will be rectangular or square, have a minimum clearance height of eight feet without obstructions (sprinklers, etc.), be at least 8’ x 10’, and not have false floors or ceilings.

f. No exposed water or gas pipes shall enter in or run through the main terminal room or data room. No drains, ducts or clean-outs will be permitted.

g. A separate HVAC thermostat control will be installed for all IDF rooms, and shall be air conditioned with separate own zone or air conditioning.
unit 24 hours a day, seven days a week. A positive pressure shall be maintained with a minimum of one air change per hour.

h. All IDFs shall be secured using a Marlock card swipe reader and striker, the access of which is to be managed by the Network Operations Center.

i. All IDFs shall be provisioned with at least one standard data rack, Panduit CMR4P84CN, bolted to the floor. These rack(s) shall be placed side-by-side, with vertical cable management, Panduit part# WMPVHC45E in between and on both sides. The racks must have a minimum of 36” of clearance front and back and at least 18” on both sides. OIT provided room drawings must be followed.

j. Enough rack space must be provided to terminate all fiber and copper, with associated cable management, plus 200%.

k. Ladder rack shall be provided and installed sufficient to secure the equipment rack to the adjacent wall(s) as determined at installation and to provide support for incoming cables.

l. A minimum of four walls must be covered by backboards as defined in Part II.

m. Floor loading shall be designed to support a minimum of 1000 pounds of equipment per data rack provided.

n. All other elements of room to be designed and provisioned per ANSI/EIA/TIA 569 or better.

G. Building Interiors

1. Underground Plant - The cables from the underground plant shall enter the building in a MDF room. Appropriate wire management shall be installed such as ladder racks, D-rings, and tie wraps so as not to exceed the acceptable cable bend radius.

2. Data Rooms - Additional IDF(s) shall be provided if necessary to prevent total length of data cable runs from exceeding 300 feet. Additional IDF rooms in multistory buildings shall be aligned vertically with the MDF room if possible.

3. Internal Backbones (Risers) - A minimum of two 4” conduits shall run between every IDF and the MDF within buildings. Pull strings shall be provided in every conduit. Data interconnections between each IDF and the MDF shall be via fiber optic cable containing a minimum of 24 strands of multi-mode and 24 strands of single-mode fiber, as defined in Part II. Fiber optic cable is to be contained inside 7-tube air-blown conduit, Sumitomo part TC07TRX. 12 Cat6 provided between every IDF and the MDF. Patch panels are to be mounted in such a manner as to allow the maximum usage of each rack.

4. Station Wiring

a. Outlets - All outlets shall be constructed using single gang, 4-port faceplates, colored almond, AMP part number 558088-1 or similar. All outlets shall have at least two network drops each.

b. Cabling - All drops shall be connected with blue network cabling from patch panels to each drop location and terminated on black data jack. Every cable shall be continuous and unspliced, with data cables attached to a single port in the patch panel at one end and to a single jack at the station end. All connections are to be done using the T568B wiring scheme. No cable run from patch panel to connection point may exceed 300 feet. All cabling must terminate in an IDF or MDF room on the same floor as the outlet unless building plans, certified by Network Development and Engineering, specify otherwise. Additional specifications for cabling, patch panels and data jacks as per specifications in Part II.

c. Habitable Space Provisioning - Every habitable space shall be provisioned a minimum of one outlet per person planned for the space or one outlet per 60 ft², whichever is greater. If the number of people planned for a space is not known, the 60 ft² guideline must be used.

d. Non-habitable Space Provisioning - Every non-habitable space shall be provisioned with one outlet every 500 ft², minimum of 1 per enclosed
space. Exceptions may be granted for unusual circumstances by Network Development and Engineering, in writing.

e. Labeling - The labeling system shall clearly identify all components of the system: racks, cables, panels and outlets. The labeling system shall designate the cable’s origin and destination. Station identifiers shall increment starting from the jack at the right when facing into the room at the main entrance and incrementing counterclockwise; and shall increment from left to right then top to bottom on each individual faceplate. All labeling information shall be recorded on the as-built drawings and all test documents shall reflect the appropriate labeling scheme. All label printing will be machine generated using indelible ink. Self-laminating labels will be used on cable jackets, appropriately sized to the OD of the cable, and placed within view at the termination point on each end. Faceplate labels will be the manufacturer’s labels provided with the outlet assembly unless otherwise specified. As-builts & test results to be provided in .PDF and CAD format. The labeling schema shall be as follows:

1) Data Room Patch Panel - All patch panels shall be labeled in the format “### - X”, where ### is the station room number, and X is the station identifier discussed above. All wireless drops must be labeled in the format “W###-X”.

2) Station Jack - All station jacks shall have the data drops on the patch panel and the station numbers labeled on the faceplate. The top label of the jack must be in the format of “#### X-Y”. #### being the station room number. “X” being the first data drop present at that faceplate location, and “Y” being the last data drop present at that faceplate location. In addition, each jack shall have an individual label placed adjacent to the jack on the perimeter of the faceplate. This label will be a single number from the X-Y range and shall be ordered from left to right and top to bottom. This number range shall start at one and increment up to the last jack in the room. The first increment for each room is one. The bottom label must also include the room number of the IDF that jack pulls to. See “Standard Outlet Configuration” in section 4.

5. Wireless – 802.11 - All wireless locations shall be mounted parallel to the ceiling, above the drop-ceiling grid panels. Two blue data cables shall run from a patch panel to data jacks in the box. These locations shall have a minimum clearance of 14” x 14” x 8”. No cable run from patch panel to connection point may exceed 300 feet.

6. Wireless Access Points Placement and Wireless Overlay for 802.11 - Locations will be specified by consultation with UNLV Network Development and Engineering. The use of 3rd party professional RF Engineering design may be required under the special conditions. These conditions include but are not limited to the following:

a. Any wireless bridge installation which requires rooftop cabling and mounting of wireless bridging hardware, antennae and masts.

b. Installations which require access points to use antennae other than the standard dipole antennae.

c. The finished ceiling plan is exposed and the customer has specified that wireless hardware and antennae placement must be as limited as possible in order to meet aesthetic requirements of the building. Consultation with UNLV Network Development and Engineering is required for all 802.11 Wireless infrastructure design.

7. Cable Trays – All cable trays must be UL rated and approved by UNLV Network Development and Engineering prior to their inclusion in specifications.

a. Supports - Cable trays for horizontal distribution cables, utilizing a center support hanger method to support the cable trays, will utilize threaded rods of not less than 1/2” in diameter.
b. Capacity - Cable trays shall be sized for a minimum growth of 50%.

8. Installation - Installation is to meet or exceed ANSI/EIA/TIA 568-B and ANSI/EIA/TIA 569. Completed installation is to be Certified Category 6 using the TIA TSB-95 testing standard or better. Test documents/results to be supplied to UNLV in .PDF and Linkware format. Completed installation is to be approved by UNLV Network Development and Engineering.

9. Pull and Splice Boxes:
   a. Location - Pull boxes must be installed in easily accessible locations. It is not permissible to locate a pull box in the ceiling for conduits larger than 2” in diameter. Conduits larger than 2” diameter, entering a box shall be routed down a wall or column and the box shall be installed accordingly.

   All pull boxes shall be placed in a straight section of conduit. Align the corresponding conduits at each end. All boxes shall be properly and adequately secured. They are not to be supported by the conduits entering the box. Install boxes for station cabling immediately above the suspended ceiling.
   b. Access – Provide boxes with a suitable cover.

H. Grounding
   1. Regulations - All conduit and cable tray systems, supports, cabinets, equipment, etc., shall be properly grounded in accordance with the latest edition of the National Electrical Code (NEC) and all other applicable codes and regulations.
   2. Installation Requirements - Provide all bonding wire and jumpers, grounding bushings, clamps, etc., required for complete grounding. Route ground conductors to provide the shortest, most direct path to the ground electrode system.
   3. Grounded Connectors - Provide a separate grounding conductor, securely grounded on each side of all conduit and cable trays that do not provide a continuous, metallic path. Size shall be in accordance with the National Electrical Code (NEC). All ground connections will have clean contact surfaces, tinned and sweated while bolting. Avoid splices in bonding or grounding conductors. If splices are required they must be cad welded. Any grounding or bonding conductor that is run through a metallic conduit should be bonded to the conduit on both ends. Do not use a gas pipe as the grounding electrode.
   4. IDF/MDF Room Grounding - All IDF and MDF rooms require an earth ground. Additionally, if the IDF/MDF room houses telecommunications switching or fiber remote equipment, single point of ground technology is required. This requires a separate ground bus in the service panel to the building transformer; otherwise power receptacles in the room must be isolated and grounded together with a number 6 AWG or larger copper wire.

PART 2 PRODUCTS AND ACCEPTED MATERIALS

2.1 BACKBOARDS
   A. All backboards required in the IDF/MDF rooms shall be plywood, ¾”, 4’ by 8’ sheets, grade A, treated on one side with fire resistant paint or material, installed with finished side exposed.

2.2 CABLE SPECIFICATIONS
   A. Data Copper - All copper data cable must be Category 6, 4 pair, UTP (Unshielded Twisted Pair). Accepted materials are Belden 2412 for non-plenum spaces, and Belden 2413 for plenum spaces. Equivalent cable must be verified by UNLV Network Development and Engineering. All terminations are to follow ANSI/ EIA/TIA 568-B.
   B. Exterior Cable - All telephone cable that supports devices external of a building such as emergency phones use Superior Essex cable part number 09-092-02.6 pair buried drop.
C. Multimode Fiber Optic - All multimode fiber optic cable must 50.0/125 micron inside 19-tube air-blown conduit, Sumitomo part number FB24M5 (24 Strand). All multimode terminations are to be LC, UPC finish.

D. Singlemode Fiber Optic - All singlemode fiber optic cable must be 9.0/125 micron inside 19-tube air-blown conduit, Sumitomo part number FB24SX (24 strand). All singlemode terminations are to be SC, UPC finish.

2.3 DATA TERMINATIONS

A. Data Copper Patch Panels - All data patch panels are to be 110 block, Category 6, in either 1U, 24 port or 2U, 48 port configuration, and must meet or exceed EIA/TIA and ISO/IEC Category 6/Class E requirements. AMP parts 1375014-1 (24 count) or 1375015-1 (48 count) or equivalent. Every group of 48 must be separated by 1U of horizontal cable management, Panduit part# NCMHF1. All terminations are to follow ANSI/EIA/TIA 568-B.

B. Voice Copper Termination Blocks - All voice wire terminations are to be terminated on patch panel(s) in data rack(s). One pair per RJ-45 block, terminated on blue/white-blue.

C. Copper Data Jacks - All modular data jacks shall be unshielded, 4-pair, 8P8C, 110 block, Category 6, black, unless otherwise specified, and must meet or exceed EIA/TIA and ISO/IEC Category 6/Class E requirements. AMP parts 1375055-2 or equivalent. All terminations are to follow ANSI/EIA/TIA 568-B.

All faceplates shall be 4 port, light almond, single gang, low profile, AMP part 558088-1 or equivalent.

D. Fiber Optic - Multi-mode fiber is to be terminated with LC style connectors, UPC Polish and single-mode fiber is to be terminated with SC style connectors, UPC Polish. Multimode and Singlemode terminated in separate rack mounted light guides.

2.4 DATA EQUIPMENT RACKS

A. All racks are to be four post, open frame, square hole, black, Panduit part number CMR4P84CN. Substitutions must be authorized in writing by UNLV Network Development and Engineering.

2.5 CABLE TRAYS

A. All cable trays are to be a minimum of 18” wide by 4” deep, solid trough or ladder. Thomas & Betts #HG(PG for pre-galvanized)1-4)-18-S(L09 for ladder with 9” rung spacing)144 or equivalent, with associated fittings, hardware, and supports.

2.6 EXCEPTIONS

A. Exceptions may be authorized for existing buildings only with approval of UNLV Network Development and Engineering and shall be granted in writing.

B. Examination

1. The minimum concrete pour depth shall 3-1/2 inches (89mm).
2. With Installer present, verify that manufacturer’s requirements for floor opening and infrastructure conditions have been satisfactorily met. Proceed with installation only after unsatisfactory conditions have been corrected.

C. Preparation

1. Arrange for jobsite approval of the equipment prior to commencing installation.
2. Verify exact locations of floorbox installation.
D. Installation
1. Install equipment in compliance with approved shop drawings and manufacturer’s installation instructions.
2. Install in position and relationship to adjoining work indicated, securely anchored to supporting structure, sealed and finished, and in a manner, which produces a level box with square, plumb, and straight edges.
3. Telecommunications Cabling Floor box shall have a total of three separate EC with pull string at each box as follows:
   a. One 3/4-inch EC from box to circuit panel. (Duplex AC Power)
   b. Two 1-1/4 inch EC from box to telecomm cable tray A.F.C (CAT. 6 data cables).
4. Coordinate installation with floor covering to finish each floor box. Install floor covering with oversized cable management pop-up pass-thru in top, matching surrounding floor covering in cover insert.

E. Adjusting
1. Adjust door and cover for proper operation.

F. Protection
1. Protect installed equipment in original undamaged condition until Substantial Completion. Remove and provide new components or units that cannot be repaired to the satisfaction of the Architect.

PART 3 EXECUTION

The UNLV has drawings detailing existing cable runs, terminal cabinets/closets, risers, etc. Copies may be obtained from UNLV Network Development and Engineering to facilitate the requirements of Part III - Execution.

Unless otherwise expressly provided in the Contract, any provisions of the standard specifications, which require the UNLV to inspect certain material or work, shall mean that the UNLV has the option, rather than the obligation, to do so. Any warranty or guarantee provisions contained in the Contractors'/Vendors' standard specifications shall be of no effect and the warranty and guarantee provisions, if any, of the Contract shall apply.

3.1 DEMOLITION

A. Coordination with UNLV Operations - No telecommunication or data jacks, cabling terminals, or other hardware will be moved, disconnected, or removed without prior approval of UNLV Network Development and Engineering. Coordination of demolition activities with the departments will be strictly enforced to minimize service disruptions.

B. Work to be Performed by Owner - Upon notification by contractor, UNLV Network Development and Engineering will dispatch a technician to the requested work location. The technician will determine if the facilities to be moved or removed are in service (hot) or out of service (dead). If station cabling is dead the technician will insure that all cross-connects have been removed. If the facilities to be moved or removed are determined to be in service, the technician will take the necessary actions to render the facilities dead. Under NO circumstances will removal of telecommunications or data facilities begin until UNLV Network Development and Engineering has ensured that services are dead.

C. Disposal of Surface-Mount Raceway - Surface mount raceway that has been vacated, or otherwise determined not required, will be removed after all cabling has been properly removed.
3.2 EXCAVATION

A. The Contractor shall be required to excavate for underground mechanical piping, and shall perform all auxiliary work that may be required to do so.

B. No trenching will commence until UNLV Planning and Construction and UNLV Network Development and Engineering grants approval. The UNLV has drawings of existing underground utilities to assist the Contractor to locate all underground utilities. All Contractors are to Call Before U Dig. All lines damaged by Contractor will be repaired at Contractor’s expense.

C. Asphalt and concrete pavement shall be sawed or cut to a depth necessary to bring about a straight-line break parallel to the sides of the trench, so as not to disturb the adjoining pavement.

D. All underground construction work, during progress and after completion, shall conform truly to lines and grades. Arrange stub-ups so curved portions of slab bends are not visible above finished slab.

E. If the trench is excavated to a greater depth than that given, the Contractor shall, at his own expense, bring such excavation to required grade with such material as directed, notwithstanding that it may be necessary to bring such material from other localities or to purchase suitable materials.

F. The material excavated shall be deposited along the side of the trench in such a manner as to create the least inconvenience possible.

G. Contractor shall not obstruct the gutter of any street or driveways, but shall use all proper means to provide the free passage of surface water along the gutters into storm water inlets. Contractor shall provide channels where required.

H. Special care shall be taken to keep all fire hydrants and gate valves on water mains accessible at all times. Fire lanes are to be kept open.

I. Wherever required, sides of the trench shall be sheeted and braced in strict accordance to the rules, orders and regulations of the State, County, and the City. Trenches shall be barricaded.

J. Grass will be replaced by a method approved by the UNLV.

K. Bricks, blocks and other debris removed from trenches will not be used as fill for trenches.

3.3 INSTALLATION

A. Regulations - All work and materials will comply with all federal and State laws, municipal ordinances, codes, regulations and direction of inspectors appointed by proper authorities having jurisdiction.

If there are violations of codes, the vendor will correct the deficiency at no cost to the UNLV.

Working conditions must meet the industry standards for safety and work procedures, and protection of property established by prevailing rules, regulations, codes, and ordinances.

B. Quality Assurance - Workmanship and neat appearance shall be as important as the mechanical and electrical efficiency of the system. All testing and clean-up shall be
completed to the satisfaction of UNLV Network Development and Engineering before sign-off. This includes, but is not limited to, cable testing, proper labeling, debris removal, and proper cable bundling and routing.

C. Damage of Existing Facilities - The Contractors shall be responsible for replacing, restoring, or bringing to at least original condition any damage to floors, ceilings, walls, furniture, grounds, pavement, etc., caused by its personnel and operations. Any damage or disfiguration will be restored at the Contractor's expense.

D. Coordination - Contractor is responsible for insuring minimal disruption of existing television, telemetry, telephone and data communications facilities and networks.

Outages shall be scheduled only with permission from UNLV Network Development and Engineering at its convenience.

All work areas shall be cleared of all litter, and properly disposed of by Contractor on a daily basis.

At its own expense, Contractor shall erect temporary fencing where required or deemed necessary by UNLV personnel, or where deemed necessary by the Contractor for securing materials.

Contractors shall provide all necessary temporary equipment and material, shall maintain them in a safe and adequate manner, and shall remove them immediately upon completion of work requiring their presence.

E. Cable Support and Anchors - All cables, wires and equipment will be firmly anchored. Fasteners and supports shall be adequate to support loads with ample safety factors.

F. Firestop Systems - A firestop system is comprised of an item or items penetrating a fire rated structure, the opening in the structure, the sealing materials, and assembly of the materials used to seal the penetrated structure. Firestop systems comprise an effective block for fire, heat, vapor and pressurized water stream. All penetrations through fire rated building structures (walls and floors) shall be sealed with an appropriate firestop system. This requirement applies to through penetrations (complete penetration) and membrane penetrations (through one side of a hollow fire rated structure). Any penetrating items i.e., riser slots and sleeves, cables, conduit, cable tray, and raceways, etc. shall be properly fire stopped using state approved fire resistant materials installed in accordance with the manufacturer's tested methods. All penetrations through fire rated surfaces shall comply with the following:

2. ASTM E 119: Methods of Fire Tests of Building Construction Materials
3. ASTM E 814: Standard Method of Fire Tests of Through-Penetration Firestops
4. ASTM C 719: Adhesion and Cohesion of Elastomeric Joint Sealants under Cyclic Movement
6. UL 263: Fire Tests of Building Construction Materials
7. UL 723: Surface Burning Characteristics of Building Materials
8. UL 1479: Fire Tests of Through Penetration Firestops

G. Conduit - Conduit shall be Electrical Metallic Tubing produced in accordance with ANSI C80.3 standard and run in the most direct route practical.

Conduit runs containing more than two 90-degree bends, or a reverse (180 degree) bend require a pull box.

All offsets shall be considered equivalent to a 90-degree bend.
Conduit bend radii will be a standard ten times the outside diameter of conduit unless otherwise approved by UNLV Network Development and Engineering.

Conduits entering the IDF through the wall shall be reamed or bushed, and terminated not more than 4 inches from the wall surface.

Conduits entering the IDF from below shall be terminated 4 inches above finished floor.

Conduit runs for distribution cables (both horizontal and vertical), except station outlets, shall be not less than 4" in diameter. They will be equipped with a plastic or nylon number 12 or larger pull line that is rated at 800-lb. test minimum.

Conduit installed for data and/or voice cabling may not be shared with any other cable.

All conduit runs for station outlets shall be not less than 3/4" in diameter.

All conduit runs for station outlets with more than 3 cables shall be not less than 1" in diameter. They will be equipped with a plastic or nylon number 12 or larger pull line that is rated at 800-lb. test minimum.

After installation, all conduits shall be clean, dry, unobstructed, capped for protection and labeled with their destination (by room number) for identification.

Allowable fill capacity is 40% or as defined by the National Electric Code, whichever is lower.

Conduit runs for horizontal distribution cables, utilizing the trapeze hanger method to support the conduits, shall utilize threaded rods of not less than 3/8" in diameter.

Conduit shall not block access to existing services.

**H. Cable Installation**

- All cable shall be installed free of kinks. A kink is defined as a violation of the manufacturer's specified Minimum Bend Radius for each type of cable. Cable shall not be formed into a condition that causes the outside sheath to wrinkle.

- Any cable to be placed through an electrical room or any other potentially hazardous conditional shall be placed in conduit.

- All cable will be secured to the backboard in such a manner as to allow cross connections to be made without crossing over any cables.

- All outlets will have a minimum of eight (8) inches of cable stored at each drop after the cable has been terminated.

- Where considerations of practicality eliminate the installation of conduit, plenum cable will be used. Cables are not permitted to lie atop a lay-in ceiling or simply drape over pipe and ductwork; appropriate wire hangers/supports or dressing will be used.

- Cables are to be anchored to the wall extensions, existing conduits, pipe, or duct work in a neat manner.

- Cable pulled in a cable tray with existing cable should not be pulled where stress would be applied to the existing cable.

- All cable is to be terminated at both ends, tested, labeled and ready to provide service to and within the building.
Installation to meet or exceed ANSI/EIA/TIA 568B and ANSI/EIA/TIA 569. UNLV Network Development and Engineering must approve completed installation.

I. Cable Testing - All cables and termination hardware shall be 100% tested for defects in installation and to verify cable performance under installed conditions. The contractor, prior to system acceptance, shall verify all conductors of each installed cable. Any defect in the cabling system installation including but not limited to cable, connectors, feed-through couplers, patch panels, and connector blocks shall be repaired or replaced in order to ensure 100% usable conductors in all cables installed.

1. Data Copper - All Data cables shall be tested in accordance with ANSI/TIA/EIA Category 6 Standard Performance Specifications for 4-Pair 250 Ohm Category 6 Cabling using TIA TSB-95 or better, and best industry practices. If any of these are in conflict, the Contractor shall be responsible to bring any discrepancies to the attention of UNLV Network Development and Engineering.

   a. Testing - Each cable shall be tested for continuity on all pairs and/or conductors. Twisted-pair voice cables shall be tested for continuity, pair reversals, and shorts. Twisted-pair data cables shall be tested for all of the above requirements, plus tests that indicate installed cable performance. The data cables shall be bi-directional tested using a Class II-E or better cable analyzer.

