ANDRADA POLYTECHNIC HIGH SCHOOL

PRESENTATION HALL BUILDING ADDITION

12960 S. HOUGHTON RD.
TUCSON, AZ

SWAIM PROJECT #1817.04
DATE: August 8, 2019
## TABLE OF CONTENTS

### ANDRADA POLYTECHNIC HIGH SCHOOL PRESENTATION HALL

#### DIVISION 00 – PROCUREMENT AND CONTRACTING REQUIREMENTS

<table>
<thead>
<tr>
<th>Topic</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>UNIFORM INSTRUCTIONS TO OFFERORS</td>
<td>3</td>
</tr>
<tr>
<td>UNIFORM GENERAL TERMS AND CONDITIONS</td>
<td>8</td>
</tr>
<tr>
<td>SPECIAL INSTRUCTIONS TO OFFERORS</td>
<td>16</td>
</tr>
<tr>
<td>SPECIAL TERMS AND CONDITIONS</td>
<td>23</td>
</tr>
<tr>
<td>SCOPE OF WORK</td>
<td>32</td>
</tr>
<tr>
<td>SUBSTITUTION REQUEST FORM</td>
<td>35</td>
</tr>
<tr>
<td>BID COVER SHEET (CHECKLIST)</td>
<td>37</td>
</tr>
<tr>
<td>BID PRICING SUBMITTAL</td>
<td>38</td>
</tr>
<tr>
<td>BID BOND FORM</td>
<td>40</td>
</tr>
<tr>
<td>PERFORMANCE BOND</td>
<td>41</td>
</tr>
<tr>
<td>PAYMENT BOND</td>
<td>42</td>
</tr>
<tr>
<td>SUBCONTRACTOR LIST</td>
<td>43</td>
</tr>
<tr>
<td>QUESTIONNAIRE</td>
<td>44</td>
</tr>
<tr>
<td>OFFER AND ACCEPTANCE (SIGNED)</td>
<td>45</td>
</tr>
<tr>
<td>CONFIDENTIAL / PROPRIETARY</td>
<td>46</td>
</tr>
<tr>
<td>CONFLICT OF INTEREST</td>
<td>47</td>
</tr>
<tr>
<td>NON-COLLUSION STATEMENT (NOTARIZED)</td>
<td>48</td>
</tr>
<tr>
<td>DEVIATIONS AND EXCEPTIONS</td>
<td>49</td>
</tr>
<tr>
<td>CERTIFICATE OF INSURANCE (SAMPLE)</td>
<td>50</td>
</tr>
<tr>
<td>VENDOR APPLICATION FORM</td>
<td>51</td>
</tr>
<tr>
<td>I.R.S. W-9 FORM</td>
<td>52</td>
</tr>
<tr>
<td>BID PACKAGE LABELS (HAND DELIVERY AND MAILING)</td>
<td>53</td>
</tr>
<tr>
<td>DISTRICT CALENDAR</td>
<td>54</td>
</tr>
</tbody>
</table>

#### DIVISION 1 – GENERAL REQUIREMENTS

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>010100</td>
<td>COMPLETION OF WORK AND SPECIAL PROVISIONS</td>
<td>1</td>
</tr>
<tr>
<td>010300</td>
<td>ADDITIVE ALTERNATES</td>
<td>1-2</td>
</tr>
<tr>
<td>010400</td>
<td>SUPERINTENDENCE</td>
<td>2</td>
</tr>
<tr>
<td>010410</td>
<td>WORK BY OTHERS</td>
<td>2</td>
</tr>
<tr>
<td>010430</td>
<td>CLAIMS FOR EXTRA COST</td>
<td>3</td>
</tr>
<tr>
<td>010950</td>
<td>REFERENCES</td>
<td>3</td>
</tr>
<tr>
<td>010960</td>
<td>CONTRACT DOCUMENT CLARIFICATIONS</td>
<td>3</td>
</tr>
<tr>
<td>010970</td>
<td>WORKMANSHP</td>
<td>3</td>
</tr>
<tr>
<td>010980</td>
<td>PERMITS</td>
<td>4</td>
</tr>
</tbody>
</table>
DIVISION 2 – EXISTING CONDITIONS