      1) Continuity - Each pair of each installed cable shall be tested for opens, shorts, polarity and pair-reversals. The test shall be recorded as pass/fail as indicated by the test set in accordance with the manufacturers recommended procedures, and referenced to the appropriate cable identification number and circuit or pair number. Any faults in the wiring shall be corrected and the cable re-tested prior to final acceptance.

      2) Length - Each installed cable shall be tested for installed length using a TDR type device. The cables shall be tested from patch panel to patch panel, block to block, patch panel to outlet or block to outlet as appropriate. The cable length shall conform to the maximum distances set forth in the TIA/EIA-568-B Standard. Cable lengths shall be recorded, referencing the cable identification number and circuit or pair number. For multipair cables, the longest pair length shall be recorded as the length for the cable.

      3) Performance Verification - Enhanced Category 6 data cable shall be performance verified using an automated test set. This test set shall be capable of testing for the continuity and length parameters defined above, and provide results for the following tests: near end crosstalk (NEXT), attenuation, ambient noise, and attenuation to crosstalk ratio (ACR).

      4) Equipment - Test results shall be automatically evaluated by the equipment, using the most up-to-date criteria from the TIA/EIA Standard, and the result shown as pass/fail. Test results shall be printed directly from the test unit or from a download file using an application from the test equipment manufacturer. The printed test results shall include all tests performed, the expected test result and the actual test result achieved. All test results to be provided to UNLV Network Development and Engineering in .PDF and Linkware format prior to acceptance of completed project. All test results must be labeled with the specific data cable that was tested by its identifier on the patch panel.

2. Fiber Optic - Test results shall be automatically evaluated by the equipment, using the most up-to-date criteria from the TIA/EIA Standard, and the result shown as pass/fail. The test results shall include all tests performed, the expected test result and the actual test result achieved. All test results to be provided to the UNLV Network Development and Engineering in .PDF format
prior to acceptance of completed project. All test results must be labeled with the specific data cable that was tested by its identifier on the patch panel.

Test evaluation for the panel to panel (backbone) shall be based on the values set forth in the EIA/TIA-568-B Annex H, Optical Fiber Link Performance Testing.

Attenuation testing shall be performed with a stable launch condition using two-meter jumpers to attach the test equipment to the cable plant. The light source shall be left in place after calibration and the power meter moved to the far end to take measurements.

The expected results for each cable (or group of cables of the same nominal length) shall be calculated before the start of testing and recorded in a space provided on the Contractor’s test matrix. Each strand of fiber in the respective cable shall be evaluated against this target number. Any fibers that exceed this number by more than -0.5dB shall be repaired or replaced at the installers' cost.

Where concatenated links are installed to complete a circuit between devices, the Contractor shall test each link from end to end to ensure the performance of the system. After the link performance test has been successfully completed, each link shall be concatenated and tested. The test method shall be the same used for the test described above. The evaluation criteria shall be established between UNLV Network Development and Engineering and the Contractor prior to the start of the test.

a. Multimode - All multimode optical fiber attenuation shall be measured at 850 nanometers (nm) and 1300 nm using an LED light source and power meter. Test set-up and performance shall be conducted in accordance with ANSI/EIA/TIA-526-14 Standard, Method B. One 2-meter patch cord shall be used for the test reference and two 2-meter patch cords shall be used for the actual test. This test method uses a one-jumper reference, two-jumper test to estimate the actual link loss of the installed cables plus the loss of two connectors. This measurement is consistent with the loss that network equipment will see under normal installation and use. Test evaluation for the panel to panel (backbone) or panel to outlet (horizontal) shall be based on the values set forth in the EIA/TIA-568-A Annex H, Optical Fiber Link. Multimode fiber optic cable must meet or exceed the following limits:
   1) Attenuation - 3.5dB/km at 850nm, 1.5dB/km at 1300nm.
   2) Bandwidth - 1500MHz*km at 850nm, 500MHz*km at 1300nm.
   3) Connectors - Max loss for a mated pair of connectors shall be less than 0.5dB.

b. Singlemode - Single mode optical fiber attenuation shall be measured at 1310 nm and 1550 nm using a laser light source and power meter. Tests shall be performed at both wavelengths in one direction on each strand of fiber. The set-up and test shall be performed in accordance with EIA/TIA-526-7 Standard, Method 1A. Two-meter patch cords shall be used as test references and for the actual test. This test method utilizes a one-jumper reference, two-jumper test to estimate the actual link loss of the install cable plus two patch cords. Singlemode fiber optic cable must meet or exceed the following limits:
   1) Attenuation - 0.4dB/km at 1310nm, 0.3dB/km at 1550nm.
   2) Connectors - Max loss for a mated pair of connectors shall be less than 0.5dB.

3. OTDR - Each cable shall be tested with an Optical Time Domain Reflectometer (OTDR) to verify installed cable length and splice losses. The OTDR measurements for length shall be performed in accordance with EIA/TIA- 455-60. The measurements to determine splice loss shall be performed in accordance with manufacturer's recommendations and best industry practices.
4. As-Builts - All labeling information shall be recorded on the as-built drawings and all test documents shall reflect the appropriate labeling scheme. The As-built drawings shall clearly identify the patch panel label and its corresponding station side location. As-builts will be created from latest digital architectural drawings, to most closely resemble exact building conditions, as possible. Hand drawings are not acceptable. As-builts & test results must be provided in both .PDF and CAD format. Upon acceptance of contract, vendor will be required to provide an acceptable time-line for provision of As-Built drawings. Acceptable time-line shall be verified by UNLV Network Development and Engineering. Ample time must be allocated for verification of As-builts & test results and subsequent corrected versions of those documents. Network equipment (Including Voice, Data and A/V services) will not be provisioned until this documentation is provided.

END OF SECTION
SECTION 27 05 26

GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:
   1. Grounding conductors.
   2. Grounding connectors.
   3. Grounding busbars.
   4. Grounding rods.
   5. Grounding labeling.

1.03 DEFINITIONS

A. BCT: Bonding conductor for telecommunications.
B. EMT: Electrical metallic tubing.
C. TGB: Telecommunications grounding busbar.
D. TMGB: Telecommunications main grounding busbar.

1.04 ACTION SUBMITTALS

A. Product Data: For each type of product.
B. Shop Drawings: For communications equipment room signal reference grid. Include plans, elevations, sections, details, and attachments to other work.

1.05 INFORMATIONAL SUBMITTALS

A. As-Built Data: Plans showing as-built locations of grounding and bonding infrastructure, including the following:
   1. Ground rods.
   2. Ground and roof rings.
   3. BCT, TMGB, TGBs, and routing of their bonding conductors.
B. Qualification Data: For Installer, installation supervisor, and field inspector.
C. Qualification Data: For testing agency and testing agency's field supervisor.
D. Field quality-control reports.

1.06 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For grounding to include in emergency, operation, and maintenance manuals.
   1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
a. Result of the ground-resistance test, measured at the point of BCT connection.
b. Result of the bonding-resistance test at each TGB and its nearest grounding electrode.

1.07 QUALITY ASSURANCE

A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.
1. Installation Supervision: Installation shall be under the direct supervision of ITS Installer 2, who shall be present at all times when Work of this Section is performed at Project site.
2. Field Inspector: Currently registered by BICSI as a registered communications distribution designer to perform the on-site inspection.

PART 2 PRODUCTS

2.01 SYSTEM COMPONENTS

A. Comply with J-STD-607-A.

2.02 CONDUCTORS

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. Harger Lightning and Grounding.
2. Panduit Corp.
3. Tyco Electronics Corp.

B. Comply with UL 486A-486B.

C. Insulated Conductors: Stranded copper wire, green or green with yellow stripe insulation, insulated for 600 V, and complying with UL 83.
1. Ground wire for custom-length equipment ground jumpers shall be No. 6 AWG, 19-strand, UL-listed, Type THHN wire.
2. Cable Tray Equipment Grounding Wire: No. 6 AWG.

D. Cable Tray Grounding Jumper:
1. Not smaller than No. 6 AWG 26 kcmils and not longer than 12 inches. If jumper is a wire, it shall have a crimped grounding lug with two holes and long barrel for two crimps. If jumper is a flexible braid, it shall have a one-hole ferrule. Attach with grounding screw or connector provided by cable tray manufacturer.
2. Not smaller than No. 10 AWG 26 kcmils and not longer than 12 inches. If jumper is a wire, it shall have a crimped grounding lug with one hole and standard barrel for one crimp. If jumper is a flexible braid, it shall have a one- or two-hole ferrule. Attach with grounding screw or connector provided by cable tray manufacturer.

E. Bare Copper Conductors:
4. Bonding Cable: 28 kcmils, 14 strands of No. 17 AWG conductor, and 1/4 inch in diameter.
5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
6. Bonding Jumper: Tinned-copper tape, braided conductors terminated with two-hole copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
2.03 CONNECTORS

A. Irreversible connectors listed for the purpose. Listed by an NRTL as complying with NFPA 70 for specific types, sizes, and combinations of conductors and other items connected. Comply with UL 486A-486B.

B. 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:

C. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
   1. Burndy; Part of Hubbell Electrical Systems.
   2. Chatsworth Products, Inc.
   3. Harger Lightning and Grounding.
   4. Panduit Corp.
   5. Tyco Electronics Corp.

D. Compression Wire Connectors: Crimp-and-compress connectors that bond to the conductor when the connector is compressed around the conductor. Comply with UL 467.
   1. Electroplated tinned copper, C and H shaped.

E. Signal Reference Grid Connectors: Combination of compression wire connectors, access floor grounding clamps, bronze U-bolt grounding clamps, and copper split-bolt connectors, designed for the purpose.

F. Busbar Connectors: Cast silicon bronze, solderless compression or exothermic-type, mechanical connector; with a long barrel and two holes spaced on 5/8- or 1-inch centers for a two-bolt connection to the busbar.

G. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

2.04 GROUNDING BUSBARS

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:

B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
   1. Chatsworth Products, Inc.
   2. Harger Lightning and Grounding.
   3. Panduit Corp.

C. TMGB: Predrilled, wall-mounted, rectangular bars of hard-drawn solid copper, [1/4 by 4 inches in cross section, length as indicated on Drawings. The busbar shall be NRTL listed for use as TMGB and shall comply with J-STD-607-A.
   1. Predrilling shall be with holes for use with lugs specified in this Section.
   2. Mounting Hardware: Stand-off brackets that provide a 4-inch
   3. Stand-off insulators for mounting shall be Lexan or PVC. Comply with UL 891 for use in 600-V switchboards, impulse tested at 5000 V.

D. TGB: Predrilled rectangular bars of hard-drawn solid copper, 1/4 by 2 inches in cross section, length as indicated on Drawings. The busbar shall be for wall mounting, shall be NRTL listed as complying with UL 467, and shall comply with J-STD-607-A.
   1. Predrilling shall be with holes for use with lugs specified in this Section.
   2. Mounting Hardware: Stand-off brackets that provide at least a 2-inch.
3. Stand-off insulators for mounting shall be Lexan or PVC. Comply with UL 891 for use in 600-V switchboards, impulse tested at 5000 V.

E. Rack and Cabinet Grounding Busbars: Rectangular bars of hard-drawn solid copper, accepting conductors ranging from No. 14 to No. 2/0 AWG, NRTL listed as complying with UL 467, and complying with J-STD-607-A. Predrilling shall be with holes for use with lugs specified in this Section.
   1. Cabinet-Mounted Busbar: Terminal block, with stainless-steel or copper-plated hardware for attachment to the cabinet.
   2. Rack-Mounted Horizontal Busbar: Designed for mounting in 19- or 23-inch equipment racks. Include a copper splice bar for transitioning to an adjoining rack, and stainless-steel or copper-plated hardware for attachment to the rack.
   3. Rack-Mounted Vertical Busbar: 72 or 36 inches stainless-steel or copper-plated hardware for attachment to the rack.

2.05 GROUND RODS

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. Harger Lightning and Grounding.
   2. Tyco Electronics Corp.

B. Ground Rods: Copper-clad steel; 3/4 inch by 10 feet in diameter.

2.06 LABELING

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:
   2. HellermannTyton.
   3. Panduit Corp.

B. Comply with TIA/EIA-606-A and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

C. Adhesive Film Label with Clear Protective Overlay: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch. Overlay shall provide a weatherproof and UV-resistant seal for label.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine the ac grounding electrode system and equipment grounding for compliance with requirements for maximum ground-resistance level and other conditions affecting performance of grounding and bonding of the electrical system.

B. Inspect the test results of the ac grounding system measured at the point of BCT connection.

C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

D. Proceed with connection of the BCT only after unsatisfactory conditions have been corrected.
3.02 INSTALLATION

A. Bonding shall include the ac utility power service entrance, the communications cable entrance, and the grounding electrode system. The bonding of these elements shall form a loop so that each element is connected to at least two others.

B. Comply with NECA 1.

C. Comply with J-STD-607-A.

3.03 APPLICATION

A. Conductors: Install solid conductor for No. 8 AWG and smaller and stranded conductors for No. 6 AWG and larger unless otherwise indicated.
   1. The bonding conductors between the TGB and structural steel of steel-frame buildings shall not be smaller than No. 6 AWG.
   2. The bonding conductors between the TMGB and structural steel of steel-frame buildings shall not be smaller than No. 6 AWG.

B. Underground Grounding Conductors: Install bare copper conductor, No. 2 AWG minimum.

C. Conductor Terminations and Connections:
   1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
   2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
   3. Connections to Ground Rods at Test Wells: Bolted connectors.

D. Conductor Support:
   1. Secure grounding and bonding conductors at intervals of not less than 36 inches.

E. Grounding and Bonding Conductors:
   1. Install in the straightest and shortest route between the origination and termination point, and no longer than required. The bend radius shall not be smaller than eight times the diameter of the conductor. No one bend may exceed 90 degrees.
   2. Install without splices.
   3. Support at not more than 36-inch intervals.
   4. Install grounding and bonding conductors in 3/4-inch PVC conduit until conduit enters a telecommunications room. The grounding and bonding conductor pathway through a plenum shall be in EMT. Conductors shall not be installed in EMT unless otherwise indicated.
      a. If a grounding and bonding conductor is installed in ferrous metallic conduit, bond the conductor to the conduit using a grounding bushing that complies with requirements in Section 270528 "Pathways for Communications Systems," and bond both ends of the conduit to a TGB.

3.04 GROUNDING ELECTRODE SYSTEM

A. The BCT between the TMBG and the ac service equipment ground shall not be smaller than No. 3/0 AWG.

3.05 GROUNDING BUSBARS

A. Indicate locations of grounding busbars on Drawings. Install busbars horizontally, on insulated spacers 2 inches minimum from wall, 12 inches above finished floor unless otherwise indicated.
B. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, and down; connect to horizontal bus.

3.06 CONNECTIONS

A. Bond metallic equipment in a telecommunications equipment room to the grounding busbar in that room, using equipment grounding conductors not smaller than No. 6 AWG.

B. Stacking of conductors under a single bolt is not permitted when connecting to busbars.

C. Assemble the wire connector to the conductor, complying with manufacturer’s written instructions and as follows:
   1. Use crimping tool and the die specific to the connector.
   2. Pretwist the conductor.
   3. Apply an antioxidant compound to all bolted and compression connections.

D. Primary Protector: Bond to the TMGB with insulated bonding conductor.

E. Interconnections: Interconnect all TGBs with the TMGB with the telecommunications backbone conductor. If more than one TMGB is installed, interconnect TMGBs using the grounding equalizer conductor. The telecommunications backbone conductor and grounding equalizer conductor size shall not be less than 2 kcmils/linear foot of conductor length, up to a maximum size of No. 3/0 AWG 168 kcmils unless otherwise indicated.

F. Telecommunications Enclosures and Equipment Racks: Bond metallic components of enclosures to the telecommunications bonding and grounding system. Install vertically mounted rack grounding busbar unless the enclosure and rack are manufactured with the busbar. Bond the equipment grounding busbar to the TGB No. 2 AWG bonding conductors.

G. Structural Steel: Where the structural steel of a steel frame building is readily accessible within the room or space, bond each TGB and TMGB to the vertical steel of the building frame.

H. Electrical Power Panelboards: Where an electrical panelboard for telecommunications equipment is located in the same room or space, bond each TGB to the ground bar of the panelboard.

I. Shielded Cable: Bond the shield of shielded cable to the TGB in communications rooms and spaces. Comply with TIA/EIA-568-B.1 and TIA/EIA-568-B.2 when grounding screened, balanced, twisted-pair cables.

J. Rack- and Cabinet-Mounted Equipment: Bond powered equipment chassis to the cabinet or rack grounding bar. Power connection shall comply with NFPA 70; the equipment grounding conductor in the power cord of cord- and plug-connected equipment shall be considered as a supplement to bonding requirements in this Section.

K. Access Floors: Bond all metal parts of access floors to the TGB.

L. Equipment Room Signal Reference Grid: Provide a low-impedance path between telecommunications cabinets, equipment racks, and the reference grid, using No. 6AWG bonding conductors.
   1. Install the conductors in grid pattern on 4-foot centers, allowing bonding of one pedestal from each access floor tile.
   2. Bond the TGB of the equipment room to the reference grid at two or more locations.
   3. Bond all conduits and piping entering the equipment room to the TGB at the perimeter of the room.

M. Towers and Antennas:
1. **Ground Ring:** Buried at least 30 inches below grade and at least 24 inches from the base of the tower or mounting.
2. **Bond each tower base and metallic frame of a dish to the ground ring, buried at least 18 inches below grade.**
3. **Bond the ground ring and antenna grounds to the equipment room TMGB or TGB, buried at least 30 inches below grade.**
4. **Bond metallic fences within 6 feet of towers and antennas to the ground ring, buried at least 18 inches below grade.**
5. **Special Requirements for Roof-Mounted Towers:**
   a. **Roof Ring:** Meet requirements for the ground ring except the conductors shall comply with requirements in Section 264113 “Lightning Protection for Structures.”
   b. **Bond tower base footings steel, the TGB in the equipment room, and antenna support guys to the roof ring.**
   c. **Connect roof ring to the perimeter conductors of the lightning protection system.**
6. **Waveguides and Coaxial Cable:**
   a. **Bond cable shields at the point of entry into the building to the TGB and to the cable entrance plate, using No. 2 AWG bonding conductors.**
   b. **Bond coaxial cable surge arrester to the ground or roof ring using bonding conductor size recommended by surge-arrester manufacturer.**

### 3.07 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS

**A. Duct-Bank Grounding Conductor:** Bury 12 inches above duct bank when indicated as part of duct-bank installation.

**B. Comply with IEEE C2 grounding requirements.**

**C. Grounding Manholes and Handholes:** Install a driven ground rod through manhole or handhole floor, close to wall, and set rod depth so 4 inches extends above finished floor. If necessary, install ground rod before manhole is placed and provide No. 1/0 AWG bare, tinned-copper conductor from ground rod into manhole through a waterproof sleeve in manhole wall. Protect ground rods passing through concrete floor with a double wrapping of pressure-sensitive insulating tape or heat-shrunk insulating sleeve from 2 inches above to 6 inches below concrete. Seal floor opening with waterproof, nonshrink grout.

**D. Grounding Connections to Manhole Components:** Bond exposed-metal parts such as inserts, cable racks, pulling irons, ladders, and cable shields within each manhole or handhole, to ground rod or grounding conductor. Make connections with No. 4 AWG minimum, bonding conductor. Train conductors level or plumb around corners and fasten to manhole walls. Connect grounding conductors to cable armor and cable shields according to written instructions by manufacturer of splicing and termination kits.

### 3.08 IDENTIFICATION

**A. Labels shall be preprinted or computer-printed type.**

1. **Label TMGB(s) with ”fs-TMGB,” where ”fs” is the telecommunications space identifier for the space containing the TMGB.**
2. **Label TGB(s) with ”fs-TGB,” where ”fs” is the telecommunications space identifier for the space containing the TGB.**
3. **Label the BCT and each telecommunications backbone conductor at its attachment point: ”WARNING! TELECOMMUNICATIONS BONDING CONDUCTOR. DO NOT REMOVE OR DISCONNECT!”**

### 3.09 FIELD QUALITY CONTROL

**A. Testing Agency:** Engage a qualified testing agency to perform tests and inspections.
B. Perform tests and inspections.

C. Tests and Inspections:
   1. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
   2. Test the bonding connections of the system using an ac earth ground-resistance tester, taking two-point bonding measurements in each telecommunications equipment room containing a TMGB and a TGB and using the process recommended by BICSI TDMM. Conduct tests with the facility in operation.
      a. Measure the resistance between the busbar and the nearest available grounding electrode. The maximum acceptable value of this bonding resistance is 100 milliohms.
   3. Test for ground loop currents using a digital clamp-on ammeter, with a full-scale of not more than 10 A, displaying current in increments of 0.01 A at an accuracy of plus/minus 2.0 percent.
      a. With the grounding infrastructure completed and the communications system electronics operating, measure the current in every conductor connected to the TMGB and in each TGB. Maximum acceptable ac current level is 1 A.

D. Excessive Ground Resistance: If resistance to ground at the BCT exceeds 5 ohms, notify Architect promptly and include recommendations to reduce ground resistance.

E. Grounding system will be considered defective if it does not pass tests and inspections.

F. Prepare test and inspection reports.

END OF SECTION
SECTION 27 05 28
PATHWAYS FOR COMMUNICATIONS SYSTEMS

PART 1  GENERAL

1.01  RELATED DOCUMENTS

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

1.02  SUMMARY

A. Section Includes:
   1. Metal conduits and fittings.
   2. Nonmetallic conduits and fittings.
   3. Optical-fiber-cable pathways and fittings.
   4. Metal wireways and auxiliary gutters.
   5. Nonmetallic wireways and auxiliary gutters.
   8. Handholes and boxes for exterior underground cabling.

B. Related Requirements:
   1. Section 260543 "Underground Ducts and Raceways for Electrical Systems" for exterior ductbanks, manholes, and underground utility construction.
   2. Section 260533 "Raceways and Boxes for Electrical Systems" for conduits, wireways, surface raceways, boxes, enclosures, cabinets, handholes, and faceplate adapters serving electrical systems.

1.03  DEFINITIONS

A. ARC: Aluminum rigid conduit.

B. GRC: Galvanized rigid steel conduit.

C. IMC: Intermediate metal conduit.

1.04  ACTION SUBMITTALS

A. Product Data: For surface pathways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

B. LEED Submittals:
   1. Product Data for Credit IEQ 4.1: For solvent cements and adhesive primers, documentation including printed statement of VOC content.
   2. Laboratory Test Reports for Credit IEQ 4: For solvent cements and adhesive primers, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. Shop Drawings: For custom enclosures and cabinets. Include plans, elevations, sections, and attachment details.
1.05 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Pathway routing plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of items involved:
   1. Structural members in paths of pathway groups with common supports.
   2. HVAC and plumbing items and architectural features in paths of conduit groups with common supports.

B. Qualification Data: For professional engineer.

C. Seismic Qualification Certificates: For pathway racks, enclosures, cabinets, equipment racks and their mounting provisions, including those for internal components, from manufacturer.
   1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
   2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
   3. Detailed description of equipment anchorage devices on which certification is based and their installation requirements.
   4. Detailed description of conduit support devices and interconnections on which certification is based and their installation requirements.

D. Source quality-control reports.

PART 2 PRODUCTS

2.01 METAL CONDUITS AND FITTINGS

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. AFC Cable Systems, Inc.
   3. Alpha Wire Company.
   4. Anamet Electrical, Inc.
   5. Electri-Flex Company.
   7. Picoma Industries; Subsidiary of Mueller Water Products, Inc.
   8. Republic Conduit.
   9. Robroy Industries.
   10. Southwire Company.
   12. Western Tube and Conduit Corporation.

B. General Requirements for Metal Conduits and Fittings:
   1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
   2. Comply with TIA-569-B.

C. GRC: Comply with ANSI C80.1 and UL 6.

D. ARC: Comply with ANSI C80.5 and UL 6A.

E. IMC: Comply with ANSI C80.6 and UL 1242.

F. PVC-Coated Steel Conduit: PVC-coated rigid steel conduit.
   1. Comply with NEMA RN 1.
2. Coating Thickness: 0.040 inch, minimum.

G. EMT: Comply with ANSI C80.3 and UL 797.

H. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.
   1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886 and NFPA 70.
   2. Fittings for EMT:
      a. Material: Steel or die cast.
      b. Type: Setscrew or compression.
   3. Expansion Fittings: PVC or steel to match conduit type, complying with UL-467, rated for environmental conditions where installed, and including flexible external bonding jumper.
   4. Coating for Fittings for PVC-Coated Conduit: Minimum thickness of 0.040 inch, with overlapping sleeves protecting threaded joints.

I. Joint Compound for IMC, GRC, or ARC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

2.02 NONMETALLIC CONDUITS AND FITTINGS

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. AFC Cable Systems, Inc.
   3. Anamet Electrical, Inc.
   5. CANTEX Inc.
   6. CertainTeed Corp.
   8. Electri-Flex Company.
   10. Lamson & Sessions; Carlon Electrical Products.
   11. Niedax-Kleinhuis USA, Inc.
   12. RACO; a Hubbell company.

B. General Requirements for Nonmetallic Conduits and Fittings:
   1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
   2. Comply with TIA-569-B.

C. RNC: Type EPC-40-PVC, complying with NEMA TC 2 and UL 651 unless otherwise indicated.

D. Rigid HDPE: Comply with UL 651A.

E. Continuous HDPE: Comply with UL 651B.

F. RTRC: Comply with UL 1684A and NEMA TC 14.

G. Fittings for RNC: Comply with NEMA TC 3; match to conduit or tubing type and material.

H. Solvent cements and adhesive primers shall have a VOC content of 510 and 550 g/L or less, respectively, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
Solvent cements and adhesive primers shall comply with the testing and product requirements of the California Department of Health Services’ “Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers.”

2.03 OPTICAL-FIBER-CABLE PATHWAYS AND FITTINGS

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. Alpha Wire Company.
   2. Arnco Corporation.
   3. Endot Industries Inc.
   4. IPEX.
   5. Lamson & Sessions; Carlon Electrical Products.

B. Description: Comply with UL 2024; flexible-type pathway, approved for plenum or general-use installation unless otherwise indicated.
   1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
   2. Comply with TIA-569-B.

2.04 METAL WIREWAYS AND AUXILIARY GUTTERS

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. Cooper B-Line, Inc.
   2. Hoffman; a Pentair company.
   4. Square D; a brand of Schneider Electric.

B. Description: Sheet metal, complying with UL 870 and NEMA 250, Type 3R unless otherwise indicated, and sized according to NFPA 70.
   1. Metal wireways installed outdoors shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
   2. Comply with TIA-569-B.

C. Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

D. Wireway Covers: Screw-cover type unless otherwise indicated.

E. Finish: Manufacturer's standard enamel finish.

2.05 NONMETALLIC WIREWAYS AND AUXILIARY GUTTERS

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. Allied Moulded Products, Inc.
   2. Hoffman; a Pentair company.
   3. Lamson & Sessions; Carlon Electrical Products.
   4. Niedax-Kleinhuis USA, Inc.

B. General Requirements for Nonmetallic Wireways and Auxiliary Gutters:
1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Comply with TIA-569-B.

C. Description: Fiberglass polyester, extruded and fabricated to required size and shape, without holes or knockouts. Cover shall be gasketed with oil-resistant gasket material and fastened with captive screws treated for corrosion resistance. Connections shall be flanged and have stainless-steel screws and oil-resistant gaskets.

D. Description: PVC, extruded and fabricated to required size and shape, and having snap-on cover, mechanically coupled connections, and plastic fasteners.

E. Fittings and Accessories: Couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings shall match and mate with wireways as required for complete system.

F. Solvent cements and adhesive primers shall have a VOC content of 510 and 550 g/L or less, respectively, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

G. Solvent cements and adhesive primers shall comply with the testing and product requirements of the California Department of Health Services’ “Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers.”

2.06 SURFACE PATHWAYS

A. General Requirements for Surface Pathways:
1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Comply with TIA-569-B.

B. Surface Metal Pathways: Galvanized steel with snap-on covers complying with UL 5. Manufacturer's standard enamel finish in color selected by Architect.
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. Mono-Systems, Inc.
   b. Niedax-Kleinhuis USA, Inc.
   c. Panduit Corp.
   d. Wiremold / Legrand.

C. Surface Nonmetallic Pathways: Two- or three-piece construction, complying with UL 5A, and manufactured of rigid PVC with texture and color selected by Architect from manufacturer's standard colors. Product shall comply with UL-94 V-0 requirements for self-extinguishing characteristics.
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. Hubbell Incorporated; Wiring Device-Kellems Division.
   b. Lamson & Sessions; Carlon Electrical Products.
   c. Mono-Systems, Inc.
   d. Panduit Corp.
   e. Wiremold / Legrand.

D. Tele-Power Poles:
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. Mono-Systems, Inc.
b. Panduit Corp.
c. Wiremold / Legrand.

3. Fittings and Accessories: Dividers, end caps, covers, cutouts, wiring harnesses, devices, mounting materials, and other fittings shall match and mate with tele-power pole as required for complete system.

2.07 BOXES, ENCLOSURES, AND CABINETS

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. Adalet.
2. Cooper Technologies Company; Cooper Crouse-Hinds.
3. EGS/Appleton Electric.
5. Hoffman; a Pentair company.
6. Hubbell Incorporated; Killark Division.
7. Lamson & Sessions; Carlon Electrical Products.
8. Milbank Manufacturing Co.
9. Molex; Woodhead Brand.
10. Mono-Systems, Inc.
12. RACO; a Hubbell company.
13. Robroy Industries.
14. Spring City Electrical Manufacturing Company.
15. Stahlin Non-Metallic Enclosures; a division of Robroy Industries.
17. Wiremold / Legrand.

B. General Requirements for Boxes, Enclosures, and Cabinets:
1. Comply with TIA-569-B.
2. Boxes, enclosures and cabinets installed in wet locations shall be listed for use in wet locations.

C. Sheet-Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.

D. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, aluminum, Type FD, with gasketed cover.

E. Box extensions used to accommodate new building finishes shall be of same material as recessed box.

F. Metal Floor Boxes:
1. Material: Cast metal or sheet metal.
2. Type: Fully adjustable.
3. Shape: Rectangular.
4. Listing and Labeling: Metal floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

G. Nonmetallic Floor Boxes: Nonadjustable, round.
1. Listing and Labeling: Nonmetallic floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

H. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
I. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, cast aluminum with gasketed cover.

J. Device Box Dimensions: 4 inches square by 2-1/8 inches.

K. Gangable boxes are allowed.

L. Nonmetallic Outlet and Device Boxes: Comply with NEMA OS 2 and UL 514C.

M. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250 Type 3R with continuous-hinge cover with flush latch unless otherwise indicated.
   1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
   2. Nonmetallic Enclosures:
      b. Finished inside with radio-frequency-resistant paint.
   3. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.

N. Cabinets:
   1. NEMA 250, Type 3R, galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
   2. Hinged door in front cover with flush latch and concealed hinge.
   3. Key latch to match panelboards.
   4. Metal barriers to separate wiring of different systems and voltage.
   5. Accessory feet where required for freestanding equipment.
   6. Nonmetallic cabinets shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.08 HANDBOLES AND BOXES FOR EXTERIOR UNDERGROUND CABLING

A. General Requirements for Handholes and Boxes:
   1. Boxes and handholes for use in underground systems shall be designed and identified as defined in NFPA 70, for intended location and application.
   2. Boxes installed in wet areas shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
   3. Comply with TIA-569-B.

B. Polymer-Concrete Handholes and Boxes with Polymer-Concrete Cover: Molded of sand and aggregate, bound together with polymer resin, and reinforced with steel, fiberglass, or a combination of the two.
   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. Armorcast Products Company.
      b. Carson Industries LLC.
      d. NewBasis.
      e. Oldcastle Precast, Inc.; Christy Concrete Products.
      f. Synertech Moulded Products; a division of Oldcastle Precast, Inc.
   2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
      a. Armorcast Products Company.
      b. Carson Industries LLC.
      d. NewBasis.
      e. Oldcastle Precast, Inc.; Christy Concrete Products.
      f. Synertech Moulded Products; a division of Oldcastle Precast, Inc.
   4. Configuration: Designed for flush burial with open bottom unless otherwise indicated.
   5. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.
   6. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
   7. Cover Legend: Molded lettering, "COMMUNICATIONS."
8. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.

C. Fiberglass Handholes and Boxes: Molded of fiberglass-reinforced polyester resin, with frame and covers of polymer concrete.
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 indicated on Drawings or comparable product by one of the following:
   a. Armorcast Products Company.
   b. Carson Industries LLC.
   d. NewBasis.
   e. Nordic Fiberglass, Inc.
   f. Oldcastle Precast, Inc.; Christy Concrete Products.
   g. Synertech Moulded Products; a division of Oldcastle Precast, Inc.
5. Configuration: Designed for flush burial with open bottom unless otherwise indicated.
6. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.
7. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
8. Cover Legend: Molded lettering, "COMMUNICATIONS."

2.09 SOURCE QUALITY CONTROL FOR UNDERGROUND ENCLOSURES

A. Handhole and Pull-Box Prototype Test: Test prototypes of handholes and boxes for compliance with SCTE 77. Strength tests shall be for specified tier ratings of products supplied.
1. Tests of materials shall be performed by an independent testing agency.
2. Strength tests of complete boxes and covers shall be by either an independent testing agency or manufacturer. A qualified registered professional engineer shall certify tests by manufacturer.
3. Testing machine pressure gages shall have current calibration certification complying with ISO 9000 and ISO 10012, and traceable to NIST standards.

PART 3 EXECUTION

3.01 PATHWAY APPLICATION

A. Outdoors: Apply pathway products as specified below unless otherwise indicated:
1. Exposed Conduit: RNC, Type EPC-40-PVC.
2. Concealed Conduit, Aboveground: EMT.
3. Underground Conduit: RNC, Type EPC-40-PVC.
4. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.

B. Indoors: Apply pathway products as specified below unless otherwise indicated:
1. Exposed, Not Subject to Physical Damage: EMT or RNC.
2. Exposed, Not Subject to Severe Physical Damage: EMT.
3. Exposed and Subject to Severe Physical Damage: IMC. Pathway locations include the following:
a. Loading dock.
b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
c. Mechanical rooms.
d. Gymnasiu

5. Damp or Wet Locations: IMC.
6. Pathways for Optical-Fiber or Communications Cable in Spaces Used for Environmental Air: Plenum-type, communications-cable pathway.
7. Pathways for Optical-Fiber or Communications-Cable Risers in Vertical Shafts: Riser-type, communications-cable pathway.
9. Boxes and Enclosures: NEMA 250 Type 1, except use NEMA 250 Type 4 nonmetallic in institutional and commercial kitchens and damp or wet locations.

C. Minimum Pathway Size: 3/4-inch trade size. Minimum size for optical-fiber cables is 1 inch.

D. Pathway Fittings: Compatible with pathways and suitable for use and location.
1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with this type of conduit. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.
3. EMT: Use setscrew or compression, steel fittings. Comply with NEMA FB 2.10.

E. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.

F. Install surface pathways only where indicated on Drawings.

G. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F.

3.02 INSTALLATION

A. Comply with NECA 1, NECA 101, and TIA-569-B for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum pathways. Comply with NFPA 70 limitations for types of pathways allowed in specific occupancies and number of floors.

B. Keep pathways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal pathway runs above water and steam piping.

C. Complete pathway installation before starting conductor installation.

D. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for hangers and supports.

E. Arrange stub-ups so curved portions of bends are not visible above finished slab.

F. Install no more than the equivalent of two 90-degree bends in any pathway run. Support within 12 inches of changes in direction. Utilize long radius ells for all optical-fiber cables.

G. Conceal conduit and EMT within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
H. Support conduit within 12 inches of enclosures to which attached.

I. Pathways Embedded in Slabs:
   1. Run conduit larger than 1-inch trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support. Secure pathways to reinforcement at maximum 10-foot intervals.
   2. Arrange pathways to cross building expansion joints at right angles with expansion fittings.
   3. Arrange pathways to keep a minimum of 2 inches of concrete cover in all directions.
   4. Do not embed threadless fittings in concrete unless specifically approved by Architect for each specific location.
   5. Change from ENT to RNC, Type EPC-40-PVC, or IMC before rising above floor.

J. Stub-ups to Above Recessed Ceilings:
   1. Use EMT, IMC, or RMC for pathways.
   2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.

K. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions:
   Apply listed compound to threads of pathway and fittings before making up joints. Follow compound manufacturer's written instructions.

L. Coat field-cut threads on PVC-coated pathway with a corrosion-preventing conductive compound prior to assembly.

M. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install insulated bushings on conduits terminated with locknuts.

N. Install pathways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.

O. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.

P. Cut conduit perpendicular to the length. For conduits of 2-inch trade size and larger, use roll cutter or a guide to ensure cut is straight and perpendicular to the length.

Q. Install pull wires in empty pathways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire. Cap underground pathways designated as spare above grade alongside pathways in use.

R. Surface Pathways:
   1. Install surface pathway for surface telecommunications outlet boxes only where indicated on Drawings.
   2. Install surface pathway with a minimum 2-inch radius control at bend points.
   3. Secure surface pathway with screws or other anchor-type devices at intervals not exceeding 48 inches and with no less than two supports per straight pathway section. Support surface pathway according to manufacturer's written instructions. Tape and glue are not acceptable support methods.

S. Pathways for Optical-Fiber and Communications Cable: Install pathways, metal and nonmetallic, rigid and flexible, as follows:
   1. 3/4-Inch Trade Size and Smaller: Install pathways in maximum lengths of 50 feet.
2. **1-Inch Trade Size and Larger**: Install pathways in maximum lengths of 75 feet. Install with a maximum of two 90-degree bends or equivalent for each length of pathway unless Drawings show stricter requirements. Separate lengths with pull or junction boxes or terminations at distribution frames or cabinets where necessary to comply with these requirements.

T. Install pathway sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed pathways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install pathway sealing fittings according to NFPA 70.

U. Install devices to seal pathway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all pathways at the following points:

1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
2. Where an underground service pathway enters a building or structure.
3. Where otherwise required by NFPA 70.

V. Comply with manufacturer's written instructions for solvent welding PVC conduit and fittings.

W. **Expansion-Joint Fittings**:

1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 30 deg F, and that has straight-run length that exceeds 25 feet. Install in each run of aboveground RMC conduit that is located where environmental temperature change may exceed 100 deg F and that has straight-run length that exceeds 100 feet.
2. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:
   a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F temperature change.
   b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F temperature change.
   c. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F temperature change.
   d. Attics: 135 deg F temperature change.
3. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F of temperature change for PVC conduits. Install fitting(s) that provide expansion and contraction for at least 0.000078 inch per foot of length of straight run per deg F of temperature change for metal conduits.
4. Install expansion fittings at all locations where conduits cross building or structure expansion joints.
5. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.

X. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to bottom of box unless otherwise indicated.

Y. **Recessed Boxes in Masonry Walls**: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surface to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box.
Z. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.

AA. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.

BB. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.

CC. Set metal floor boxes level and flush with finished floor surface.

DD. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

3.03 INSTALLATION OF UNDERGROUND CONDUIT

A. Direct-Buried Conduit:
   1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom as specified in Section 312000 "Earth Moving" for pipe less than 6 inches in nominal diameter.
   2. Install backfill as specified in Section 312000 "Earth Moving."
   3. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified in Section 312000 "Earth Moving."
   4. Install manufactured duct elbows for stub-ups at poles and equipment and at building entrances through floor unless otherwise indicated. Encase elbows for stub-up ducts throughout length of elbow.
   5. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through floor.
      a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches of concrete for a minimum of 12 inches on each side of the coupling.
      b. For stub-ups at equipment mounted on outdoor concrete bases and where conduits penetrate building foundations, extend steel conduit horizontally a minimum of 60 inches from edge of foundation or equipment base. Install insulated grounding bushings on terminations at equipment.
   6. Warning Planks: Bury warning planks approximately 12 inches above direct-buried conduits, but a minimum of 6 inches below grade. Align planks along centerline of conduit.
   7. Underground Warning Tape: Comply with requirements in Section 260553 "Identification for Electrical Systems."

3.04 INSTALLATION OF UNDERGROUND HANDBOLES AND BOXES

A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting conduits to minimize bends and deflections required for proper entrances.

B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.

C. Elevation: In paved areas, set so cover surface will be flush with finished grade. Set covers of other enclosures 1 inch above finished grade.
D. Install handholes with bottom below frost line, below grade.

E. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated. Select arm lengths to be long enough to provide spare space for future cables, but short enough to preserve adequate working clearances in enclosure.

F. Field cut openings for conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

3.05 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR COMMUNICATIONS PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 270544 "Sleeves and Sleeve Seals for Communications Pathways and Cabling."

3.06 FIRESTOPPING

A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.07 PROTECTION

A. Protect coatings, finishes, and cabinets from damage or deterioration.
   1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
   2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION
SECTION 27 05 36

CABLE TRAYS FOR COMMUNICATIONS SYSTEMS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:
   1. Ladder cable trays.
   2. Wire-basket cable trays.
   4. Trough cable trays.
   5. Fiberglass cable trays.

B. Related Requirements:
   1. Section 260536 "Cable Trays for Electrical Systems" for cable trays and accessories serving electrical systems.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of cable tray.
   1. Include data indicating dimensions and finishes for each type of cable tray indicated.

B. Shop Drawings: For each type of cable tray.
   1. Show fabrication and installation details of cable trays, including plans, elevations, and sections of components and attachments to other construction elements. Designate components and accessories, including clamps, brackets, hanger rods, splice-plate connectors, expansion-joint assemblies, straight lengths, and fittings.

C. Delegated-Design Submittal: For seismic restraints.
   1. Seismic-Restraint Details: Signed and sealed by a qualified professional engineer, licensed in the state where Project is located, who is responsible for their preparation.
   2. Design Calculations: Calculate requirements for selecting seismic restraints.
   3. Detail fabrication, including anchorages and attachments to structure and to supported cable trays.

1.04 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Floor plans and sections, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
   1. Include scaled cable tray layout and relationships between components and adjacent structural, electrical, and mechanical elements.
   2. Vertical and horizontal offsets and transitions.
   3. Clearances for access above and to side of cable trays.
   4. Vertical elevation of cable trays above the floor or below bottom of ceiling structure.

B. Seismic Qualification Certificates: For cable trays, accessories, and components, from manufacturer.
1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Field quality-control reports.

PART 2  PRODUCTS

2.01  PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design cable tray supports and seismic bracing.

B. Seismic Performance: Cable trays and supports shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
   1. The term "withstand" means "the cable trays will remain in place without separation of any parts when subjected to the seismic forces specified."
   2. Component Importance Factor: 1.5.
   3. See ASCE/SEI 7, Coefficients for Architectural Component Table and Seismic Coefficients for Mechanical and Electrical Components Table for requirements to be inserted in subparagraph below.

C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes in cable tray installed outdoors.
   1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

2.02  GENERAL REQUIREMENTS FOR CABLE TRAYS

A. Cable Trays and Accessories: Identified as defined in NFPA 70 and marked for intended location, application, and grounding.
   1. Source Limitations: Obtain cable trays and components from single manufacturer.

B. Sizes and Configurations: See the Cable Tray Schedule on Drawings for specific requirements for types, materials, sizes, and configurations.

C. Structural Performance: See articles for individual cable tray types for specific values for the following parameters:
   1. Uniform Load Distribution: Capable of supporting a uniformly distributed load on the indicated support span when supported as a simple span and tested according to NEMA VE 1.
   2. Concentrated Load: A load applied at midpoint of span and centerline of tray.
   3. Load and Safety Factors: Applicable to both side rails and rung capacities.

2.03  LADDER CABLE TRAYS

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:

B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
   1. Allied Tube & Conduit; a Tyco International Ltd. Co.
   2. Chalfant Manufacturing Company.
   3. Cooper B-Line, Inc.
5. MP Husky.
6. Niedax-Kleinhuis USA, Inc.

C. Description:
1. Configuration: Two I-beam side rails with transverse rungs welded to side rails.
2. Rung Spacing 9 inches o.c.
3. Radius-Fitting Rung Spacing: 9 inches at center of tray's width.
5. No portion of the rungs shall protrude below the bottom plane of side rails.
6. Structural Performance of Each Rung: Capable of supporting a maximum cable load, with a safety factor of 1.5, plus a 200-lb concentrated load, when tested according to NEMA VE 1.
8. Straight Section Lengths: 10 feet (3 m) except where shorter lengths are required to facilitate tray assembly.
9. Width: 12 inches unless otherwise indicated on Drawings.
10. Fitting Minimum Radius: [12 inches].
11. Class Designation: Comply with NEMA VE 1, Class 12B.
12. Splicing Assemblies: Bolted type using serrated flange locknuts.
13. Hardware and Fasteners: ASTM F 593 and ASTM F 594 stainless steel, Type 316
14. Splice Plate Capacity: Splices located within support span shall not diminish rated loading capacity of cable tray.

2.04 WIRE-BASKET CABLE TRAYS

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:

B. Basis-of-Design Product: Subject to compliance with requirements, provide [product indicated on Drawings] <Insert manufacturer's name; product name or designation> or comparable product by one of the following:
1. Allied Tube & Conduit; a Tyco International Ltd. Co.
2. Cablofil/Legrande.
4. Cooper B-Line, Inc.
5. Enduro Systems, Inc.
7. MP Husky.
8. Niedax-Kleinhuis USA, Inc.
10. Wiremaid Products Division; Vutec Corporation.