NOT USED IN THIS SPECIFICATION

DIVISION 3 – CONCRETE

031000 CONCRETE FORMWORK..............................................................1-3
032000 CONCRETE REINFORCING STEEL..............................................1-3
033000 CAST-IN-PLACE CONCRETE.......................................................1-13
033300 ARCHITECTURAL CONCRETE (SITE)...........................................1-14
033500 DENSIFIED CONCRETE FINISH..................................................1-2

DIVISION 4 – MASONRY

042000 UNIT MASONRY...........................................................................1-7

DIVISION 5 – METALS

051200 STRUCTURAL STEEL.................................................................1-8
052100 STEEL JOISTS .............................................................................1-5
053100 STEEL ROOF DECK.................................................................1-4
055000 METAL FABRICATIONS............................................................1-6
### DIVISION 6 – WOOD AND PLASTICS

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
<th>Pages</th>
</tr>
</thead>
<tbody>
<tr>
<td>061000</td>
<td>ROUGH CARPENTRY</td>
<td>1-2</td>
</tr>
<tr>
<td>064116</td>
<td>PLASTIC LAMINATE FACED ARCHITECTURAL CABINETS</td>
<td>1-2</td>
</tr>
</tbody>
</table>

### DIVISION 7 – THERMAL AND MOISTURE PROTECTION

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
<th>Pages</th>
</tr>
</thead>
<tbody>
<tr>
<td>071900</td>
<td>WATER REPELLENTS &amp; ANTI-GRAFFITI COATINGS &amp; STAINS</td>
<td>1-7</td>
</tr>
<tr>
<td>072610</td>
<td>UNDER-SLAB VAPOR BARRIER</td>
<td>1-3</td>
</tr>
<tr>
<td>075423</td>
<td>THERMOPLASTIC POLYOLEFIN (TPO) ROOFING</td>
<td>1-14</td>
</tr>
<tr>
<td>076200</td>
<td>SHEET METAL FLASHING &amp; TRIM</td>
<td>1-8</td>
</tr>
<tr>
<td>077200</td>
<td>ROOF ACCESSORIES</td>
<td>1-4</td>
</tr>
<tr>
<td>079200</td>
<td>JOINT SEALANTS</td>
<td>1-2</td>
</tr>
</tbody>
</table>

### DIVISION 8 – DOORS AND WINDOWS

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
<th>Pages</th>
</tr>
</thead>
<tbody>
<tr>
<td>081113</td>
<td>METAL DOORS AND FRAMES</td>
<td>1-2</td>
</tr>
<tr>
<td>083113</td>
<td>ACCESS DOOR</td>
<td>1</td>
</tr>
<tr>
<td>087100</td>
<td>DOOR HARDWARE</td>
<td>1-18</td>
</tr>
</tbody>
</table>

### DIVISION 9 – FINISHES

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
<th>Pages</th>
</tr>
</thead>
<tbody>
<tr>
<td>092216</td>
<td>NON-STRUCTURAL METAL FRAMING</td>
<td>1-3</td>
</tr>
<tr>
<td>092900</td>
<td>GYPSUM BOARD</td>
<td>1-2</td>
</tr>
<tr>
<td>093013</td>
<td>CERAMIC TILING</td>
<td>1-3</td>
</tr>
<tr>
<td>096513</td>
<td>RESILIENT BASE AND ACCESSORIES</td>
<td>1-2</td>
</tr>
<tr>
<td>099000</td>
<td>PAINTING</td>
<td>1-7</td>
</tr>
</tbody>
</table>