C. Description:
1. Configuration: Wires are formed into a standard 2-by-4-inch wire mesh pattern with intersecting wires welded together. Mesh sections must have at least one bottom longitudinal wire along entire length of section.
4. Sizes:
   a. Straight sections shall be furnished in standard 118-inch lengths.
   b. Wire-Basket Depth: 1-inch usable loading depth by 12 inches wide.
   c. Wire-Basket Depth: 2-inch usable loading depth by 8 inches wide.
   d. Wire-Basket Depth: 4-inch usable loading depth by 24 inches wide.
   e. Wire-Basket Depth: 6-inch usable loading depth by 24 inches wide.
5. Connector Assemblies: Bolt welded to plate shaped to fit around adjoining tray wires and mating plate. Mechanically joins adjacent tray wires to splice sections together or to create horizontal fittings.
6. Connector Assembly Capacity: Splices located within support span shall not diminish rated loading capacity of cable tray.

7. Hardware and Fasteners: ASTM F 593 and ASTM F 594 stainless steel, Type 316

2.05 SINGLE-RAIL CABLE TRAYS

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:

B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
   1. Allied Tube & Conduit; a Tyco International Ltd. Co.
   2. Cooper B-Line, Inc.
   4. MP Husky.

C. Description:
   1. Configuration: Center rail with extruded-aluminum rungs arranged symmetrically about the center rail.
   2. Construction: Aluminum rungs mechanically connected to aluminum center rail in at least two places, with ends finished to protect installers and cables.
   3. Rung Spacing 9 inches o.c.
   4. Radius-Fitting Rung Spacing: 9 inches at center of tray's width.
   5. Straight Section Lengths: 10 feet except where shorter lengths are required to facilitate tray assembly.
   6. Width: 12 inches unless otherwise indicated on Drawings.
   7. Support Point: Splice fittings shall be hanger support point.
   8. Support Spacing: Support each section at midpoint. Support wall-mounted sections a maximum of one-sixth of the section length from each end.
   9. Loading Depth: 4 inches.
   11. Splicing Assemblies: Bolted type using serrated flange locknuts.
   12. Splicing Assembly Capacity: Splices located within support span shall not diminish rated loading capacity of cable tray.
   14. Splices and Connectors: Protect cables from edges of center rail and do not intrude into cable fill area.

2.06 MATERIALS AND FINISHES

A. Steel:
   1. Straight Section and Fitting Side Rails and Rungs: Steel complies with the minimum mechanical properties of ASTM A 1011/A 1011M, SS, Grade 33.
   2. Steel Tray Splice Plates: ASTM A 1011/A 1011M, HSLAS, Grade 50, Class 1.
   3. Fasteners: Steel complies with the minimum mechanical properties of ASTM A 510/A 510M, Grade 1008.
   5. Finish: Electrogalvanized before fabrication.
a. Powder-Coat Enamel: Cable tray manufacturer's recommended primer and corrosion-inhibiting treatment, with factory-applied powder-coat paint.

b. Epoxy-Resin Prime Coat: Cold-curing epoxy primer, MPI# 101.

c. Epoxy-Resin Topcoat: Epoxy, cold-cured, gloss, MPI# 77.

d. Hardware: Chromium-zinc plated, ASTM F 1136.

8. Finish: Factory-standard primer, ready for field painting, with chromium-zinc-plated hardware according to ASTM F 1136.

9. Finish: Black oxide finish for support accessories and miscellaneous hardware according to ASTM D 769.

B. Aluminum:

1. Materials: Alloy 6063-T6 according to ANSI H 35.1/H 35.1M for extruded components and Alloy 5052-H32 or Alloy 6061-T6 according to ANSI H 35.1/H 35.1M for fabricated parts.


3. Hardware for Aluminum Cable Tray Used Outdoors: Stainless steel, Type 316, ASTM F 593 and ASTM F 594.

C. Stainless Steel:

1. Materials: Low-carbon, passivated, stainless steel, Type 304L or Type 316L, ASTM F 593 and ASTM F 594.

2. Hardware for Stainless-Steel Cable Tray Used Outdoors: Stainless steel, Type 316, ASTM F 593 and ASTM F 594.

2.07 CABLE TRAY ACCESSORIES

A. Fittings: Tees, crosses, risers, elbows, and other fittings as indicated, of same materials and finishes as cable tray.

B. Covers: Solid type made of same materials and with same finishes as cable tray.

C. Barrier Strips: Same materials and finishes as for cable tray.

D. Cable tray supports and connectors, including bonding jumpers, as recommended by cable tray manufacturer.

2.08 WARNING SIGNS

A. Lettering: 1-1/2-inch high, black letters on yellow background with legend "Warning! Not To Be Used as Walkway, Ladder, or Support for Ladders or Personnel."

B. Comply with requirements for fasteners in Section 260553 "Identification for Electrical Systems."

2.09 SOURCE QUALITY CONTROL

A. Testing: Test and inspect cable trays according to NEMA FG 1.

PART 3 EXECUTION

3.01 CABLE TRAY INSTALLATION

A. Install cable trays according to NEMA FG 1.

B. Install cable trays as a complete system, including fasteners, hold-down clips, support systems, barrier strips, adjustable horizontal and vertical splice plates, elbows, reducers, tees, crosses, cable dropouts, adapters, covers, and bonding.
C. Install cable trays so that the tray is accessible for cable installation and all splices are accessible for inspection and adjustment.

D. Remove burrs and sharp edges from cable trays.

E. Join aluminum cable tray with splice plates; use four square neck-carriage bolts and locknuts.

F. Fasten cable tray supports to building structure and install seismic restraints.

G. Design fasteners and supports to carry cable tray, the cables, and a concentrated load of 200 lb. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems." Comply with seismic-restraint details according to Section 260548 "Vibration and Seismic Controls for Electrical Systems."

H. Place supports so that spans do not exceed maximum spans on schedules and provide clearances shown on Drawings. Install intermediate supports when cable weight exceeds the load-carrying capacity of the tray rungs.

I. Construct supports from channel members, threaded rods, and other appurtenances furnished by cable tray manufacturer. Arrange supports in trapeze or wall-bracket form as required by application.

J. Support bus assembly to prevent twisting from eccentric loading.

K. Install center-hung supports for single-rail trays designed for 60 versus 40 percent eccentric loading condition, with a safety factor of 3.

L. Locate and install supports according to NEMA FG 1. Do not install more than one cable tray splice between supports.

M. Support wire-basket cable trays with center support hangers.

N. Support center support hangers for wire-basket trays with 1/4-inch diameter rods.

O. Make connections to equipment with flanged fittings fastened to cable trays and to equipment. Support cable trays independent of fittings. Do not carry weight of cable trays on equipment enclosure.

P. Install expansion connectors where cable trays cross building expansion joints and in cable tray runs that exceed dimensions recommended in NEMA FG 1. Space connectors and set gaps according to applicable standard.

Q. Make changes in direction and elevation using manufacturer's recommended fittings.

R. Make cable tray connections using manufacturer's recommended fittings.

S. Seal penetrations through fire and smoke barriers. Comply with requirements in Section 078413 "Penetration Firestopping."

T. Install capped metal sleeves for future cables through firestop-sealed cable tray penetrations of fire and smoke barriers.

U. Install cable trays with enough workspace to permit access for installing cables.

V. Install barriers to separate cables of different systems, such as power, communications, and data processing; or of different insulation levels, such as 600, 5000, and 15 000 V.
W. Install permanent covers, if used, after installing cable. Install cover clamps according to NEMA VE 2.

X. Clamp covers on cable trays installed outdoors with heavy-duty clamps.

Y. Install warning signs in visible locations on or near cable trays after cable tray installation.

3.02 CABLE TRAY GROUNDING

A. Ground cable trays according to NFPA 70 unless additional grounding is specified. Comply with requirements in Section 260526 "Grounding and Bonding for Electrical Systems."

B. Cable trays with communications cable shall be bonded together with splice plates listed for grounding purposes or with listed bonding jumpers.

C. Cable trays with control conductors shall be bonded together with splice plates listed for grounding purposes or with listed bonding jumpers.

D. When using epoxy- or powder-coat painted cable trays as a grounding conductor, completely remove coating at all splice contact points or ground connector attachment. After completing splice-to-grounding bolt attachment, repair the coated surfaces with coating materials recommended by cable tray manufacturer.

E. Bond cable trays to power source for cables contained within with bonding conductors sized according to NFPA 70, Article 250.122, "Size of Equipment Grounding Conductors."

3.03 CABLE INSTALLATION

A. Install cables only when each cable tray run has been completed and inspected.

B. Fasten cables on horizontal runs with cable clamps or cable ties according to NEMA VE 2. Tighten clamps only enough to secure the cable, without indenting the cable jacket. Install cable ties with a tool that includes an automatic pressure-limiting device.

C. Fasten cables on vertical runs to cable trays every 18 inches.

D. Fasten and support cables that pass from one cable tray to another or drop from cable trays to equipment enclosures. Fasten cables to the cable tray at the point of exit and support cables independent of the enclosure. The cable length between cable trays or between cable tray and enclosure shall be no more than 72 inches.

E. Tie MI cables down every 36 inches where required to provide a 2-hour fire rating and every 72 inches elsewhere.

F. In existing construction, remove inactive or dead cables from cable trays.

3.04 CONNECTIONS

A. Remove paint from all connection points before making connections. Repair paint after the connections are completed.

B. Connect pathways to cable trays according to requirements in NEMA VE 2 and NEMA FG 1.
3.05 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:
1. After installing cable trays and after electrical circuitry has been energized, survey for compliance with requirements.
2. Visually inspect cable insulation for damage. Correct sharp corners, protuberances in cable trays, vibrations, and thermal expansion and contraction conditions, which may cause or have caused damage.
3. Verify that the number, size, and voltage of cables in cable trays do not exceed that permitted by NFPA 70. Verify that communications or data-processing circuits are separated from power circuits by barriers or are installed in separate cable trays.
4. Verify that there are no intruding items such as pipes, hangers, or other equipment in the cable tray.
5. Remove dust deposits, industrial process materials, trash of any description, and any blockage of tray ventilation.
6. Visually inspect each cable tray joint and each ground connection for mechanical continuity. Check bolted connections between sections for corrosion. Clean and retorque in suspect areas.
7. Check for improperly sized or installed bonding jumpers.
8. Check for missing, incorrect, or damaged bolts, bolt heads, or nuts. When found, replace with specified hardware.
9. Perform visual and mechanical checks for adequacy of cable tray grounding; verify that all takeoff raceways are bonded to cable trays. Test entire cable tray system for continuity. Maximum allowable resistance is 1 ohm.

B. Prepare test and inspection reports.

3.06 PROTECTION

A. Protect installed cable trays and cables.
1. Install temporary protection for cables in open trays to safeguard exposed cables against falling objects or debris during construction. Temporary protection for cables and cable tray can be constructed of wood or metal materials and shall remain in place until the risk of damage is over.
2. Repair damage to galvanized finishes with zinc-rich paint recommended by cable tray manufacturer.
3. Repair damage to paint finishes with matching touchup coating recommended by cable tray manufacturer.

END OF SECTION
SECTION 27 05 44
SLEEVES AND SLEEVE SEALS FOR COMMUNICATIONS PATHWAYS AND CABLING

PART 1  GENERAL

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

1.02  SUMMARY
A.  Section Includes:
1.  Sleeves for pathway and cable penetration of non-fire-rated construction walls and floors.
2.  Sleeve-seal systems.
5.  Silicone sealants.

B.  Related Requirements:
1.  Section 078413 “Penetration Firestopping” for penetration firestopping installed in fire-resistance-rated walls, horizontal assemblies, and smoke barriers, with and without penetrating items.

1.03  ACTION SUBMITTALS
A.  Product Data:  For each type of product.

B.  LEED Submittals:
1.  Product Data for Credit EQ 4.1:  For sealants, documentation including printed statement of VOC content.
2.  Laboratory Test Reports for Credit EQ 4:  For sealants, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services’ “Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers.”

PART 2  PRODUCTS

2.01  SLEEVES
A.  Wall Sleeves:
2.  Cast-Iron Pipe Sleeves:  Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.

B.  Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies:
Galvanized-steel sheet; 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint, with tabs for screw-fastening the sleeve to the board.

C.  PVC-Pipe Sleeves:  ASTM D 1785, Schedule 40.

D.  Molded-PVC Sleeves:  With nailing flange for attaching to wooden forms.
E. Molded-PE or -PP Sleeves: Removable, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.

F. Sleeves for Rectangular Openings:
   2. Minimum Metal Thickness:
      a. For sleeve cross-section rectangle perimeter less than 50 inches and with no side larger than 16 inches, thickness shall be 0.052 inch.
      b. For sleeve cross-section rectangle perimeter 50 inches or more and one or more sides larger than 16 inches, thickness shall be 0.138 inch).

2.02 SLEEVE-SEAL SYSTEMS

A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and pathway or cable.
   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 indicated on Drawings or comparable product by one of the following:
      a. Advance Products & Systems, Inc.
      b. CALPICO, Inc.
      c. Metraflex Company (The).
      d. Pipeline Seal and Insulator, Inc.
      e. Proco Products, Inc.
   3. Sealing Elements: EPDM rubber interlocking links shaped to fit surface of pipe.
   4. Pressure Plates: Carbon steel.
   5. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating.

2.03 SLEEVE-SEAL FITTINGS

A. Description: Manufactured plastic, sleeve-type, waterstop assembly made for embedding in concrete slab or wall. Unit shall have plastic or rubber waterstop collar with center opening to match piping OD.
   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 indicated on Drawings or comparable product by one of the following:
      a. Presealed Systems.

2.04 GROUT

A. Description: Nonshrink; recommended for interior and exterior sealing openings in non-fire-rated walls or floors.


C. Design Mix: 5000-psi, 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

2.05 SILICONE SEALANTS

A. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below.
1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces that are not fire rated.

2. Sealant shall have VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

3. Sealant shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

B. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

PART 3 EXECUTION

3.01 SLEEVE INSTALLATION FOR NON-FIRE-RATED ELECTRICAL PENETRATIONS

A. Comply with NECA 1.

B. Comply with NEMA VE 2 for cable tray and cable penetrations.

C. Sleeves for Conduits Penetrating Above-Grade Non-Fire-Rated Concrete and Masonry-Unit Floors and Walls:
   1. Interior Penetrations of Non-Fire-Rated Walls and Floors:
      a. Seal annular space between sleeve and pathway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Section 079200 "Joint Sealants."
      b. Seal space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect material while curing.
   2. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
   3. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and pathway or cable unless sleeve seal is to be installed or unless seismic criteria require different clearance.
   4. Install sleeves for wall penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of walls. Cut sleeves to length for mounting flush with both surfaces of walls. Deburr after cutting.
   5. Install sleeves for floor penetrations. Extend sleeves installed in floors 2 inches above finished floor level. Install sleeves during erection of floors.

D. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies:
   1. Use circular metal sleeves unless penetration arrangement requires rectangular sleeved opening.
   2. Seal space outside of sleeves with approved joint compound for gypsum board assemblies.

E. Roof-Penetration Sleeves: Seal penetration of individual pathways and cables with flexible boot-type flashing units applied in coordination with roofing work.

F. Aboveground, Exterior-Wall Penetrations: Seal penetrations using [steel] [cast-iron] pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

G. Underground, Exterior-Wall and Floor Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch annular clear space between pathway or cable and sleeve for installing sleeve-seal system.
3.02 SLEEVE-SEAL-SYSTEM INSTALLATION

A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at pathway entries into building.

B. Install type and number of sealing elements recommended by manufacturer for pathway or cable material and size. Position pathway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pathway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.03 SLEEVE-SEAL-FITTING INSTALLATION

A. Install sleeve-seal fittings in new walls and slabs as they are constructed.

B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.

C. Secure nailing flanges to concrete forms.

D. Using grout, seal the space around outside of sleeve-seal fittings.

END OF SECTION
SECTION 27 11 00

COMMUNICATIONS EQUIPMENT ROOM FITTINGS

PART 1  GENERAL

1.01  RELATED DOCUMENTS

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

1.02  SUMMARY

A. Section Includes:
1. Telecommunications mounting elements.
2. Backboards.
3. Telecommunications equipment racks and cabinets.

B. Related Requirements:
1. Section 270536 "Cable Trays for Communications Systems" for cable trays and accessories.
2. Section 271300 "Communications Backbone Cabling" for voice and data cabling associated with system panels and devices.
3. Section 271500 "Communications Horizontal Cabling" for voice and data cabling associated with system panels and devices.
4. Section 280513 "Conductors and Cables for Electronic Safety and Security" for voice and data cabling associated with system panels and devices.

1.03  DEFINITIONS

B. LAN: Local area network.
C. RCDD: Registered Communications Distribution Designer.

1.04  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 equipment racks and cabinets.
   2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: For communications equipment room fittings. Include plans, elevations, sections, details, and attachments to other work.
   1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
   2. Equipment Racks and Cabinets: Include workspace requirements and access for cable connections.
   3. Grounding: Indicate location of grounding bus bar and its mounting detail showing standoff insulators and wall mounting brackets.

1.05  INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer, qualified layout technician, installation supervisor, and field inspector.
B. Seismic Qualification Certificates: For equipment frames from manufacturer.
   1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
   2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions. Base certification on the maximum number of components capable of being mounted in each rack type. Identify components on which certification is based.
   3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

1.06 QUALITY ASSURANCE

A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.
   1. Layout Responsibility: Preparation of Shop Drawings shall be under the direct supervision of RCDD.
   2. Installation Supervision: Installation shall be under the direct supervision of Registered Technician, who shall be present at all times when Work of this Section is performed at Project site.
   3. Field Inspector: Currently registered by BICSI as RCDD to perform the on-site inspection.

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Equipment frames shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
   1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

2.02 BACKBOARDS

A. Backboards: Plywood, fire-retardant treated, 3/4 by 48 by 96 inches. Comply with requirements for plywood backing panels specified in Section 061000 "Rough Carpentry."

2.03 EQUIPMENT FRAMES

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:

B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
   1. ADC.
   2. Belden Inc.
   3. Cooper B-Line.
   5. Hubbell Premise Wiring.
   6. Leviton Commercial Networks Division.
   7. Middle Atlantic Products, Inc.
   8. Ortronics, Inc.
   9. Panduit Corp.
   10. Siemon Co. (The).
   11. Tyco Electronics Corporation; AMP Products.

C. General Frame Requirements:
   1. Distribution Frames: Freestanding and wall-mounting, modular-steel units designed for telecommunications terminal support and coordinated with dimensions of units to be supported.
3. Finish: Manufacturer's standard, baked-polyester powder coat.

D. Floor-Mounted Racks: Modular-type, aluminum construction.
   1. Vertical and horizontal cable management channels, top and bottom cable troughs, grounding lug, and a power strip.
   2. Baked-polyester powder coat finish.

E. Modular Freestanding Cabinets:
   1. Removable and lockable side panels.
   2. Hinged and lockable front and rear doors.
   3. Adjustable feet for leveling.
   4. Screened ventilation openings in the roof and rear door.
   5. Cable access provisions in the roof and base.
   10. All cabinets keyed alike.

F. Modular Wall Cabinets:
   1. Wall mounting.
   2. Steel or aluminum construction.
   3. Treated to resist corrosion.
   4. Lockable front and rear doors.
   5. Louvered side panels.
   6. Cable access provisions top and bottom.
   7. Grounding lug.
   10. All cabinets keyed alike.

G. Cable Management for Equipment Frames:
   1. Metal, with integral wire retaining fingers.
   2. Baked-polyester powder coat finish.
   3. Vertical cable management panels shall have front and rear channels, with covers.
   4. Provide horizontal crossover cable manager at the top of each relay rack, with a minimum height of two rack units each.

2.04 POWER STRIPS

A. Power Strips: Comply with UL 1363.
   1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
   2. Rack mounting.
   4. LED indicator lights for power and protection status.
   5. LED indicator lights for reverse polarity and open outlet ground.
   6. Circuit Breaker and Thermal Fusing: When protection is lost, circuit opens and cannot be reset.
   7. Circuit Breaker and Thermal Fusing: Unit continues to supply power if protection is lost.
   9. Rocker-type on-off switch, illuminated when in on position.
   11. Protection modes shall be line to neutral, line to ground, and neutral to ground. UL 1449 clamping voltage for all three modes shall be not more than 330 V.
2.05 GROUNDING

A. Comply with requirements in Section 260526 "Grounding and Bonding for Electrical Systems" for grounding conductors and connectors.

B. Telecommunications Main Bus Bar:
   1. Connectors: Mechanical type, cast silicon bronze, solderless exothermic-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.
   2. Ground Bus Bar: Copper, minimum 1/4 inch thick by 4 inches wide with 9/32-inch holes spaced 1-1/8 inches apart.
   3. Stand-Off Insulators: Comply with UL 891 for use in switchboards, 600 V. Lexan or PVC, impulse tested at 5000 V.

C. Comply with J-STD-607-A.

2.06 LABELING

A. Comply with TIA/EIA-606-A and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

PART 3 EXECUTION

3.01 ENTRANCE FACILITIES

A. Contact telecommunications service provider and arrange for installation of demarcation point, protected entrance terminals, and a housing when so directed by service provider.

B. Comply with requirements in Section 270528 "Pathways for Communications Systems" for materials and installation requirements for underground pathways.

3.02 INSTALLATION

A. Comply with NECA 1.

B. Comply with BICSI TDMM for layout and installation of communications equipment rooms.

C. Bundle, lace, and train conductors and cables to terminal points without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.

D. Coordinate layout and installation of communications equipment with Owner's telecommunications and LAN equipment and service suppliers. Coordinate service entrance arrangement with local exchange carrier.
   1. Meet jointly with telecommunications and LAN equipment suppliers, local exchange carrier representatives, and Owner to exchange information and agree on details of equipment arrangements and installation interfaces.
   2. Record agreements reached in meetings and distribute them to other participants.
   3. Adjust arrangements and locations of distribution frames, cross-connects, and patch panels in equipment rooms to accommodate and optimize arrangement and space requirements of telephone switch and LAN equipment.
   4. Adjust arrangements and locations of equipment with distribution frames, cross-connects, and patch panels of cabling systems of other communications, electronic safety and security, and related systems that share space in the equipment room.

E. Coordinate location of power raceways and receptacles with locations of communications equipment requiring electrical power to operate.
3.03 SLEEVE AND SLEEVE SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 270544 "Sleeves and Sleeve Seals for Communications Pathways and Cabling."

3.04 FIRESTOPPING

A. Comply with requirements in Section 078413 "Penetration Firestopping."

B. Comply with TIA-569-B, Annex A, "Firestopping."

C. Comply with BICSI TDMM, "Firestopping Systems" Article.

3.05 GROUNDING

A. Install grounding according to BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.

B. Comply with J-STD-607-A.

C. Locate grounding bus bar to minimize the length of bonding conductors. Fasten to wall allowing at least 2-inch clearance behind the grounding bus bar. Connect grounding bus bar with a minimum No. 4 AWG grounding electrode conductor from grounding bus bar to suitable electrical building ground.

D. Bond metallic equipment to the grounding bus bar, using not smaller than No. 6 AWG equipment grounding conductor.
   1. Bond the shield of shielded cable to the grounding bus bar in communications rooms and spaces.

3.06 IDENTIFICATION

A. Identify system components, wiring, and cabling complying with TIA/EIA-606-A. Comply with requirements in Section 260553 "Identification for Electrical Systems."

B. Comply with requirements in Section 099123 "Interior Painting" for painting backboards. For fire-resistant plywood, do not paint over manufacturer's label.

C. Paint and label colors for equipment identification shall comply with TIA/EIA-606-A for Class 3 level of administration including optional identification requirements of this standard.

D. Labels shall be preprinted or computer-printed type.

END OF SECTION
SECTION 27 15 00

COMMUNICATIONS HORIZONTAL CABLES

PART 1  GENERAL

1.01  RELATED DOCUMENTS

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

1.02  SUMMARY

A. Section Includes:
   1. UTP cabling.
   2. 50/125 or 62.5/125-micrometer, optical fiber cabling.
   3. Coaxial cable.
   4. Multiuser telecommunications outlet assemblies.
   5. Cable connecting hardware, patch panels, and cross-connects.
   6. Telecommunications outlet/connectors.
   7. Cabling system identification products.
   8. Cable management system.

B. Related Requirements:
   1. Section 271300 "Communications Backbone Cabling" for voice and data cabling
      associated with system panels and devices.
   2. Section 280513 "Conductors and Cables for Electronic Safety and Security" for
      voice and data cabling associated with system panels and devices.

1.03  DEFINITIONS


B. Consolidation Point: A location for interconnection between horizontal cables extending
   from building pathways and horizontal cables extending into furniture pathways.

C. Cross-Connect: A facility enabling the termination of cable elements and their
   interconnection or cross-connection.

D. EMI: Electromagnetic interference.

E. IDC: Insulation displacement connector.

F. LAN: Local area network.

G. MUTOA: Multiuser telecommunications outlet assembly, a grouping in one location of
   several telecommunications outlet/connectors.

H. Outlet/Connectors: A connecting device in the work area on which horizontal cable or
   outlet cable terminates.

I. RCDD: Registered Communications Distribution Designer.

J. UTP: Unshielded twisted pair.
1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordinate layout and installation of telecommunications cabling with Owner's telecommunications and LAN equipment and service suppliers.

B. Coordinate telecommunications outlet/connector locations with location of power receptacles at each work area.

1.05 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. For coaxial cable, include the following installation data for each type used:
      a. Nominal OD.
      b. Minimum bending radius.
      c. Maximum pulling tension.

B. Shop Drawings:
   1. System Labeling Schedules: Electronic copy of labeling schedules, in software and format selected by Owner.
   2. System Labeling Schedules: Electronic copy of labeling schedules that are part of the cabling and asset identification system of the software.
   3. Cabling administration drawings and printouts.
   4. Wiring diagrams to show typical wiring schematics, including the following:
      b. Patch panels.
      c. Patch cords.
   5. Cross-connects and patch panels. Detail mounting assemblies, and show elevations and physical relationship between the installed components.

C. Samples: For workstation outlets, jacks, jack assemblies, in specified finish, one for each size and outlet configuration.

1.06 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer, qualified layout technician, installation supervisor, and field inspector.

B. Source quality-control reports.

C. Field quality-control reports.

1.07 CLOSEOUT SUBMITTALS

A. Maintenance Data: For splices and connectors to include in maintenance manuals.

B. Software and Firmware Operational Documentation:
   1. Software operating and upgrade manuals.
   2. Program Software Backup: On magnetic media or compact disk, complete with data files.
   3. Device address list.
   4. Printout of software application and graphic screens.

1.08 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Patch-Panel Units: One of each type.
   2. Connecting Blocks: One of each type.
   3. Device Plates: One of each type.
4. Multiuser Telecommunications Outlet Assemblies: One of each type.

1.09 QUALITY ASSURANCE

A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.
   1. Layout Responsibility: Preparation of Shop Drawings and Cabling Administration Drawings, Cabling Administration Drawings, and field testing program development by an RCDD.
   2. Installation Supervision: Installation shall be under the direct supervision of Registered Technician, who shall be present at all times when Work of this Section is performed at Project site.
   3. Testing Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.

B. Testing Agency Qualifications: An NRTL.
   1. Testing Agency's Field Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Test cables upon receipt at Project site.
   1. Test optical fiber cables to determine the continuity of the strand end to end. Use optical fiber flashlight or optical loss test set.
   2. Test optical fiber cables while on reels. Use an optical time domain reflectometer to verify the cable length and locate cable defects, splices, and connector; including the loss value of each. Retain test data and include the record in maintenance data.
   3. Test each pair of UTP cable for open and short circuits.

PART 2 PRODUCTS

2.01 HORIZONTAL CABLING DESCRIPTION

A. Horizontal cable and its connecting hardware provide the means of transporting signals between the telecommunications outlet/connector and the horizontal cross-connect located in the communications equipment room. This cabling and its connecting hardware are called a "permanent link," a term that is used in the testing protocols.
   1. TIA/EIA-568-B.1 requires that a minimum of two telecommunications outlet/connections be installed for each work area.
   2. Horizontal cabling shall contain no more than one transition point or consolidation point between the horizontal cross-connect and the telecommunications outlet/connector.
   3. Bridged taps and splices shall not be installed in the horizontal cabling.
   4. Splitters shall not be installed as part of the optical fiber cabling.

B. A work area is approximately 100 sq. ft., and includes the components that extend from the telecommunications outlet/connections to the station equipment.

C. The maximum allowable horizontal cable length is 295 feet. This maximum allowable length does not include an allowance for the length of 16 feet to the workstation equipment or in the horizontal cross-connect.

2.02 PERFORMANCE REQUIREMENTS

A. General Performance: Horizontal cabling system shall comply with transmission standards in TIA/EIA-568-B.1 when tested according to test procedures of this standard.

B. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
   1. Flame-Spread Index: 25 or less.
2. Smoke-Developed Index: 50 450 or less.

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.


2.03 BACKBOARDS

A. Backboards: Plywood, fire-retardant treated, 3/4 by 48 by 96 inches. Comply with requirements in Section 061000 “Rough Carpentry” for plywood backing panels.

2.04 UTP CABLE

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:

B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. ADC.
2. Belden Inc.
3. Berk-Tek; a Nexans company.
4. CommScope, Inc.
5. Draka Cableteq USA.
7. Mohawk; a division of Belden Networking, Inc.
8. Superior Essex Inc.
9. SYSTIMAX Solutions; a CommScope, Inc. brand.
10. 3M Communication Markets Division.
11. Tyco Electronics Corporation; AMP Products.

C. Description: 100-ohm, four-pair UTP, formed into 25-pair, binder groups covered with a blue thermoplastic jacket.

1. Comply with ICEA S-90-661 for mechanical properties.
2. Comply with TIA/EIA-568-B.1 for performance specifications.
4. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444 and NFPA 70 for the following types:
   a. Communications, General Purpose: Type CM or CMG.
   b. Communications, Plenum Rated: Type CMP complying with NFPA 262.
   c. Communications, Riser Rated: Type CMR, complying with UL 1666.
   d. Communications, Limited Purpose: Type CMX.
   e. Multipurpose: Type MP or MPG.
   f. Multipurpose, Plenum Rated: Type MPP, complying with NFPA 262.
   g. Multipurpose, Riser Rated: Type MPR, complying with UL 1666.

2.05 UTP CABLE HARDWARE

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:

B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. ADC.
3. Belden Inc.
4. Dynacom Inc.
5. Hubbell Premise Wiring.
6. Leviton Commercial Networks Division.
7. Molex Premise Networks; a division of Molex, Inc.
8. Panduit Corp.
10. Tyco Electronics Corporation; AMP Products.

C. General Requirements for Cable Connecting Hardware: Comply with TIA/EIA-568-B.2, IDC type, with modules designed for punch-down caps or tools. Cables shall be terminated with connecting hardware of same category or higher.

D. Connecting Blocks: 110-style IDC for Category. Provide blocks for the number of cables terminated on the block, plus 25 percent spare. Integral with connector bodies, including plugs and jacks where indicated.

E. Cross-Connect: Modular array of connecting blocks arranged to terminate building cables and permit interconnection between cables.
   1. Number of Terminals per Field: One for each conductor in assigned cables.

F. Patch Panel: Modular panels housing multiple-numbered jack units with IDC-type connectors at each jack for permanent termination of pair groups of installed cables.
   1. Number of Jacks per Field: One for each four-pair UTP cable indicated.

G. Jacks and Jack Assemblies: Modular, color-coded, eight-position modular receptacle units with integral IDC-type terminals.

H. Patch Cords: Factory-made, four-pair cables in 36-inch 48-inch lengths; terminated with eight-position modular plug at each end.
   1. Patch cords shall have bend-relief-compliant boots and color-coded icons to ensure Category 6 performance. Patch cords shall have latch guards to protect against snagging.
   2. Patch cords shall have color-coded boots for circuit identification.

2.06 OPTICAL FIBER CABLE

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:

B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
   1. Belden Inc.
   2. Berk-Tek; a Nexans company.
   3. CommScope, Inc.
   4. Corning Cable Systems.
   5. CSI Technologies Inc.
   6. General Cable Technologies Corporation.
   7. Mohawk; a division of Belden Networking, Inc.
   8. Superior Essex Inc.
   9. SYSTIMAX Solutions; a CommScope, Inc. brand.
   10. 3M Communication Markets Division.
   11. Tyco Electronics Corporation; AMP Products.

C. Description: Multimode, 50/125 or 62.5/125-micrometer, 2, 4, or 6 -fiber, tight buffer, optical fiber cable.
   1. Comply with ICEA S-83-596 for mechanical properties.
   2. Comply with TIA/EIA-568-B.3 for performance specifications.
   3. Comply with TIA-492AAAB for detailed specifications.
   4. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444, UL 1651, and NFPA 70 for the following types:
a. General Purpose, Nonconductive: Type OFN or OFNG.
b. Plenum Rated, Nonconductive: Type OFNP, complying with NFPA 262.
c. Riser Rated, Nonconductive: Type OFNR, complying with UL 1666.
d. General Purpose, Conductive: Type OFC or OFCG.
e. Plenum Rated, Conductive: Type OFCP, complying with NFPA 262.
f. Riser Rated, Conductive: Type OFCR, complying with UL 1666.

5. Conductive cable shall be aluminum armored type.
6. Maximum Attenuation: 3.50 dB/km at 850 nm; 1.5 dB/km at 1300 nm.
7. Minimum Modal Bandwidth: 160 MHz-km at 850 nm; 500 MHz-km at 1300 nm.

D. Jacket:
   2. Cable cordage jacket, fiber, unit, and group color shall be according to TIA-598-C.
   3. Imprinted with fiber count, fiber type, and aggregate length at regular intervals not to exceed 40 inches.

2.07 OPTICAL FIBER CABLE HARDWARE

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:

B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
   1. ADC.
   3. Belden Inc.
   4. Berk-Tek; a Nexans company.
   5. Corning Cable Systems.
   6. CSI Technologies Inc.
   7. Dynacom Inc.
   8. Hubbell Premise Wiring.
   9. Molex Premise Networks; a division of Molex, Inc.
   10. Siemon Co. (The).

C. Cross-Connects and Patch Panels: Modular panels housing multiple-numbered, duplex cable connectors.
   1. Number of Connectors per Field: One for each fiber of cable or cables assigned to field, plus spares and blank positions adequate to suit specified expansion criteria.

D. Patch Cords: Factory-made, dual-fiber cables in 36-inch lengths.

E. Cable Connecting Hardware:
   2. Quick-connect, simplex and duplex, Type LC connectors. Insertion loss not more than 0.75 dB.
   3. Type SFF connectors may be used in termination racks, panels, and equipment packages.

2.08 TELECOMMUNICATIONS OUTLET/CONNECTORS

B. Workstation Outlets: Two or Four-port-connector assemblies mounted in single faceplate.
   1. Plastic Faceplate: High-impact plastic. Coordinate color with Section 262726 "Wiring Devices."
   2. Metal Faceplate: Stainless steel, complying with requirements in Section 262726 "Wiring Devices."
   3. For use with snap-in jacks accommodating any combination of UTP, optical fiber, and coaxial work area cords.
      a. Flush mounting jacks, positioning the cord at a 45-degree angle.
   4. Legend: Factory labeled by silk-screening or engraving for stainless steel.
   5. Legend: Machine printed, in the field, using adhesive-tape label.

2.09 GROUNDING

A. Comply with requirements in Section 260526 "Grounding and Bonding for Electrical Systems" for grounding conductors and connectors.

B. Comply with J-STD-607-A.

2.10 IDENTIFICATION PRODUCTS

A. Comply with TIA/EIA-606-A and UL 969 for labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

B. Comply with requirements in Section 260553 "Identification for Electrical Systems."

2.11 CABLE MANAGEMENT SYSTEM

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:

B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
   1. iTARCS Corporation, Inc.
   2. TelSoft Solutions.

C. Description: Computer-based cable management system, with integrated database and graphic capabilities.

D. Document physical characteristics by recording the network, TIA/EIA details, and connections between equipment and cable.

E. Information shall be presented in database view, schematic plans, or technical drawings.
   1. AutoCAD drawing software shall be used as drawing and schematic plans software.

F. System shall interface with the following testing and recording devices:
   1. Direct upload tests from circuit testing instrument into the personal computer.
   2. Direct download circuit labeling into labeling printer.

2.12 SOURCE QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to evaluate cables.

B. Factory test UTP and optical fiber cables on reels according to TIA/EIA-568-B.1.

C. Factory test UTP cables according to TIA/EIA-568-B.2.
D. Factory test multimode optical fiber cables according to TIA-526-14-A and TIA/EIA-568-B.3.

E. Factory-sweep test coaxial cables at frequencies from 5 MHz to 1 GHz. Sweep test shall test the frequency response, or attenuation over frequency, of a cable by generating a voltage whose frequency is varied through the specified frequency range and graphing the results.

F. Cable will be considered defective if it does not pass tests and inspections.

G. Prepare test and inspection reports.

PART 3 EXECUTION

3.01 ENTRANCE FACILITIES

A. Coordinate backbone cabling with the protectors and demarcation point provided by communications service provider.

3.02 WIRING METHODS

A. Install cables in pathways and cable trays except within consoles, cabinets, desks, and counters and except in accessible ceiling spaces and in gypsum board partitions where unenclosed wiring method may be used. Conceal pathways and cables except in unfinished spaces.
   1. Install plenum cable in environmental air spaces, including plenum ceilings.
   2. Comply with requirements in Section 270528 "Pathways for Communications Systems."
   3. Comply with requirements in Section 270536 "Cable Trays for Communications Systems."

B. Conceal conductors and cables in accessible ceilings, walls, and floors where possible.

C. Wiring within Enclosures:
   1. Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.
   2. Install lacing bars and distribution spools.
   3. Install conductors parallel with or at right angles to sides and back of enclosure.

3.03 INSTALLATION OF CABLES

A. Comply with NECA 1.

B. General Requirements for Cabling:
   2. Comply with BICSI ITSIM, Ch. 6, "Cable Termination Practices."
   3. Install 110-style IDC termination hardware unless otherwise indicated.
   4. MUTOA shall not be used as a cross-connect point.
   5. Consolidation points may be used only for making a direct connection to telecommunications outlet/connectors:
      a. Do not use consolidation point as a cross-connect point, as a patch connection, or for direct connection to workstation equipment.
      b. Locate consolidation points for UTP at least 49 feet from communications equipment room.
   6. Terminate conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.
   7. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches and not more than 6 inches from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
8. Install lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.

9. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIM, "Cabling Termination Practices" Chapter. Install lacing bars and distribution spools.

10. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.

11. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.

12. In the communications equipment room, install a 10-foot long service loop on each end of cable.

13. Pulling Cable: Comply with BICSI ITSIM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.

C. UTP Cable Installation:
   2. Do not untwist UTP cables more than 1/2 inch from the point of termination to maintain cable geometry.

D. Optical Fiber Cable Installation:
   2. Cable may be terminated on connecting hardware that is rack or cabinet mounted.

E. Open-Cable Installation:
   1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
   2. Suspend UTP cable not in a wireway or pathway a minimum of 8 inches above ceilings by cable supports not more than 60 inches apart.
   3. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.

F. Installation of Cable Routed Exposed under Raised Floors:
   1. Install plenum-rated cable only.
   2. Install cabling after the flooring system has been installed in raised floor areas.
   3. Coil cable 6 feet long not less than 12 inches in diameter below each feed point.

G. Outdoor Coaxial Cable Installation:
   1. Install outdoor connections in enclosures complying with NEMA 250, Type 4X. Install corrosion-resistant connectors with properly designed O-rings to keep out moisture.
   2. Attach antenna lead-in cable to support structure at intervals not exceeding 36 inches.

H. Group connecting hardware for cables into separate logical fields.

I. Separation from EMI Sources:
   1. Comply with BICSI TDM and TIA-569-B for separating unshielded copper voice and data communication cable from potential EMI sources, including electrical power lines and equipment.
   2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:
b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches.
3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:
   b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches.
4. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:
   b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches.
5. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches.
6. Separation between Communications Cables and Fluorescent Fixtures: A minimum of 5 inches.

3.04 FIRESTOPPING

A. Comply with requirements in Section 078413 "Penetration Firestopping."
B. Comply with TIA-569-B, Annex A, "Firestopping."
C. Comply with BICSI TDMM, "Firestopping Systems" Article.

3.05 GROUNDING

A. Install grounding according to BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.
B. Comply with J-STD-607-A.
C. Locate grounding bus bar to minimize the length of bonding conductors. Fasten to wall allowing at least 2-inch clearance behind the grounding bus bar. Connect grounding bus bar with a minimum No. 4 AWG grounding electrode conductor from grounding bus bar to suitable electrical building ground.
D. Bond metallic equipment to the grounding bus bar, using not smaller than No. 6 AWG equipment grounding conductor.

3.06 IDENTIFICATION

A. Identify system components, wiring, and cabling complying with TIA/EIA-606-A. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
   1. Administration Class: 3.
   2. Color-code cross-connect fields. Apply colors to voice and data service backboards, connections, covers, and labels.
B. Using cable management system software specified in Part 2, develop Cabling Administration Drawings for system identification, testing, and management. Use unique, alphanumeric designation for each cable and label cable, jacks, connectors, and terminals to which it connects with same designation. At completion, cable and asset management software shall reflect as-built conditions.
C. Comply with requirements in Section 099123 "Interior Painting" for painting backboards. For fire-resistant plywood, do not paint over manufacturer's label.

D. Paint and label colors for equipment identification shall comply with TIA/EIA-606-A for Class 3 level of administration, including optional identification requirements of this standard.

E. Cable Schedule: Post in prominent location in each equipment room and wiring closet. List incoming and outgoing cables and their designations, origins, and destinations. Protect with rigid frame and clear plastic cover. Furnish an electronic copy of final comprehensive schedules for Project.

F. Cabling Administration Drawings: Show building floor plans with cabling administration-point labeling. Identify labeling convention and show labels for telecommunications closets, backbone pathways, entrance pathways and cables, terminal hardware and positions, horizontal cables, work areas and workstation terminal positions, grounding buses and pathways, and equipment grounding conductors. Follow convention of TIA/EIA-606-A. Furnish electronic record of all drawings, in software and format selected by Owner.

G. Cable and Wire Identification:
   1. Label each cable within 4 inches of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.
   2. Each wire connected to building-mounted devices is not required to be numbered at device if color of wire is consistent with associated wire connected and numbered within panel or cabinet.
   3. Exposed Cables and Cables in Cable Trays and Wire Troughs: Label each cable at intervals not exceeding 15 feet.
   4. Label each terminal strip and screw terminal in each cabinet, rack, or panel.
      a. Individually number wiring conductors connected to terminal strips, and identify each cable or wiring group being extended from a panel or cabinet to a building-mounted device shall be identified with name and number of particular device as shown.
      b. Label each unit and field within distribution racks and frames.
   5. Identification within Connector Fields in Equipment Rooms and Wiring Closets: Label each connector and each discrete unit of cable-terminating and connecting hardware. Where similar jacks and plugs are used for both voice and data communication cabling, use a different color for jacks and plugs of each service.
   6. Uniquely identify and label work area cables extending from the MUTOA to the work area. These cables may not exceed the length stated on the MUTOA label.

H. Labels shall be preprinted or computer-printed type with printing area and font color that contrasts with cable jacket color but still complies with requirements in TIA/EIA-606-A.
   1. Cables use flexible vinyl or polyester that flex as cables are bent.

3.07 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

C. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
   2. Visually confirm Category 6, marking of outlets, cover plates, outlet/connectors, and patch panels.
3. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.

4. Test UTP backbone copper cabling for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination but not cross-connection.
   a. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-B.2. Perform tests with a tester that complies with performance requirements in "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.

5. Optical Fiber Cable Tests:
   a. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-B.1. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
   b. Link End-to-End Attenuation Tests:
      1) Horizontal and multimode backbone link measurements: Test at 850 or 1300 nm in 1 direction according to TIA-526-14-A, Method B, One Reference Jumper.
      2) Attenuation test results for backbone links shall be less than 2.0 dB. Attenuation test results shall be less than that calculated according to equation in TIA/EIA-568-B.1.

6. UTP Performance Tests:
   a. Test for each outlet and MUTOA. Perform the following tests according to TIA/EIA-568-B.1 and TIA/EIA-568-B.2:
      1) Wire map.
      2) Length (physical vs. electrical, and length requirements).
      3) Insertion loss.
      4) Near-end crosstalk (NEXT) loss.
      5) Power sum near-end crosstalk (PSNEXT) loss.
      6) Equal-level far-end crosstalk (ELFEXT).
      7) Power sum equal-level far-end crosstalk (PSELFEXT).
      8) Return loss.
      9) Propagation delay.
      10) Delay skew.

7. Optical Fiber Cable Performance Tests: Perform optical fiber end-to-end link tests according to TIA/EIA-568-B.1 and TIA/EIA-568-B.3.

8. Coaxial Cable Tests: Conduct tests according to Section 274133 "Master Antenna Television System."

9. Final Verification Tests: Perform verification tests for UTP and optical fiber systems after the complete communications cabling and workstation outlet/connectors are installed.
   a. Voice Tests: These tests assume that dial tone service has been installed. Connect to the network interface device at the demarcation point. Go off-hook and listen and receive a dial tone. If a test number is available, make and receive a local, long distance, and digital subscription line telephone call.
   b. Data Tests: These tests assume the Information Technology Staff has a network installed and is available to assist with testing. Connect to the network interface device at the demarcation point. Log onto the network to ensure proper connection to the network.