### DIVISION 10 – SPECIALTIES

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
<th>Pages</th>
</tr>
</thead>
<tbody>
<tr>
<td>101400</td>
<td>SIGNAGE</td>
<td>1-2</td>
</tr>
<tr>
<td>102800</td>
<td>TOILET, BATH &amp; LAUNDRY ACCESSORIES</td>
<td>1</td>
</tr>
<tr>
<td>102813.14</td>
<td>ELECTRIC HAND DRYER</td>
<td>1-4</td>
</tr>
<tr>
<td>104413</td>
<td>FIRE PROTECTION CABINETS</td>
<td>1-3</td>
</tr>
<tr>
<td>104416</td>
<td>FIRE EXTINGUISHERS</td>
<td>1-2</td>
</tr>
</tbody>
</table>

### DIVISION 11 – EQUIPMENT

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
<th>Pages</th>
</tr>
</thead>
<tbody>
<tr>
<td>115213</td>
<td>PROJECTION SCREENS</td>
<td>1-3</td>
</tr>
<tr>
<td>116143</td>
<td>STAGE CURTAINS</td>
<td>1-5</td>
</tr>
<tr>
<td>116153</td>
<td>PORTABLE RISER</td>
<td>1-2</td>
</tr>
</tbody>
</table>

TABLE OF CONTENTS
DIVISION 21 – FIRE SUPPRESSION

210500 COMMON WORK RESULTS FOR FIRE SUPPRESSION ................................. 1-11
210523 VALVES FOR FIRE SUPPRESSION ....................................................... 1-4
210529 SUPPORTS, ANCHORS & SLEEVES FOR FIRE SUPPRESSION .............. 1-4
211313 WET PIPE SPRINKLER SYSTEMS .................................................... 1-7

DIVISION 22 – PLUMBING

220500 COMMON WORK RESULTS FOR PLUMBING ........................................ 1-11
220523 VALVES FOR PLUMBING ................................................................. 1-4
220529 SUPPORTS, ANCHORS & SLEEVES FOR PLUMBING ....................... 1-4
220700 PLUMBING INSULATION ................................................................. 1-3
221116 PLUMBING PIPING ........................................................................ 1-5
221119 PLUMBING SPECIALTIES .............................................................. 1-3
223000 PLUMBING EQUIPMENT ................................................................. 1-3
224000 PLUMBING FIXTURES .................................................................... 1-3

DIVISION 23 – HEATING, VENTILATING, AND AIR CONDITIONING (HVAC)

230500 COMMON WORK RESULTS FOR HVAC ............................................. 1-11
230529 HANGERS & SUPPORTS FOR HVAC PIPING & EQUIPMENT ............. 1-4
230593 TESTING, ADJUSTING & BALANCING FOR HVAC ............................ 1-6
232300 REFRIGERANT PIPING ................................................................. 1-2
233113 DUCTWORK .................................................................................. 1-3
233114 DUCT LINING ............................................................................... 1-2
233115 DUCT INSULATION ........................................................................ 1-3
233300 AIR DUCT ACCESSORIES ............................................................... 1-3
233423 HVAC POWER VENTILATORS ......................................................... 1-2
233713 DIFFUSERS, REGISTERS & GRILLES .............................................. 1-2
236200 PACKAGED HEATING/COOLING UNITS ......................................... 1-4
236315 DUCTLESS AIR CONDITIONING UNITS ........................................... 1-3