D. Document data for each measurement. Data for submittals shall be printed in a summary report that is formatted similar to Table 10.1 in BICSI TDMM, or transferred from the instrument to the computer, saved as text files, and printed and submitted.

E. End-to-end cabling will be considered defective if it does not pass tests and inspections.
F. Prepare test and inspection reports.

3.08 DEMONSTRATION

A. Train Owner's maintenance personnel in cable-plant management operations, including changing signal pathways for different workstations, rerouting signals in failed cables, and keeping records of cabling assignments and revisions when extending wiring to establish new workstation outlets. Include training in cabling administration software.

END OF SECTION
PART 1 DATA AND VOIP OUTLETS

1.1 COMMSCOPE – ADC KRONE

Note: For those locations where the patch panel is installed in a cabinet or primary rack, the data outlets are not individually installed in the patch panel. Refer to Commscope – ADC Krone Part No. 6653 1 679-24 (24-Port Category 6 Patch Panel with Snap-in Port ID Tabs and Paper Labels, T568A/B Compatible) or 6653 1 679-48 (48-Port Category 6 Patch Panel with Snap-in Port ID Tabs and Paper Labels, T568A/B Compatible).

A. Terminate each data outlet with one (1) black, Category 6, 8 position snap-in jack. Commscope – ADC Krone Part No. 6830 1 830-04.

B. Terminate each Power-Over-Ethernet data / VoIP phone outlet with one (1) green, Category 6, 8 position snap-in jack. Commscope – ADC Krone Part No. 6830 1 830-07.

C. Provide ivory blank modules as necessary to fill all unused positions of the faceplate. Use Commscope – ADC Krone Part No. 6645 1 160-02.

PROVIDE QUANTITY OF: AS REQUIRED

1.2 SIEMON

Note: For those locations where the patch panel is installed in a cabinet or primary rack, the data outlets are not individually installed in the patch panel. Refer to Siemon Part No. HD6-24 (24-Port Panel, T568A/B wiring, 1RMS) or HD6-48 (48-Port Panel, T568A/B wiring, 2RMS)

A. Terminate each data outlet installed in a faceplate with one (1) black, angled, Category 6, 8 position snap-in jack. Siemon Part No. MX6-01

B. Terminate each data outlet installed in a patch panel with one (1) black, flat, Category 6, 8 position snap-in jack. Siemon Part no. MX6-F01.

C. Terminate each Power Over Ethernet data/ VoIP phone outlet installed in a faceplate not mounted at +46° A.F.F. with one (1) green, angled, Category 6, 8 position snap-in jack. Siemon Part No. MX6-07.

D. Terminate each Power Over Ethernet data/VoIP phone outlet installed in a patch panel with one (1) green, flat, Category 6, 8 position snap-in jack. Siemon Part No. MX6-F07.

F. Provide ivory blank modules as necessary to fill all unused positions of the faceplate. Use Siemon Part No. MX-BL-20.

PROVIDE QUANTITY OF: AS REQUIRED

1.3 COMMSCOPE - SYSTIMAX

Note: For those locations where the patch panel is installed in a cabinet or primary rack, the data outlets are not individually installed in the patch panel. Refer to Commscope - Systimax Part No. 360-IPR-1100-E-GS3-1U-24 (760152561) or 360-IPR-1100-E-GS3-2U-48 (760152579).
A. Terminate each data outlet installed in a faceplate with one (1) black, Category 6, 8 position snap-in jack. Commscope - Systimax Part No. MGS400-003, 700206667 mounted in the angled position.

B. Terminate each data outlet installed in a patch panel with one (1) black, Category 6, 8 position snap-in jack. Commscope - Systimax Part No. MGS400-003, 700206667 mounted in the flat position.

C. Terminate each Power-Over-Ethernet data / VoIP phone outlet installed in a faceplate not mounted at +46” A.F.F. with one (1) green, Category 6, 8 position snap-in jack. Commscope - Systimax Part No. MGS400-226 (700206709), mounted in the angled position. The only exception is for those outlets installed in flat faceplates on either DS4000 or 4000 series Wiremold raceway which is mounted horizontally on the wall (typically in computer labs). For those single gang faceplates mounted vertically on DS4000 (also a vertical run), the jacks shall be angled downward.

D. Terminate each Power-Over-Ethernet data / VoIP phone outlet installed in a modular patch panel with one (1) green, Category 6, 8 position snap-in jack. Commscope - Systimax Part No. MGS400-226 (700206709), mounted in the flat position.

E. Provide ivory blank modules as necessary to fill all unused positions of the faceplate. Use Commscope - Systimax Part No. M20AP-246, 107067860.

PROVIDE QUANTITY OF: AS REQUIRED

1.4 BLT BERK-TEK/LEVITON

Note: For those locations where the patch panel is installed in a cabinet or primary rack, the data outlets are not individually installed in the patch panel. Refer to BLT Leviton Part No. 69586-U24 (24-Port Category 6 Patch Panel with Drop-in Port ID Tabs and Paper Labels, T568A/B Compatible) or 69586-U48 -48 (48-Port Category 6 Patch Panel with Drop-in Port ID Tabs and Paper Labels, T568A/B Compatible).

A. Terminate each data outlet with one (1) black, Category 6, 8 position snap-in jack. BLT Leviton Part No. 61110-RE6.

B. Terminate each Power-Over-Ethernet data / VoIP phone outlet with one (1) green, Category 6, 8 position snap-in jack. BLT Leviton Part No. 61110-RV6.

C. Provide ivory blank modules as necessary to fill all unused positions of the faceplate. Use BLT Leviton Part No. 41084-BIB.

PROVIDE QUANTITY OF: AS REQUIRED

PART 2 CAT6A SHIELDED OUTLETS – WIRELESS POE

2.1 COMMSCOPE – ADC KRONE

Commscope – ADC Krone does not have a product, and therefore requires the cable and connectivity from another Commscope cable manufacturer. Use Commscope – Systimax as a solution. Provide appropriate manufacturer faceplates and any associated materials at wireless outlet locations to match.

2.2 SIEMON

For locations where a 1U, 24 port modular CAT6A shielded patch panel is shown, the contractor shall provide patch panel Z6AS-PNL-24. The part number comes with all the CAT6A shielded jacks required to fully populate the patch panel.
A. Install Siemon Part No. Z6A-S07 at locations designated for CAT6A wireless outlets identified in the drawings.

PROVIDE QUANTITY OF: AS REQUIRED

2.3 COMMSCOPE – SYSTIMAX

A. Install CommScope – Systimax Part No. HGS620 (760152801) at locations designated for CAT6A wireless outlets identified in the drawings.

1. Provide an M-series adapter for each faceplate location, CommScope - Systimax Part No. HGS-A-GREEN (760154237).

B. Install CommScope – Systimax Part No. HGS620 (760152801) for each modular opening on the 24 port shielded patch panels Part No. 360-IPR-MFTP-E-HD6B-1U-24 identified in the drawings.

PROVIDE QUANTITY OF: AS REQUIRED

2.4 BLT – BERKTEK/LEVITON

BLT Berk-Tek: Not approved at this time. Contractor shall use one of the other three solutions provided. Contractor shall attain certification and provide 15 year warranty for installation. Provide appropriate manufacturer faceplates and any associated materials at wireless outlet locations to match.

PART 3 PHONE OUTLETS

3.1 COMMSCOPE – ADC KRONE

A. Terminate each phone outlet with one (1) white, RJ-11 snap-in jack. Use CommScope – ADC Krone Part No. 6467 5 195-20.

1. Provide ivory blank modules as necessary to fill all unused positions of the faceplate. Use CommScope – ADC Krone Part No. 6645 1 160-02.

PROVIDE QUANTITY OF: AS REQUIRED

3.2 SIEMON

A. Terminate each phone outlet mounted at +18” A.F.F. with one (1) white, angled, RJ-11 snap-in jack. Use Siemon Part No. MX3-U3-02.

B. Terminate each phone outlet mounted at +46” A.F.F. with one (1) white, flat, RJ-11 snap-in jack. Use Siemon Part No. MX3-F-U3-02.

C. Terminate each Power-Over-Ethernet VolP phone outlet mounted at +46” A.F.F. with one (1) green, flat, Category 6 RJ-45 snap-in jack. Siemon Part No. MX6-F07.

D. Provide ivory blank modules as necessary to fill all unused positions of the faceplate. Use Siemon Part No. MX-BL-20.

PROVIDE QUANTITY OF: AS REQUIRED

3.3 COMMSCOPE - SYSTIMAX

A. Terminate each phone outlet mounted at +18” A.F.F. with one (1) white, RJ-11 snap-in jack, mounted in the angled position. Use CommScope - Systimax Part No. M1AH-262, 107322166.

B. Terminate each phone outlet mounted at +46” A.F.F. with one (1) white, RJ-11 snap-in jack, mounted in the flat position. Use CommScope - Systimax Part No. M1AH-262, 107322166.
C. Terminate each Power-Over-Ethernet VoIP phone outlet mounted at +46" A.F.F. with one (1) green, Category 6, 8 position snap-in jack. Commscope - Systimax Part No. MGS400-226, 700206709 mounted in the flat position.

D. Provide ivory blank modules as necessary to fill all unused positions of the faceplate. Use Commscope - Systimax Part No. M20AP-246, 107067860.

PROVIDE QUANTITY OF: AS REQUIRED

3.4 BLT BERK-TEK/LEVITION

A. Terminate each phone outlet with one (1) white, RJ-11 snap-in jack. Use BLT Leviton Part No. 41106-RW6.

B. Provide ivory blank modules as necessary to fill all unused positions of the faceplate. Use BLT Leviton Part No. 41084-BIB.

PROVIDE QUANTITY OF: AS REQUIRED

PART 4 FACEPLATES

4.1 GENERAL

A. Provide each data outlet and +18" A.F.F. telephone outlet with an ivory, single-gang, four port, angled (downward) faceplate at each location not using the Wiremold 4000 series.
   1. Commscope – ADC Krone Part No. 6644 1 174-02
      a. When installing plates in the Wiremold 4000 series, use appropriate Commscope – ADC Krone faceplate.
   2. Siemon Part No. MX-FP-S-04-20
      a. When installing plates in the Wiremold 4000 series, use appropriate Siemon faceplate.
      a. When installing plates in the Wiremold 4000 series, use appropriate Commscope- Systimax faceplate.
   4. BLT Leviton Part No. 42081-4IP.
      a. When installing plates in the Wiremold 4000 series, use appropriate BLT Leviton faceplate.

PROVIDE QUANTITY OF: AS REQUIRED

4.2 WALL MOUNT PHONES

A. Provide each telephone outlet designated as a wall mount location with an ivory, single-gang, two port, flush/flat faceplate.
   1. Commscope – ADC Krone Part No. 6644 1 152-02.
   4. BLT Leviton Part No. 42080-2IS.

PROVIDE QUANTITY OF: AS REQUIRED

4.3 MULTI USE CEILING ENCLOSURES

A. Provide each data outlet, fiber snap-in jack and/or audio/video control and distribution cable outlet installed in a Multi-Use Ceiling Enclosure with an ivory, double-gang, twelve port, flush faceplate.
   2. Siemon Part No. MX-FP-D-12-20.
   4. BLT Leviton Part No. 42080-12I.

PROVIDE QUANTITY OF: AS REQUIRED
B. Provide double outlet adapters for all six (6) adaptor positions in the flexible faceplate to accommodate copper and optical fiber cabling snap-in jacks.
      PROVIDE QUANTITY OF: AS REQUIRED

4.4 SURFACE MOUNT CAT6A WIRELESS BOXES

A. Provide a 2 port ivory surface outlet box on the surface of wall locations where identified in the drawings. Use Wiremold V2400 series raceway directly down from the accessible ceiling space to the outlet box at +96" AFF. Jacks shall always face downward.
      PROVIDE QUANTITY OF: AS REQUIRED

4.5 WIRELESS OUTLET FACEPLATE

A. The CAT6A Shielded wireless junction boxes, if not using surface mount boxes, shall be installed in acoustical tile ceilings or in walls at +96" AFF. These locations will be using the 5-square Telecom junction box with 2-gang mud ring. These locations require a 2-gang faceplate, using two holes for the wireless. The jacks/faceplate shall be angled (downward if on wall). The Contractor shall submit, as part of their product submittal, the faceplate which they intend to use. The faceplate shall be from the manufacturer of the approved CAT6A Shielded manufacturer they intend to use on the project. The faceplate can be multiport, provided blanks are the same color of the faceplate are inserted in unused ports.
   1. For ceiling faceplates, the color of the angled, 2-gang faceplate shall be colored white.
   2. For wall mounted faceplates, the color of the angled, 2-gang faceplate shall be colored ivory.
      PROVIDE QUANTITY OF: AS REQUIRED

PART 5 MULTI MODE OPTICAL FIBER CABLE TERMINATIONS

5.1 OM3 / OM4 LC CONNECTORS

A. Terminate all multimode fiber optic cables as required with an LC connector. Land the LC connectors in the fiber interconnect center LC adapter plate as shown in the detail drawings. All fiber optic LC connectors shall be capable of achieving an insertion loss of 0.30 dB or less which is guaranteed under the warranty (using a contractor certified with the manufacturer) provided by the following manufacturers. The lower loss is necessary to meet the performance link loss / insertion loss requirements identified in Specification Section 27 13 00.
   2. Siemon Part No. FC1-LC-MM-B80.
   3. Commscope - Systimax Part No. 760117887 (MFC-LCF-09-5X) Qwik II-LC.
   4. Leviton Part No. 49991-LLC.
      PROVIDE QUANTITY OF: AS REQUIRED

PART 6 WIRELESS OUTLET PATCH CORDS

6.1 CONTRACTOR PROVIDED, OWNER INSTALLED PATCH CORDS

A. In order to avoid impedance mismatches by mixing patch cords from different manufacturers, the contractor shall provide the CAT6A shielded patch cords to the Owner prior to the submittal of test reports. The Contractor shall provide Quantity 12 each of the following patch cords for each 24 port CAT6A patch panel shown in the drawings, regardless of how many outlets are being terminated. Provide twelve 3 foot long and twelve 4 foot long white patch cords for each CAT6A shielded patch panel shown. Patch Cords shall match manufacturer of cable and outlets installed.
   1. Siemon Part No. ZM6A-S03-02 (CAT6A Shielded White 3FT)
2. Siemon Part No. ZM6A-S04-02 (CAT6A Shielded White 4FT)
3. Commscope – Systimax Part No. CPCGG32-08F003 (G10FP-WH-3FT)
4. Commscope – Systimax Part No. CPCGG32-08F004 (G10FP-WH-4FT)

PART 7 WIRELESS OUTLET (SPECIAL CONDITIONS)

7.1 WIRELESS ACCESS POINT ENCLOSURE FOR GYMS

A. For those CAT6A Wireless outlets installed at +96” AFF in a Gym, the Contractor shall install a protective enclosure next to the outlet in order to protect the Access Point (AP) which will be installed by the Owner. The bottom of the enclosure shall be in-line with the bottom of the Wireless outlet faceplate or surface outlet box. Place enclosure approximately 6 inches away from the edge of the faceplate or surface outlet box, upright (door swings to side), and drill a one inch (1”) hole in the bottom of the enclosure. Drilled hole shall be located close to edge nearest the outlet and two inches (2”) from back of enclosure. Contractor shall also install back panel inside enclosure so Owner can mount a Wireless Access Point inside. Coordinate locations prior to installation to be certain bot outlet and enclosure can fit in the designated location. Take care to avoid any murals, conduit, or acoustical dampening panels. Use the following parts:

1. Enclosure with clear cover, 17.65"H x 16.68"W x 9.98"D. Use Stahlin Polystar series enclosure Part Number PC1614CC.
2. Rear mounting back panel. Use Stahlin Polystar series panel Part Number BP1614.

PROVIDE QUANTITY OF: AS REQUIRED

7.2 ACCESS POINT MOUNT FOR PLASTER, CMU, OR Poured CONCRETE (TILT-UP) WALLS

A. When a wireless outlet is installed on a plaster, CMU, or poured concrete (tilt-up) wall, the Contractor shall install an 8 inch x 8 inch (8” x 8”) piece of ¾” backboard. Paint backboard to match background colors.

1. Contractor shall coordinate with Architect, CCSD Inspection Services, and the Engineer in writing regarding requirement to establish if there are any conflicts with materials and if there is a preferred alternate which should be used.

PROVIDE QUANTITY OF: AS REQUIRED

END OF SECTION
PART 1 - GENERAL

1.1 DESCRIPTION

A. This section of the specification includes the furnishing, installation, connection and testing of the microprocessor controlled, intelligent reporting fire alarm equipment required to form a complete, fully functional, coordinated system. It shall include, but not be limited to, alarm initiating devices, alarm notification appliances, Fire Alarm Control Panel (FACP), Auxiliary Control Devices including Remote Testing Units, Annunciators, Radio Alarm Transmitter, and wiring as specified herein.

B. The fire alarm system shall comply with requirements of NFPA Standard 72 for Protected Premises Signaling Systems except as modified and supplemented by this specification. The system shall be electrically supervised and monitor the integrity of all conductors.

C. The installing company shall employ NICET (minimum Level II certification in fire protection engineering technology, sub field of fire alarm systems) technician to review and sign off on shop drawings and to be on Site to guide the final checkout and to ensure system integrity.

1.2 SCOPE

A. A new intelligent reporting, microprocessor controlled fire detection system shall be installed in accordance to the project specifications and drawings.

B. Basic Performance:
   1. Alarm, trouble and supervisory signals from all intelligent reporting devices shall be encoded on NFPA Style 4 (Class B) Signaling Line Circuits (SLC).
   2. Initiation Device Circuits (IDC) shall be wired Class A (NFPA Style D) as part of an addressable device connected by the SLC Circuit.
   3. Notification Appliance Circuits (NAC) shall be wired Class A (NFPA Style Z) as part of an addressable device connected by the SLC Circuit.
   4. On Style 6 or 7 (Class A) configurations a single ground fault or open circuit on the system Signaling Line Circuit shall not cause system malfunction, loss of operating power or the ability to report an alarm.
   5. Alarm signals arriving at the FACP shall not be lost following a primary power failure (or outage) until the alarm signal is processed and recorded.

C. Basic System Functional Operation

When a fire alarm condition is detected and reported by one of the system initiating devices, the following functions shall immediately occur:
   1. The system alarm on the system display shall flash.
   2. A local electric signal in the FACP and Annunciator Panel shall sound.
   3. A lighted display shall indicate all information associated with the alarm condition, including the type of alarm point and its location within the protected premises.
   4. Event history storage equipment shall log the information associated each new alarm control panel condition, along with time and date of occurrence.
   5. All system output programs assigned via control-by-event interlock programming to be activated by the particular point in alarm shall be executed, and the associated system outputs (notification appliances and/or relays) shall be activated.
1.3 SUBMITTALS

A. General:
1. Submittals shall be reviewed by the Engineer prior to submitting them to the AHJ (authority having jurisdiction).
2. Three (3) copies of complete submittals for all equipment and devices, as specified, shall be submitted to the Owner for review and approval not later than seven (7) calendar days after notification of Intent to Award.
3. All references to manufacturer's model numbers and other pertinent information herein is intended to establish minimum standards of performance, function and quality. Equivalent compatible UL-Listed equipment from other manufacturers may be substituted for the specified equipment as long as the minimum standards are met.
4. For equipment other than that specified, the contractor shall supply proof that such substitute equipment equals or exceeds the features, functions, performance, and quality of the specified equipment.

B. Shop Drawings.
1. Sufficient information, clearly presented, shall be included to determine compliance with drawings and specifications and current adopted code of the AHJ.
2. Include manufacturer's name(s), model numbers, ratings, power requirements, equipment layout, device arrangement, complete wiring point-to-point diagrams, and conduit layouts.
3. Show annunciator layout, configurations, and terminations.

C. Manuals:
1. Submit simultaneously with the shop drawings, complete operating and maintenance manuals listing the manufacturer's name(s), including technical data sheets.
2. Wiring diagrams shall indicate internal wiring for each device and the interconnections between the items of equipment.
3. Provide a clear and concise description of operation that gives, in detail, the information required to properly operate the equipment and system.

D. Software Modifications
1. Provide the services of a manufacturer trained and authorized technician to perform all system software modifications, upgrades or changes. Response time of the technician to the site shall not exceed 4 hours.
2. Provide all hardware, software, programming tools and documentation necessary to modify the system on site. Modification includes addition and deletion of devices, circuits, zones and changes to system operation and custom label changes for devices or zones. The system structure and software shall place no limit on the type or extent of software modifications on-site.

E. Certifications:

Together with the shop drawing submittal, submit a certification from the major equipment manufacturer indicating that the proposed supervisor of the installation and the proposed performer of contract maintenance is an authorized representative of the major equipment manufacturer. Include names and addresses in the certification.

1.4 GUARANTY:

All work performed and all material and equipment furnished under this contract shall be free from defects and shall remain so for a period of at least one (1) year from the date of acceptance by the AHJ. The full cost of maintenance, labor and materials required to correct any defect during this one year period shall be included in the submittal bid.
1.5. POST CONTRACT MAINTENANCE AND TESTING:

A. All maintenance and repair service for the fire alarm system shall be available from a factory trained authorized representative of the manufacturer of the major equipment for a period of two (2) years after acceptance by the AHJ.

B. Provide all maintenance, tests, and repairs described below for two (2) years from date of acceptance by AHJ. The full cost of maintenance, testing, labor and materials during this two year period shall be included in the submittal bid.

C. Maintenance and testing shall be on a quarterly basis with approximately one quarter of the devices serviced/tested during each quarterly inspection. A preventive maintenance schedule shall be provided by the contractor describing the protocol for preventive maintenance. The schedule shall include:
   1. Systematic examination, adjustment and cleaning of all detectors, manual fire alarm stations, control panels, power supplies, relays, water flow and tamper switches and all accessories of the fire alarm system.
   2. Each circuit in the fire alarm system shall be tested semiannually.
   3. Each smoke detector shall be tested in accordance with the requirements of NFPA 72 Chapter 7.

1.6 POST CONTRACT EXPANSIONS: - NOT REQUIRED

1.7 APPLICABLE STANDARDS AND SPECIFICATIONS:

The specifications and standards listed below form a part of this specification. The system shall fully comply with the latest issue of these standards, if applicable.