DIVISION 26 – ELECTRICAL

260500 ELECTRICAL ...................................................................................... 1-

DIVISION 27 – COMMUNICATION SYSTEMS

270500 BASIC COMMUNICATIONS SYSTEMS REQUIREMENTS .................. 1-10
<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
<th>Pages</th>
</tr>
</thead>
<tbody>
<tr>
<td>270526</td>
<td>GROUNDING AND BONDING FOR COMM. SYSTEMS</td>
<td>1-7</td>
</tr>
<tr>
<td>270529</td>
<td>HANGERS &amp; SUPPORTS FOR COMM. SYSTEMS</td>
<td>1-3</td>
</tr>
<tr>
<td>270532</td>
<td>FIRESTOPPING FOR TELECOMMUNICATION SYSTEMS</td>
<td>1-6</td>
</tr>
<tr>
<td>270533</td>
<td>CONDUITS AND BACKBOXES FOR COMM. SYSTEMS</td>
<td>1-7</td>
</tr>
<tr>
<td>270536</td>
<td>CABLE TRAYS FOR COMM. SYSTEMS</td>
<td>1-5</td>
</tr>
<tr>
<td>270553</td>
<td>IDENTIFICATION FOR COMM. SYSTEMS</td>
<td>1-7</td>
</tr>
<tr>
<td>271116</td>
<td>COMM. CABINETS, RACKS, FRAMES &amp; ENCLOSURES</td>
<td>1-8</td>
</tr>
<tr>
<td>271119</td>
<td>COMM. TERMINATION BLOCKS &amp; PATCH PANELS</td>
<td>1-3</td>
</tr>
<tr>
<td>271123</td>
<td>COMM. CABLE MANAGEMENT &amp; LADDER RACK</td>
<td>1-5</td>
</tr>
<tr>
<td>271323</td>
<td>COMM. OPTICAL FIBER BACKBONE CABLING</td>
<td>1-3</td>
</tr>
<tr>
<td>271513</td>
<td>COMM. COPPER HORIZONTAL CABLE</td>
<td>1-7</td>
</tr>
<tr>
<td>271543</td>
<td>COMM. FACEPLATES &amp; CONNECTORS</td>
<td>1-7</td>
</tr>
<tr>
<td>271526</td>
<td>VIDEO SURVEILLANCE CAMERAS, REMOTE DEVICES</td>
<td>1-3</td>
</tr>
<tr>
<td>283100</td>
<td>FIRE ALARM SYSTEM</td>
<td>1-10</td>
</tr>
<tr>
<td>311000</td>
<td>EARTHWORK</td>
<td>1-9</td>
</tr>
<tr>
<td></td>
<td>(SOILS REPORT)</td>
<td>1-48</td>
</tr>
<tr>
<td>312150</td>
<td>EXCAVATION, FILLING AND BACKFILLING</td>
<td>1-3</td>
</tr>
<tr>
<td>312210</td>
<td>TRENCHING AND BACKFILLING</td>
<td>1-3</td>
</tr>
<tr>
<td>313116</td>
<td>TERMITE TREATMENT</td>
<td>1</td>
</tr>
</tbody>
</table>

**DIVISION 28 — ELECTRONIC SAFETY & SECURITY**

**DIVISION 31 — EARTHWORK**

**DIVISION 32 — EXTERIOR IMPROVEMENTS**

NOT USED IN THIS SPECIFICATION

END OF TABLE OF CONTENTS
DIVISION 1 - GENERAL REQUIREMENTS

010100 – COMPLETION OF WORK AND SPECIAL PROVISIONS

The Contractor shall provide and pay for all materials, labor services, tools, and other items necessary to complete the Project as specified and shown on the drawings. All materials shall be new, and both workmanship and materials shall be of good quality. All workmen and subcontractors shall be skilled in their trades. The Contractor shall be responsible for safe, proper, and lawful construction and shall construct in the best and most workmanlike manner a complete project reasonably implied. The Contractor shall protect the work and be responsible for any damage or injury due to his act or neglect. The Contractor shall keep the premises free from accumulation of waste materials at all times. Measurements must be taken on the job before erection or fabrication. Extra compensation will not be allowed because of differences between job and drawings that have not been brought to the attention of the Architect in writing before starting the work. Mention in the specifications or indication on the drawings of articles, materials, operations, or methods requires that the Contractor provide each item mentioned, perform each operation and provide all necessary labor, equipment, and incidentals.

1. PROJECT SCHEDULE:

The project shall be completed as follows:

A. Substantial Completion: June 30, 2020

2. GENERAL NOTES:

A. Smoking and all other tobacco products are not allowed on campus.

B. Before the project will be classified as “final completion,” the Contractor will develop and complete a punch list. The Owner and Architect will determine when the project meets "final completion." A punch list must be established and completed within the project calendar day time frame.

END OF SECTION

010300 ADDITIVE ALTERNATES

This section identifies each Alternate and describes basic changes to the Work only when that Alternate is made a part of the Work by specific provision in the Agreement.

1. The scope of Work for all Alternates shall be in accordance with applicable Drawings and Specifications.
2. Each Alternate is intended to cover all of the work required for a complete finished job.

3. Coordinate related Work and modify surrounding Work as required to properly and completely integrate the Alternates into the Work.

4. The Base Bid and the Alternates are exclusive in their scope of work. There is no overlap between or among the Base Bid and Alternates. The cost of any item of work shall be included only once, in the Base Bid or in the Alternates.

The Contractor shall include in his proposal the costs to accomplish each of the following described items of work:

1. Portable Dance Floor
2. Portable Risers

END OF SECTION

010400 SUPERINTENDENCE

The Contractor shall keep on his work a competent superintendent satisfactory to Architect. The superintendent shall not be changed except with the consent of the Architect, unless the superintendent proves to be unsatisfactory to the Contractor and ceases to be in his employ. The superintendent shall represent the Contractor in his absence and all directions given to him shall be as binding as if given to the Contractor. Important directions shall be confirmed in writing to the Contractor. Other directions shall be so confirmed on written request in each case.

END OF SECTION

010410 WORK BY OTHERS

The following work shall be furnished and installed by others under separate contract with the Owner. Contractor shall allow access to the site and adequate space for storage of materials and equipment, cooperate and coordinate with Owner to accommodate the work within the specified time period. Responsibility for related work under this contract is noted. Where facilities are to be provided for rough-in only, under this contract, he shall verify requirements before proceeding with the work. Such items are as follows:

1. Furnishings.

END OF SECTION
010430 CLAIMS FOR EXTRA COST

If the Contractor claims that any instructions by drawings or otherwise involve extra cost under this contract, he shall give the Architect written notice thereof after the receipt of such instructions and in any event before executing the work. Submit a detailed cost breakdown with quantities and unit prices. No such claim will be valid unless so made. Cost of extra work shall be established and approved by the Architect before executing the work.

END OF SECTION

010950 REFERENCES

References to standard specifications and codes shall mean latest published edition at date of contract.

END OF SECTION

010960 CONTRACT DOCUMENT CLARIFICATIONS

Prior to commencing work, Contractor shall carefully examine the drawings, visit the site of work, and fully inform himself of all existing conditions and limitations excepting in underground and inaccessible locations. Should the Contractor, at any time during the course of this project, become aware of any inconsistencies, errors, omissions, or conflicts in drawings, specifications, codes, ordinances, or existing conditions, he shall notify the Architect in writing to request clarification direction. In the event of failure to so notify the Architect, the Contractor shall correct any deficiencies resulting therefrom as directed by the Architect at no extra cost.

END OF SECTION

010970 WORKMANSHIP

If, in Contractor's opinion, any work is shown on drawings or specifications in such a manner to make it impossible to produce a high caliber of workmanship, such conditions shall be referred to Architect for clarification. Failure to notify Architect of such conditions and proceeding with work shall be cause for rejection of work and must be reworked or reinstalled in acceptable manner at no extra cost to Owner. Should conflict occur between drawings and specifications, Contractor shall be deemed to have estimated the more expensive way, unless certified in writing by Architect. Cutting or repairing work in place necessary because of progress of work or negligence of Contractor shall be paid for by the Contractor responsible for the work in progress or the negligence.

END OF SECTION
010980 PERMITS

Building permits and utility connection fees shall be paid for the Owner. All other permits shall be paid for by the Contractor.