A. National Fire Protection Association (NFPA) - USA:
   No. 13 Sprinkler Systems
   No. 15 Water Spray Systems
   No. 72 National Fire Alarm Code
   No. 101 Life Safety Code

B. Local and State Building Codes.

C. All requirements of the Authority Having Jurisdiction (AHJ).

1.8 APPROVALS:

A. The system shall have proper listing and/or approval from the following nationally recognized agencies:
   UL Underwriters Laboratories Inc
   ULC Underwriters Laboratories Canada

A. The fire alarm control panel shall meet UL Standard 864 (Control Units).

PART 2 - PRODUCTS

2.1 EQUIPMENT AND MATERIAL, GENERAL:
A. All equipment and components provided shall be "open source" and available from multiple independent, competitive dealers.

B. All equipment and components shall be new, and the manufacturer's current model. The materials, appliances, equipment and devices shall be tested and listed by a nationally recognized approvals agency for use as part of a protective signaling system, meeting the National Fire Alarm Code. All batteries shall be installed within 90 days of manufacture date.

C. All equipment and components shall be installed in strict compliance with manufacturers' recommendations. Consult the manufacturer's installation manuals for all wiring diagrams, schematics, physical equipment sizes, etc., before beginning system installation.

D. All equipment shall be attached to walls and ceiling/floor assemblies and shall be held firmly in place (e.g., detectors shall not be supported solely by suspended ceilings). Fasteners and supports shall be adequate to support the required load.

### 2.2 CONDUIT AND CABLE AND WIRE:

#### A. Conduit:
1. Conduit shall be in accordance with The National Electrical Code (NEC), local and state requirements.
2. Where required, all wiring shall be installed in conduit or raceway. Conduit fill shall not exceed 40 percent of interior cross sectional area where three or more cables are contained within a single conduit.
3. Cable must be separated from any open conductors of power, or Class 1 circuits, and shall not be placed in any conduit, junction box or raceway containing these conductors, per NEC Article 760-55.
4. Wiring for 24-volt DC control, alarm notification, emergency communication and similar power-limited auxiliary functions may be run in the same conduit as initiating and signaling line circuits. All circuits shall be provided with transient suppression devices and the system shall be designed to permit simultaneous operation of all circuits without interference or loss of signals.
5. Conduit shall not enter the fire alarm control panel, or any other remotely mounted control panel equipment or backboxes, except where conduit entry is specified by the FACP manufacturer.
6. Conduit shall be 3/4-inch (19.1 mm) minimum.

#### B. Cable and Wire:
1. All alarm system cable and wiring shall be new.
2. Wiring shall be in accordance with local, state and national codes (e.g., NEC Article 760) and as recommended by the manufacturer of the fire alarm system. Number and size of conductors shall be as recommended by the fire alarm system manufacturer, but not less than 18 AWG (1.02 mm) for Initiating Device Circuits and Signaling Line Circuits, and 14 AWG (1.63 mm) for Notification Appliance Circuits.
3. All wire and cable shall be listed and/or approved by a recognized testing agency for use with a protective signaling system.
4. Wire and cable not installed in conduit shall have a fire resistance rating suitable for the installation as indicated in NFPA 70 (e.g. FPLR).
5. Wiring used for the multiplex communication circuit (SLC) shall be twisted and unshielded and support a minimum wiring distance of 12,500 feet. The design of the system shall permit use of IDC and NAC wiring in the same conduit with the SLC communication circuit.
6. All field wiring shall be electrically supervised for open circuit and ground fault.
7. The fire alarm control panel shall be capable of t-tapping Class B (NFPA Style 4) Signaling Line Circuits (SLCs). Systems that do not allow or have restrictions in, for example, the amount of t-taps, length of t-taps etc., are not acceptable.
C. Terminal Boxes, Junction Boxes and Cabinets:

All boxes and cabinets shall be UL listed for their use and purpose.

D. Initiating circuits shall be arranged to serve like categories (manual, smoke, water flow). Mixed category circuitry shall not be permitted except on signaling line circuits connected to intelligent reporting devices.

E. The Fire Alarm Control Panel shall be connected to a separate dedicated branch circuit, maximum 20 amperes. This circuit shall be labeled at the main power distribution panel as FIRE ALARM. Fire alarm control panel primary power wiring shall be 12 AWG. The control panel cabinet shall be grounded securely to either a cold-water pipe or grounding rod.

2.3 MAIN FIRE ALARM CONTROL PANEL OR NETWORK NODE:

A. Main FACP or network node shall contain a microprocessor based Central Processing Unit (CPU) and power. The CPU shall communicate with and control the following types of equipment used to make up the system: intelligent addressable smoke and/or thermal (heat) detectors, addressable modules, annunciators, and other system controlled devices.

B. Operator Control

1. Acknowledge Switch:
   a. Activation of the control panel acknowledge switch in response to new alarms and/or troubles shall silence the local panel piezo electric signal and change the alarm and trouble LEDs from flashing mode to steady-ON mode. If multiple alarm or trouble conditions exist, depression of this switch shall advance the display to the next alarm or trouble condition.
   b. Depression of the Acknowledge switch shall also silence all remote annunciator piezo sounders.

2. Alarm Silence Switch:

   Activation of the alarm silence switch shall cause all programmed alarm notification appliances and relays to return to the normal condition after an alarm condition. The selection of notification circuits and relays that are silenceable by this switch shall be fully field programmable within the confines of all applicable standards. The FACP software shall include silence inhibit and auto-silence timers.

3. Alarm Activate (Drill) Switch:

   The Alarm Activate switch shall activate all notification appliance circuits only. The drill function shall latch until the panel is silenced or reset.

4. System Reset Switch:

   Activation of the System Reset switch shall cause all electronically-latched initiating devices, appliances or software zones: as well as all associated output devices and circuits, to return to their normal condition.

5. Lamp Test:

   The Lamp Test switch shall activate all local system LEDs, light each segment of the liquid crystal display.

C. System Capacity and General Operation

1. The control panel or each network node shall provide, or be capable of expansion to a minimum of 400 intelligent/addressable devices.

2. The control panel or each network node shall include Form-C alarm, trouble, supervisory, and security relays rated at a minimum of 2.0 amps @ 30 VDC.

3. It shall also include four Class B (NFPA Style Y) or Class A (NFPA Style Z) programmable Notification Appliance Circuits.
4. The Notification Appliance Circuits shall be programmable to synchronize with applicable appliances.

5. The system shall include a full featured operator interface control and annunciation panel that shall include a backlit Liquid Crystal Display (LCD), individual color coded system status LEDs, and an alphanumeric keypad with easy touch keys for the field programming and control of the fire alarm system.

6. The system shall be programmable, configurable, and expandable in the field without the need for special tools, PROM programmers or PC based programmers. It shall not require replacement of memory ICs to facilitate programming changes.

7. The system shall allow the programming of any input to activate any output or group of outputs. Systems that have limited programming (such as general alarm), have complicated programming (such as a diode matrix), or require a computer are not considered suitable substitutes. The FACP shall support up to 20 logic equations, including "and," "or," and "not," or time delay equations to be used for advanced programming.

8. The FACP or each network node shall provide the following features:
   a. Drift compensation to extend detector accuracy over life. Drift compensation shall also include a smoothing feature, allowing transient noise signals to be filtered out
   b. Detector sensitivity test, meeting requirements of NFPA 72, Chapter 7.
   c. Maintenance alert, with two levels (maintenance alert/maintenance urgent), to warn of excessive smoke detector dirt or dust accumulation.
   d. Nine sensitivity levels for alarm, selected by detector. The alarm level range shall be .5 to 2.35 percent per foot for photoelectric detectors and 0.5 to 2.5 percent per foot for ionization detectors. The system shall also support sensitive advanced detection laser detectors with an alarm level range of .03 percent per foot to 1.0 percent per foot. The system shall also include up to nine levels of Pre-alarm, selected by detector, to indicate impending alarms to maintenance personnel.
   e. The ability to display and print system reports.
   f. Alarm verification, with counters and a trouble indication to alert maintenance personnel when a detector enters verification 20 times. § PAS pre-signal, meeting NFPA 72 3-8.3 requirements.
   g. PAS pre-signal, meeting NFPA 72 3-8.4 requirements.
   h. Rapid manual station reporting (under 3 seconds) and shall meet NFPA 72 Chapter 1 requirements for activation of notification circuits within 10 seconds of initiating device activation.
   i. Periodic detector test, conducted automatically by the software.
   j. Self-optimizing pre-alarm for advanced fire warning, which allows each detector to learn its particular environment and set its pre-alarm level to just above normal peaks.
   k. Cross zoning with the capability of counting: two detectors in alarm, two software zones in alarm, or one smoke detector and one thermal detector.
   l. Walk test) with a check for two detectors set to same address.
   m. Control-by-time for non-fire operations, with holiday schedules.
   n. Day/night automatic adjustment of detector sensitivity.

9. The FACP shall be capable of coding main panel node notification circuits in March Time (120 PPM), and Temporal (NFPA 72 A-2-2 °). Panel notification circuits (NAC 1 1213 and 4) shall also support Two-Stage operation. Two stage operation shall allow 20 Pulses Per Minute (PPM) on alarm and 120 PPM after 5 minutes or when a second device activates. Canadian Dual stage is the same as Two-Stage except will only switch to second stage by activation of Drill Switch 3 or 5 minute timer. The panel shall also provide a coding option that will synchronize specific strobe lights designed to accept a specific "sync pulse."

10. Network Communication
   a. The FACP shall be capable of communicating on a Local Area Network (LAN), a firmware package that utilizes a peer-to-peer, inherently regenerative communication format and protocol.

D. Central Microprocessor
1. The microprocessor shall be a state-of-the-art, high speed, 16-bit RISC device and it shall communicate with, monitor and control all external interfaces. It shall include an EPROM for system program storage. Flash memory for building-specific program storage, and a timer circuit to detect and report microprocessor failure.

2. The microprocessor shall contain and execute all control-by-event programs for specific action to be taken if an alarm condition is detected by the system. Control-by-event equations shall be held in non-volatile programmable memory, and shall not be lost even if system primary and secondary power failure occurs.

3. The microprocessor shall also provide a real-time clock for time annotation of system displays, printer, and history file. The time-of-day and date shall not be lost if system primary and secondary power supplies fail. The real time clock may also be used to control non-fire functions at programmed time-of-day, day-of-week, and day-of-year.

4. A special program check function shall be provided to detect common operator errors.

5. An auto-program (self-learn) function shall be provided to quickly install initial functions and make the system operational.

6. For flexibility and to ensure program validity, an optional Windows(TM) based program utility shall be available. This program shall be used to off-line program the system with batch upload/download, and have the ability to upgrade the manufacturers (FLASH) system code changes. This program shall also have a verification utility, which scans the program files, identifying possible errors. It shall also have the ability to compare old program files to new ones, identifying differences in the two files to allow complete testing of any system operating changes. This shall be in compliance with the NFPA 72 requirements for testing after system modification.

E. System Display

1. The display shall provide all the controls and indicators used by the system operator:

   The display (80 or 640-character) shall include the following operator control switches: ACKNOWLEDGE, ALARM SILENCE, ALARM ACTIVATE (drill)l SYSTEM RESET, and LAMP TEST.

2. The display shall annunciate status information and custom alphanumeric labels for all intelligent detectors, addressable modules, internal panel circuits, and software zones.

3. The display shall provide Light-Emitting-Diodes (LEDs), that indicate the status of the following system parameters: AC POWER, FIRE ALARM, PRE-ALARM WARNING, SUPERVISORY SIGNAL, SYSTEM TROUBLE, DISABLED POINTS, ALARM SILENCED, Controls Active, Pre-Discharge, Discharge and Abort.

4. The display keypad shall be an easy to use QWERTY type keypad, similar to a PC keyboard. This shall be part of the standard system and have the capability to commend all system functions, entry of any alphabetic or numeric information, and field programming. Two different password levels shall be provided to prevent unauthorized system control or programming.

5. The system shall support the display of battery charging current and voltage.

F. Signaling Line Circuits (SLC)

1. Each FACP or FACP network node shall support up to two SLCs. Each SLC interface shall provide power to and communicate with up to 159 intelligent detectors (ionization, photoelectric or thermal) and 159 intelligent modules (monitor or control) for a loop capacity of 318 devices. The addition of the optional second loop shall double the device capacity, supporting a total of 636 devices. Each SLC shall be capable of NFPA 72 Style 4, Style 6, or Style 7 (Class A or B) wiring.

2. CPU shall receive information from all intelligent detectors to be processed to determine whether normal, alarm, pre-alarm, or trouble conditions exist for each detector. The software shall automatically maintain the detector's desired sensitivity level by adjusting for the effects of environmental factors, including
the accumulation of dust in each detector. The information shall also be used for automatic detector testing and for the automatic determination of detector maintenance requirements.

G. Serial Interfaces
1. The system shall include two serial EIA-232 interfaces. Each interface shall be a means of connecting UL Listed Information Technology Equipment (ITE) peripherals.
   a. One EIA-232 interface shall be used to connect an UL-Listed 40 or 80 column printer. Printers that are not UL-Listed are not considered acceptable substitutes.
   b. One EIA-232 interface shall be used to connect a UL-listed CRT terminal. This interface shall include special protocol methods that allow off-site monitoring of the FACP over standard dial-up phone lines. This ancillary capability shall allow remote readout of all status information, including analog values, and shall not interfere with or degrade FACP operations when used. It shall allow remote FACP Acknowledge, Reset, or Signal Silence in this mode. It shall also allow adjustment of detector sensitivity and readout of the history file.
   c. The system shall include an EIA-485 port for the serial connection of optional annunciators and remote LCD displays.
   d. The EIA-485 interface may be used for network connection to a proprietary-receiving unit.

I. Enclosures:
1. The control panel shall be housed in a UI-listed cabinet suitable for surface or semi-flush mounting. The cabinet and front shall be corrosion protected, given a rust-resistant prime coat, and manufacturer’s standard finish.
2. The back box and door shall be constructed with provisions for electrical conduit connections into the sides and top.
3. The door shall provide a key lock and shall include a glass or other transparent opening for viewing of all indicators. For convenience, the door may be site configured for either right or left hand hinging.

J. Power Supply:
1. An off-line switching power supply shall be available for the fire alarm control panel or network node and provide 6.0 amps of available power for the control panel and peripheral devices.
2. Provisions will be made to allow the audio-visual power to be increased as required by adding modular expansion audio-visual power supplies.
3. Positive-Temperature-Coefficient (PTC) thermistors, circuit breakers, or other over-current protection shall be provided on all power outputs. The power supply shall provide an integral battery charger for use with batteries up to 55 AH or may be used with an external battery and charger system. Battery arrangement may be configured in the field.
4. The power supply shall continuously monitor all field wires for earth ground conditions, and shall have the following LED indicators:
   Ground Fault LED
   AC Power Fail LED
   NAC on LED (4)
5. The main power supply shall operate on 120 VACI 60 Hz, and shall provide all necessary power for the FACP.
6. The main power supply shall provide a battery charger using dual-rate charging techniques for fast battery recharge and be capable of charging batteries up to 200 AH.
7. All circuits shall be power-limited, per UL864 requirements.

K. Auxiliary Field Power Supply - Addressable
1. The auxiliary addressable power supply is a remote 24 VDC power supply used to power Notification Devices and field devices that require regulated 24VDC power. The power supply shall also include and charge backup batteries.

2. The addressable power supply shall operate on 120 or 240 V AC, 50/60 Hz. All circuits shall be power-limited per UL 864 requirements.

3. The addressable power supply shall provide built-in synchronization for certain Notification Appliances on each circuit without the need for additional synchronization modules. The power supply's output circuits shall be individually selected for synchronization. A single addressable power supply shall be capable of supporting both synchronized and non-synchronized Notification Devices at the same time.

4. The interface to the power supply from the Fire Alarm Control Panel (FACP) shall be via the Signaling Line Circuit (SLC) or other multiplexed means.

5. The addressable power supply shall supervise for battery charging failure, AC power loss, power brownout, battery failure, NAC loss, and optional ground fault detection. In the event of a trouble condition, the addressable power supply shall report the incident and the applicable address to the FACP via the SLC.

6. The addressable power supply shall have an AC Power Loss Delay option. If this option is utilized and the addressable power supply experiences an AC power loss, reporting of the incident to the FACP will be delayed. A delay time of eight or sixteen hours shall be Dipswitch selected.

7. The addressable power supply mounts in either the FACP backbox or it's own dedicated surface mounted backbox with cover.

8. Each of the power supply's four output circuits shall be DIP-switch selected for Notification Appliance Circuit or General Purpose 24 VDC power. Any output circuit shall be able to provide up to 2.5 amps of 24 VDC power.

9. The addressable power supply's output circuits shall be individually supervised when they are selected to be either a Notification Appliance Circuit when wired Class 'IA' or by the use of and end-of-line resistor. When the power supply's output circuit is selected as General 24VDC power, the circuit shall be individually supervised when an end-of-line relay is used.

10. When selected for Notification Appliance Circuits, the output circuits shall be individually DIP-switch selectable for Steady, March Time, Dual Stage or Temporal.

11. When selected as a Notification Appliance Circuit, the output circuits of the addressable power supply shall have the option to be coded by the use of a universal zone coder.

12. The addressable power supply shall interface and synchronize with other power supplies of the same type. The required wiring to interface multiple addressable power supplies shall be a single unshielded, twisted pair wire.

13. All individual or multiple interfaced addressable power supplies shall have the option to use an external charger for battery charging. Interfaced power supplies shall have the option to share backup battery power.

L. Field Charging Power Supply (FCPS)

The FCPS is designed for use as either a remote 24 volt power supply or used to power Notification Appliances.

1. The FCPS shall offer up to 6.0 amps (4.0 amps continuous) of regulated 24 volt power. It shall include an integral charger designed to charge 70 amp hour batteries and to support 60 hour standby.

2. The Field Charging Power Supply shall have two input triggers. The input trigger shall be a Notification Appliance Circuit (from the fire alarm control panel) or a relay. Four outputs (two Style Y or Z and two style Y) shall be available for connection to the Notification devices.

3. The FCPS shall include an attractive surface mount backbox.

4. The Field Charging Power Supply shall include the ability to delay the AC fail delay per NFPA requirements.

M. Specific System Operations

1. Alarm Verification: Each of the intelligent addressable smoke detectors in the system may be independently selected and enabled to be an alarm verified...
detector. The alarm verification delay shall be programmable from 5 to 30 seconds and each detector shall be able to be selected for verification. The FACP shall keep a count of the number of times that each detector has entered the verification cycle. These counters may be displayed and reset by the proper operator commands.

3. Point Disable: Any addressable device or conventional circuit in the system may be enabled or disabled through the system keypad.

4. Point Read: The system shall be able to display or print the following point status diagnostic functions:
   a. Device status
   b. Device type
   c. Custom device label
   d. View analog detector values
   e. Device zone assignments
   f. All program parameters

5. System Status Reports: Upon command from an operator of the system, a status report will be generated and printed, listing all system status.

6. System History Recording and Reporting: The fire alarm control panel shall contain a history buffer that will be capable of storing up to 800 events. Up to 200 events shall be dedicated to alarm and the remaining events are general purpose. Systems that do not have dedicated alarm storage, where events are overridden by non-alarm type events, are not suitable substitutes. Each of these activations will be stored and time and date stamped with the actual time of the activation. The contents of the history buffer may be manually reviewed, one event at a time, or printed in its entirety. The history buffer shall use non-volatile memory. Systems that use volatile memory for history storage are not acceptable substitutes.

7. Automatic Detector Maintenance Alert: The fire alarm control panel shall automatically interrogate each intelligent detector and shall analyze the detector responses over a period of time. If any intelligent detector in the system responds with a reading that is above or below normal limits, then the system will enter the trouble mode, and the particular detector will be annunciated on the system display, and printed on the optional printer. This feature shall in no way inhibit the receipt of alarm conditions in the system, nor shall it require any special hardware, special tools or computer expertise to perform.

8. Pre-Alarm Function: The system shall provide two levels of pre-alarm warning to give advance notice of a possible fire situation. Both pre-alarm levels shall be fully field adjustable. The first level shall give an audible indication at the panel. The second level shall give an audible indication and may also activate control relays. The system shall also have the ability to activate local detector sounder bases at the pre-alarm level, to assist in avoiding nuisance alarms.

9. Software Zones: The FACP shall provide 100 software zones, 10 additional special function zones, 10 releasing zones, and 20 logic zones.

10. The fire alarm control panel shall include a walk test feature. It shall include the ability to test initiating device circuits and notification appliance circuits from the field without returning to the panel to reset the system. Operation shall be as follows:
   a. Alarming an initiating device shall activate programmed outputs, which are selected to participate in walk test, for 3 seconds.
   b. Introducing a trouble into the initiating device shall activate the programmed outputs for 8 seconds.
   c. All devices tested in walk test shall be recorded in the history buffer.

11. Water flow Operation:
    An alarm from a water flow detection device shall activate the appropriate alarm message on the main panel display, turn on all programmed notification appliance circuits and shall not be affected by the signal silence switch.

12. Supervisory Operation:
    An alarm from a supervisory device shall cause the appropriate indication on the system display, light a common supervisory LED, but will not cause the system to enter the trouble mode.
13. **Signal Silence Operation:**
   The FACP shall have the ability to program each output circuit (notification, relay, speaker etc.) to deactivate upon depression of the signal silence switch.

14. **Non-Alarm Input Operation**
   Any addressable initiating device in the system may be used as a non-alarm input to monitor normally open contact type devices. Non-alarm functions are a lower priority than fire alarm initiating devices.

15. **Combo Zone**
   A special type code shall be available to allow water flow and supervisory devices to share a common addressable module. Water flow devices shall be wired in parallel, supervisory devices in series.

2.4 **SYSTEM COMPONENTS:**

   **A. Strobe lights** shall meet the requirements of the ADA, UL Standard 1 971 1 be fully synchronized, and shall meet the following criteria:
   1. The maximum pulse duration shall be 2/1 0 of one second.
   2. Strobe intensity shall meet the requirements of UL 1971.
   3. The flash rate shall meet the requirements of UL 1971.

   **B. Manual Fire Alarm Station(s)**
   1. Manual fire alarm stations shall be non-code, non-break glass type, equipped with key lock so that they may be tested without operating the handle.
   2. Stations must be designed such that after an actual activation, they cannot be restored to normal except by key reset.
   3. An operated station shall automatically condition itself so as to be visually detected, as operated, at a minimum distance of 1 00 feet (30.5 m) front or side.

   **C. Conventional Photoelectric Area Smoke Detectors**
   1. Photoelectric smoke detectors shall be e 24 VDC, two wire, ceiling-mounted, light scattering type using an LED light source.
   2. Each detector shall contain a remote LED output and a built-in test switch.
   3. Detector shall be provided on a twist-lock base.
   4. It shall be possible to perform a calibrated sensitivity and performance test on the detector without the need for the generation of smoke. The test method shall test all detector circuits.
   5. A visual indication of an alarm shall be provided by dual latching Light Emitting Diodes (LEDs), on the detector, which may be seen from ground level over 360 degrees. These LEDs shall flash at least every 10 seconds, indicating that power is applied to the detector.
   6. The detector shall not go into alarm when exposed to air velocities of up to 3000 feet (914,4 m) per minute.
   7. The detector screen and cover assembly shall be easily removable for field cleaning of the detector chamber.
   8. All field wire connections shall be made to the base through the use of a clamping plate and screw.