END OF SECTION

011000 REGULATIONS AND STANDARDS

1. Conform to all codes and regulations having jurisdiction over this project, including International Building Code, local codes, and applicable mechanical and electrical codes.

A. Regulations: Comply with requirements of local laws and regulations covering construction and local industry standards, in the installation and maintenance of temporary services and facilities including but not limited to, the following:

(1) Building codes, including local requirements for permits, testing, and inspection.
(2) Health and safety regulations.
(3) Utility company regulations and recommendations governing temporary utility services.
(4) Police and Fire Department rules and recommendations.
(5) Police and Rescue Squad recommendations.
(6) Environmental protection regulations governing use of water and energy, and the control of dust, noise, and other nuisances.

B. Standards:


(2) Refer to "Guidelines for Bid Conditions for Temporary Job Utilities and Services", as prepared jointly by AGC and ASC for industry recommendations.

END OF SECTION
011100 DEFINITIONS

"Or (approved) equal" shall mean approved as an equal in opinion of Architect prior to bid. "Approved" shall mean approved in writing by Architect. "As required" shall mean as required by competent construction practices. "As acceptable" shall mean acceptable by Architect. "As recommended" shall mean as recommended by Manufacturer.

END OF SECTION

011200 CONTRACTOR'S LICENSE LAW

Contractor shall comply with, and require all subcontractors to comply with, State and City Contractor's License Law and to be duly registered and licensed thereunder.

END OF SECTION

011300 SPECIFICATION HEADINGS

For convenience of reference, these specifications are separated into titled divisions. Such separations shall not operate to make the Architect or Owner an arbitrator to establish limits to the contracts between Contractor and subcontractors.

END OF SECTION

013300 SHOP DRAWINGS AND SAMPLES

Contractor shall supply the Architect with a schedule of all shop drawings to be submitted. Submit samples where required. Approved sample shall constitute example of work expected of entire project. All submissions are through General Contractor and shall be stamped, reviewed, and approved by the Contractor prior to submitting to the Architect. The Contractor shall not proceed with work until submittals are approved.

Review is for general conformance with the design concept and contract documents. Markings or comments shall not be construed as relieving the Contractor from compliance with the contract plans and specifications or departure therefrom. The Contractor remains responsible for details and accuracy, for confirming and correlating all quantities and dimensions, for selecting fabrication processes, for techniques of construction and assembly, for coordination of his work and that of all other trades, and for performing his work in a safe and satisfactory manner.

1. Shop Drawings:
A. Submit one (1) electronic copy for annotation and correction by Architect.

B. All submittals shall have an 8.5” x 11” cover sheet indicating the type of submittal and project name. The remainder of the sheet shall be reserved for approval stamps from Contractor, Architect, and Consultants.

2. Materials List and Literature:

   A. Manufacturer’s literature and materials’ lists shall be submitted electronically. All color selection information shall be submitted in hard copy form or with actual samples for review.

   B. Manufacturer’s literature shall be labeled to indicate the name of the project, manufacturer, brand or other identification where required. In addition, catalogues shall be marked to indicate the specific items submitted for approval.

   C. The right is reserved to require submission of samples of any material, and any materials' lists, whether or not specifically mentioned herein.

   END OF SECTION

013310 COST BREAKDOWN AND PROGRESS SCHEDULE

After construction contract is awarded, Contractor shall provide a breakdown of his costs into categories, and an estimated schedule of progress in graph form. The schedule shall be updated monthly.

END OF SECTION

013345 PRIOR APPROVAL REQUESTS

All prior approval requests must include documentation which clearly indicates the differences in specification between the requested prior approval and the base specification. A sample manufacturer's warranty and a product sample is required where applicable. All prior approval requests must be received by the Architect with the time limits prescribed in the instructions to bidders. Requests received after that time will not be considered.