   **D. Conventional Ionization Type Area Smoke Detectors**
   1. Ionization type smoke detectors shall be a two wire, 24 VDC type using a dual unipolar chamber.
   2. Each detector shall contain a remote LED output and a built-in test switch.
   3. Detector shall be provided on a twist-lock base.
   4. It shall be possible to perform a calibration sensitivity and performance test on the detector without the need for the generation of smoke.
5. A visual indication of an alarm shall be provided by dual latching Light Emitting Diodes (LEDs) over 360 degrees, on the detector, which may be seen from ground level. This LED shall flash every 10 seconds, indicating that power is applied to the detector.

6. The detector shall not alarm when exposed to air velocities of up to 1,200 feet (365.76 m) per minute. The detector screen and cover assembly shall be easily removable for field cleaning of the detector chamber.

7. All field wire connections shall be made to the base through the use of a clamping plate and screw.

E. Duct Smoke Detectors

Duct smoke detectors shall be a 24 VDC type with visual alarm and power indicators, and a reset switch. Each detector shall be installed upon the composite supply/return air ducts(s), with properly sized air sampling tubes. Install duct detector remote test stations for all duct detectors at readily accessible heights inside.

F. Automatic Conventional Heat Detectors

1. Automatic heat detectors shall have a combination rate of rise and fixed temperature rated at 135 degrees Fahrenheit (57.2 Celsius) for areas where ambient temperatures do not exceed 100 degrees (37.7 Celsius), and 200 degrees (93.33 Celsius) for areas where the temperature does not exceed 150 degrees (65.5 Celsius).

2. Automatic heat detectors shall be a low profile, ceiling mount type with positive indication of activation.

3. The rate of rise element shall consist of an air chamber, a flexible metal diaphragm, and a factory calibrated, moisture-proof, trouble free vent, and shall operate when the rate of temperature rise exceeds 15 degrees F (9.4 degrees C) per minute.

4. The fixed temperature element shall consist of a fusible alloy retainer and actuator shaft.

5. Automatic heat detectors shall have a smooth ceiling rating of 2500 square feet (762 square meters).

G. Water flow Indicator:

1. Water flow Switches shall be an integral, mechanical, non-coded, non-accumulative retard type.

2. Water flow Switches shall have an alarm transmission delay time which is conveniently adjustable from 0 to 60 seconds, Initial settings shall be 30-45 seconds.

3. Water flow switches shall be provided and connected under this section but installed by the mechanical contractor.

4. Where possible, locate water flow switches a minimum of one (1) foot from a fitting which changes the direction of the flow and a minimum of three (3) feet from a valve.

H. Sprinkler and Standpipe Valve Supervisory Switches:

1. Each sprinkler system water supply control valve riser, zone control valve, and standpipe system riser control valve shall be equipped with a supervisory switch. Standpipe hose valves, and test and drain valves shall not be equipped with supervisory switches.

2. PIV (post indicator valve) or main gate valves shall be equipped with a supervisory switch.

3. The switch shall be mounted so as not to interfere with the normal operation of the valve and adjusted to operate within two revolutions toward the closed position of the valve control, or when the stem has moved no more than one-fifth of the distance from its normal position.

4. The supervisory switch shall be contained in a weatherproof housing, which shall provide a 3/4 inch (19 mm) conduit entrance and incorporate the necessary facilities for attachment to the valves.

5. The switch housing shall be finished in red baked enamel.
6. The entire installed assembly shall be tamper proof and arranged to cause a switch operation if the housing cover is removed, or if the unit is removed from its mounting.

7. Valve supervisory switches shall be provided and connected under this section and installed by mechanical contractor.
   a. This unit shall provide for each zone: alarm indications, using a red alarm and yellow trouble long-life LEDs and control switches for the control of fire alarm control panel functions. The annunciator will also have an ON-LINE LED, local piezo electric signal, local acknowledge/lamp test switch, and custom slide-in zone/function identification labels.
   b. Switches shall be available for remote annunciation and control of output points in the system, system acknowledge, telephone zone select, speaker select, global signal silence, and global system reset within the confines of all applicable standards.

I. Alphanumeric LCD Type Annunciator:
   1. The alphanumeric display annunciator shall be a supervised, remotely located back-lit LCD display containing a minimum of eighty (80) characters for alarm annunciation in clear English text.
   2. The LCD annunciator shall display all alarm and trouble conditions in the system.
   3. An audible indication of alarm shall be integral to the alphanumeric display.
   4. The display shall be UL listed for fire alarm application.
   5. The annunciator shall connect to a separate, dedicated "terminal mode" EIA-485 interface. This is a two-wire loop connection and shall be capable of distances to 6,000 feet. Each terminal mode LCD display shall mimic the main control panel.
   6. The system shall allow the following system functions: Acknowledge, Signal Silence and Reset, which shall be protected from unauthorized use by a key switch or password.
   7. The LED annunciator shall offer an interface to a graphic style annunciator and provide each of the features listed above.

J. All interfaces and associated equipment are to be protected so that they will not be affected by voltage surges or line transients consistent with UL standard 864.

K. Radio Alarm Transmitter:
   1. Transmitter shall comply with NFPA 1221 and shall be listed and labeled by an NRTL.
   2. Comply with 47 CFR 90.
   3. Description: Manufacturer's standard commercial product; factory assembled, wired, tested, and ready for installation and operation.
      a. Packaging: A single, modular, NEMA 250, Type 1 metal enclosure with a tamper-resistant flush tumbler lock.
      b. Signal Transmission Mode and Frequency: VHF or UHF 2-W power output, coordinated with operating characteristics of the established remote alarm receiving station designated by Owner.
      c. Normal Power Input 120-V ac.
      e. Antenna: Omnidirectional, coaxial half-wave, dipole type with driving point impedance matched to transmitter and antenna cable output impedance. Wind-load strength of antenna and mounting hardware supports shall withstand 1 00 mph with a gust factor of 1.3 without failure.
      f. Antenna Cable: Coaxial cable with impedance matched to the transmitter output impedance.
      g. Antenna-Cable Connectors: Weatherproof.
      h. Alarm Interface Devices: Circuit boards, modules, and other auxiliary devices, integral to the transmitter, matching fire-alarm and other system outputs to message-generating inputs of the transmitter that produce required message transmissions.
4. Functional Performance: Unit shall receive an alarm, supervisory, or trouble signal from fire-alarm control unit or from its own internal sensors or controls and shall automatically transmit signal along with a unique code that identifies the transmitting station to the remote alarm receiving station. Transmitted messages shall correspond to standard designations for fire-reporting system to which the signal being transmitted and shall include separately designated messages in response to the following events or conditions.
   a. Transmitter Low-Battery Condition: Sent when battery voltage is below 85 percent of rated value.
   b. System Test Message: Initiated manually by a test switch within the transmitter cabinet, or automatically at an optionally preselected time, once every 24 hours, with transmission time controlled by a programmed timing device integral to transmitter controls.
   c. Transmitter Trouble Message: Actuated by failure, in excess of one-minute duration, of the transmitter normal power source, derangement of the wiring of the transmitter, or any alarm input interface circuit or device connected to it.
   d. Local Fire-Alarm-System Trouble Message: Initiated by events or conditions that cause a trouble signal to be indicated on the building system.
   e. Local Fire-Alarm-System Alarm Message: Actuated when the building system goes into an alarm state. Identifies device that initiated the alarm.
   f. Local Fire-Alarm-System Supervisory-Alarm Message: Actuated when the building alarm system indicates a supervisory alarm.

L. Field Wiring Terminal Blocks
   For ease of service all panel I/O wiring terminal blocks shall be removable, plug-in types and have sufficient capacity for #18 to #12 AWG wire. Terminal blocks that are permanently fixed are not acceptable.

M. Video Display Terminal
   1. The Video Display Terminal shall provide a visual display and an audible alert of all changes in status of the system and shall annotate such displays with the current time-of-day and date.
   2. The Video Display Terminal shall be enclosed in a cabinet suitable for placement on a desktop or table.
   3. A detachable keyboard shall be provided that may be used for programming, testing, and control of the system. Individual keys shall be provided on the keyboard for the ACKNOWLEDGE, RESET, LAMP TEST, SYSTEM TEST, and SIGNAL SILENCE functions of the control panel.
   4. The video display terminal shall include a count of all alarms and troubles in the system, as well as a count of all alarms and trouble requiring acknowledgment. These counts shall be continuously displayed during all FACP operations.

2.5 SYSTEM COMPONENTS ADDRESSABLE DEVICES

A. Addressable Devices - General
   1. Addressable devices shall use simple to install and maintain decade, decimal address switches. Devices shall be capable of being set to an address in a range of 001 to 159.
   2. Addressable devices, which use a binary-coded address setting method, such as a DIP switch, are not an allowable substitute.
   3. Detectors shall be intelligent (analog) and addressable, and shall be connect with two wires to the fire alarm control panel Signaling Line Circuits.
   4. Addressable smoke and thermal detectors shall provide dual alarm and power/polling LEDs. Both LEDs shall flash green under normal conditions, indicating that the detector is operational and in regular communication with the control panel, and both LEDs shall be placed into steady red illumination by the control panel, indicating that an alarm condition has been detected. If required, the LED flash shall have the ability to be removed from the system program. An
output connection shall also be provided in the base to connect an external remote alarm LED.

5. The fire alarm control panel shall permit detector sensitivity adjustment through field programming of the system. The panel on a time-of-day basis shall automatically adjust sensitivity.

6. Using software in the FACP, detectors shall automatically compensate for dust accumulation and other slow environmental changes that may affect their performance. The detectors shall be listed by UL as meeting the calibrated sensitivity test requirements of NFPA Standard 72, Chapter 7.

7. The detectors shall be ceiling-mount and shall include a separate twist-lock base with tamper proof feature. Bases shall include a sounder base with a built-in (local) sounder rated at 85 DBA minimum, a relay base and an isolator base designed for Style 7 applications.

8. The detectors shall provide a test means whereby they will simulate an alarm condition and report that condition to the control panel. Such a test may be initiated at the detector itself (by activating a magnetic switch) or initiated remotely on command from the control panel.

9. Detectors shall also store an internal identifying type code that the control panel shall use to identify the type of device (ION, PHOTO, THERMAL).

10. Detectors will operate in an analog fashion, where the detector simply measures its designed environment variable and transmits an analog value to the FACP based on real time measured values. The FACP software, not the detector, shall make the alarm/normal decision, thereby allowing the sensitivity of each detector to be set in the FACP program and allowing the system operator to view the current analog value of each detector.

11. Addressable devices shall store an internal identifying code that the control panel shall use to identify the type of device.

12. A magnetic test switch shall be provided to test detectors and modules. Detectors shall report an indication of an analog value reaching 100% of the alarm threshold.

13. Addressable modules shall mount in a 4-inch square (101.6 mm square), 2-1/8 inch (54 mm) deep electrical box. An optional surface mount Lexan enclosure shall be available.

B. Addressable Manual Fire Alarm Box (manual station)

1. Addressable manual fire alarm boxes shall, on command from the control panel, send data to the panel representing the state of the manual switch and the addressable communication module status. They shall use a key operated test-reset lock, and shall be designed so that after actual emergency operation, they cannot be restored to normal use except by the use of a key.

2. All operated stations shall have a positive, visual indication of operation and utilize a key type reset.

3. Manual fire alarm boxes shall have clearly visible operating instructions provided on the cover. The word FIRE shall appear on the front of the stations in raised letters, 1.75 inches (44 mm) or larger.

C. Intelligent Photoelectric Smoke Detector

1. The detectors shall use the photoelectric (light-scattering) principal to measure smoke density and shall, on command from the control panel, send data to the panel representing the analog level of smoke density.

D. Intelligent Laser Photo Smoke Detector

1. The intelligent laser photo smoke detector shall be a spot type detector that incorporates an extremely bright laser diode and an integral lens that focuses the light beam to a very small volume near a receiving photo sensor. The scattering of smoke particles shall activate the photo sensor.

2. The laser detector shall have conductive plastic so that dust accumulation is reduced significantly.

3. The intelligent laser photo detector shall have nine sensitivity levels and be sensitive to a minimum obscuration of 0.03 percent per foot.

4. The laser detector shall not require expensive conduit, special fittings or PVC pipe.
5. The intelligent laser photo detector shall support standard, relay, isolator and sounder detector bases.

6. The laser photo detector shall not require other cleaning requirements than those listed in NFPA 72. Replacement, refurbishment or specialized cleaning of the detector head shall not be required.

7. The laser photo detector shall include two bicolor LEDs that flash green in normal operation and turn on steady red in alarm.

E. Intelligent Ionization Smoke Detector
   1. The detectors shall use the dual-chamber ionization principal to measure products of combustion and shall, on command from the control panel, send data to the panel representing the analog level of products of combustion.

F. Intelligent Multi-Criteria Acclimating Detector
   1. The intelligent multi criteria Acclimate detector shall be an addressable device that is designed to monitor a minimum of photoelectric and thermal technologies in a single sensing device. The design shall include the ability to adapt to its environment by utilizing a built-in microprocessor to determine its environment and choose the appropriate sensing settings. The detector design shall allow a wide sensitivity window, no less than 1 to 4% per foot obscuration. This detector shall utilize advanced electronics that react to slow smoldering fires and thermal properties all within a single sensing device.
   2. The microprocessor design shall be capable of selecting the appropriate sensitivity levels based on the environment type it is in (office, manufacturing, kitchen etc.) and then have the ability to automatically change the setting as the environment changes (as walls are moved or as the occupancy changes).
   3. The intelligent multi criteria detection device shall include the ability to combine the signal of the thermal sensor with the signal of the photoelectric signal in an effort to react hastily in the event of a fire situation. It shall also include the inherent ability to distinguish between a fire condition and a false alarm condition by examining the characteristics of the thermal and smoke sensing chambers and comparing them to a database of actual fire and deceptive phenomena.

G. Intelligent Thermal Detectors
   1. Thermal detectors shall be intelligent addressable devices rated at 135 degrees Fahrenheit (58 degrees Celsius) and have a rate-of-rise element rated at 1 5 degrees F (9.4 degrees C) per minute. It shall connect via two wires to the fire alarm control panel signaling line circuit.

H. Intelligent Duct Smoke Detector
   1. The smoke detector housing shall accommodate either an intelligent ionization detector or an intelligent photoelectric detector, that provides continuous analog monitoring and alarm verification from the panel.
   2. When sufficient smoke is sensed, an alarm signal is initiated at the FACP, and appropriate action taken to change over air handling systems to help prevent the rapid distribution of toxic smoke and fire gases throughout the areas served by the duct system.

I. Hostile-Area Smoke Detector
   1. The detector shall be designed to provide early warning smoke detection in environments where traditional smoke detectors are not practical,
   2. The detector shall have a filter system to remove particles down to 25 microns.
   3. This filter system shall remove unwanted airborne particles and water mist. This shall allow the detector to operate in environments where traditional smoke detectors would have nuisance alarms.
   4. The filter system shall consist of 2 filters one of which is field replaceable.
   5. The filter system shall have an intake fan to draw air and smoke through the filters into the sensing chamber.
   6. The filter system shall be supervised so that if the filter is clogged or the fan fails the control panel reports trouble.
   7. The filter system shall be powered from 24 VDC separate from the SLC communications.
8. The detector shall utilize a photoelectric sensing chamber.

J. Addressable Dry Contact Monitor Module
   1. Addressable monitor modules shall be provided to connect one supervised IDC zone of conventional alarm initiating devices (any N.O. dry contact device) to one of the fire alarm control panel SLCs.
   2. The IDC zone shall be suitable for Style D or Style B operation. An LED shall be provided that shall flash under normal conditions, indicating that the monitor module is operational and in regular communication with the control panel.
   3. For difficult to reach areas, the monitor module shall be available in a miniature package and shall be no larger than 2-3/4 inch (70 mm) x 1-1/4 inch (31.7 mm) x 1/2 inch (12.7 mm). This version need not include Style D or an LED.

K. Two Wire Detector Monitor Module
   1. Addressable monitor modules shall be provided to connect one supervised IDC zone of conventional 2-wire smoke detectors or alarm initiating devices (any N.O. dry contact device).
   2. The IDC zone may be wired for Class A or B (Style D or Style B) operation. An LED shall be provided that shall flash under normal conditions, indicating that the monitor module is operational and in regular communication with the control panel.

L. Addressable Control Module
   1. Addressable control modules shall be provided to supervise and control the operation of one conventional NACs of compatible, 24 VDC powered, polarized audio/visual notification appliances.
   2. The control module NAC may be wired for Style Z or Style Y (Class A/B) with up to 1 amp of inductive AA/ signal, or 2 amps of resistive AN signal operation.
   3. Audio/visual power shall be provided by a separate supervised power circuit from the main fire alarm control panel or from a supervised UL listed remote power supply.
   4. The control module shall be suitable for pilot duty applications and rated for a minimum of 0.6 amps at 30 VDC.

M. Addressable Relay Module
   1. Addressable Relay Modules shall be available for HVAC control and other building functions. The relay shall be form C and rated for a minimum of 2.0 Amps resistive or 1.0 Amps inductive. The relay coil shall be magnetically latched to reduce wiring connection requirements, and to insure that 100% of all auxiliary relay or NACs may be energized at the same time on the same pair of wires.

N. Isolator Module
   1. Isolator modules shall be provided to automatically isolate wire-to-wire short circuits on an SLC Class A or Class B branch. The isolator module shall limit the number of modules or detectors that may be rendered inoperative by a short circuit fault on the SLC loop segment or branch. At least one isolator module shall be provided for each floor or protected zone of the building.
   2. If a wire-to-wire short occurs, the isolator module shall automatically open-circuit (disconnect) the SLC. When the short circuit condition is corrected, the isolator module shall automatically reconnect the isolated section.
   3. The isolator module shall not require address-setting, and its operations shall be totally automatic. It shall not be necessary to replace or reset an isolator module after its normal operation.
   4. The isolator module shall provide a single LED that shall flash to indicate that the isolator is operational and shall illuminate steadily to indicate that a short circuit condition has been detected and isolated.

O. Smoke Control Annunciator
   1. On/Auto/Off switches and status indicators (LEDS) shall be provided for monitoring and manual control of each fan, damper, HVAC control unit, stairwell pressurization fan, and smoke exhaust fan. To ensure compliance the units
supplied shall meet the following UL categories: I-JUKL, PAZX, UDTZ, QVAX as well as the requirements of NFPA 90A, HVAC, and NFPA 92A & 92B, Smoke Control. The control system shall be field programmable for either 90A operation or 92A/B operation to allow for future use and system expansion.

2. The OFF LED shall be Yellow, the ON LED shall be green, the Trouble/Fault LED shall be Amber/Orange for each switch. The Trouble/Fault indicator shall indicate a trouble in the control and/or monitor points associated with that switch. In addition, each group of eight switches shall have two LEDs and one momentary switch which allow the following functions: An Amber LED to indicate an OFF-NORMAL switch position, in the ON or OFF position; A Green LED to indicate ALL AUTO switch position; A Local Acknowledge/Lamp Test momentary switch.

3. Each switch shall have the capability to monitor and control two addressable inputs and two addressable outputs. In all modes, the ON and OFF indicators shall continuously follow the device status not the switch position. Positive feedback shall be employed to verify correct operation of the device being controlled. Systems that indicate on/off/auto by physical switch position only are not acceptable.

4. All HVAC switches (i.e., limit switches, vane switches, etc.) shall be provided and installed by the HVAC contractor.

5. It shall be possible to meet the requirements mentioned above utilizing wall mounted custom graphic.

2.6 BATTERIES:

A. Batteries shall have sufficient capacity to power the fire alarm system for not less than twenty-four hours plus 5 minutes of alarm upon a normal AC power failure.

B. The batteries are to be completely maintenance free. No liquids are required. Fluid level checks for refilling, spills and leakage shall not be required.

C. If necessary to meet standby requirements, external battery and charger systems may be used.

D. All batteries to be installed within 90 days of the manufacture date.

PART 3 - EXECUTION

3.1 INSTALLATION:

A. Installation shall be in accordance with the NEC, NFPA 72, local and state codes, as shown on the drawings, and as recommended by the major equipment manufacturer.

B. All conduit, junction boxes, conduit supports and hangers shall be concealed in finished areas and may be exposed in unfinished areas. Smoke detectors shall not be installed prior to the system programming and test period. If construction is ongoing during this period, measures shall be taken to protect smoke detectors from contamination and physical damage.

C. All fire detection and alarm system devices, control panels and remote annunciators shall be flush mounted when located in finished areas and may be surface mounted when located in unfinished areas.

D. Manual fire alarm boxes shall be suitable for surface mounting or semi-flush mounting as shown on the plans, and shall be installed not less than 42 inches (1067 mm), nor more than 48 inches (122 mm) above the finished floor.

3.2 TEST:

The service of a competent, factory-trained engineer or technician authorized by the manufacturer of the fire alarm equipment shall be provided to technically supervise and participate during all of the adjustments and tests for the system. All testing shall be in accordance with NFPA 72, Chapter 7.
A. Before energizing the cables and wires, check for correct connections and test for short circuits, ground faults, continuity, and insulation.

B. Close each sprinkler system flow valve and verify proper supervisory alarm at the FACP.

C. Verify activation of all water flow switches.

D. Open initiating device circuits and verify that the trouble signal actuates.

E. Open and short signaling line circuits and verify that the trouble signal actuates.

F. Open and short notification appliance circuits and verify that trouble signal actuates.

G. Ground all circuits and verify response of trouble signals.

H. Check presence and audibility of tone at all alarm notification devices.

I. Check installation, supervision, and operation of all intelligent smoke detectors using the walk test.

J. Each of the alarm conditions that the system is required to detect should be introduced on the system. Verify the proper receipt and the proper processing of the signal at the FACP and the correct activation of the control points.

K. When the system is equipped with optional features, the manufacturer's manual shall be consulted to determine the proper testing procedures. This is intended to address such items as verifying controls performed by individually addressed or grouped devices, sensitivity monitoring, verification functionality and similar.

3.3 FINAL INSPECTION:

A. At the final inspection, a factory-trained representative of the manufacturer of the major equipment shall demonstrate that the system functions properly in every respect.

3.4 INSTRUCTION:

A. Instruction shall be provided as required for operating the system. Hands-on demonstrations of the operation of all system components and the entire system including program changes and functions shall be provided.

B. The contractor and/or the systems manufacturer's representatives shall provide a typewritten “Sequence of Operation.”

END OF SECTION