END OF SECTION
015000 TEMPORARY FACILITIES

The Contractor shall provide temporary field office, telephone, and restroom facilities. Connections for temporary power and water shall be by the contractor. Power and water shall be paid for by the Owner.

END OF SECTION

015100 SITE PROTECTION

No existing trees or other vegetation shall be removed, trimmed, or damaged without approval of the Architect. Vegetation located in the vicinity of construction shall be tagged, fenced off, and/or tied back for protection. Portions of the site not affected by new construction shall remain undisturbed.

END OF SECTION

015150 TEMPORARY ENCLOSURES, BARRIERS AND FENCES

1. Provide and maintain all fences, barricades, lights, shoring and other protective structures or devices necessary for the safety of workmen, equipment, the public, and property as required by state or municipal laws and regulations, local ordinances, laws, and other requirements of the county, state, and other authorities having jurisdiction with regard to safety precautions, operation, and fires hazards.

2. Provide 6 foot high woven wire temporary fencing around the construction area. Fencing shall be erected and secured in a manner to withstand the forces to which it may be subjected. Locate gates for access to the areas as required. Close and lock all gates after normal working hours. Barbed wire is not permitted on fencing.

3. Protect all elements of construction from any danger of damage from wind, rain, dust, frost, freezing temperatures, or other infiltration of weather.

END OF SECTION

015200 SECURITY

The Architect and the Owner do not assume any responsibility, at any time, for the protection of construction areas and premises, or for loss of materials, from the time that the contract operations have commenced until the final acceptance of the work by the Architect and Owner. If watchman service is deemed necessary by the Contractor, such protection shall be provided and paid for by the Contractor.

END OF SECTION
015250  NOISE AND DUST CONTROL

Exercise all possible care to control excessive noise and dust during the construction to keep these problems to a minimum. Traffic or construction areas shall be sprinkled with water or chemicals as required and in accordance with applicable County requirements. The contractor shall pay for and provide all water necessary to minimize dust during the project.

END OF SECTION

016000  MATERIALS

Each Contractor is responsible for proper care of his materials and equipment until date of acceptance of work. Materials damaged or destroyed shall be removed and replaced with new materials. All materials shall be new unless noted otherwise. Installation of materials over sub-surface will be considered as acceptance of sub-surface by materials applicator.

END OF SECTION

017700  PROJECT CLOSEOUT

1. General:

A. Related Documents:

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

2. Summary:

A. This section specifies administrative and procedural requirements for project closeout including, but not limited to, the following:

   Review procedures
   Project record document submittal
   Operating and maintenance manual submittal
   Submittal of warranties
   Final cleaning

3. Substantial Completion:

A. Preliminary Procedures: Before requesting inspection for certification of Substantial Completion, complete the following. List exceptions in request.
(1) In the Application for Payment that coincides with, or follows, the date Substantial Completion is claimed, show 100 percent completion for the portion of the Work claimed as substantially complete. Include supporting documentation for completion as indicated in these Contract Documents and as statement showing an accounting of changes to the Contract Sum.

(2) If 100 percent completion cannot be shown, include a list of incomplete items, the value of incomplete construction, and reasons the Work is not complete.

(3) Submit specific warranties, workmanship bonds, maintenance agreements, final certifications, and similar documents.

(4) Submit record drawings, maintenance manuals, final project photographs, damage or settlement survey, property survey, and similar final record information.

(5) Deliver extra stock and similar items.

(6) Complete final clean-up requirements, including touch-up painting. Touch-up and otherwise repair and restore marred exposed finishes.

(7) The Owner's Representative will repeat review when requested and assure that the Work has been substantially completed.

(8) Results of the completed review will form the basis of requirements for final acceptance.

4. Final Acceptance

A. Preliminary Procedures: Before requesting final inspection for certification of final acceptance and final payment, complete the following. List exceptions in the request.

(1) Submit the final payment request with releases and supporting documentation not previously submitted and accepted. Include certificates of insurance for products and completed operations where required.

(2) Submit an updated final statement, accounting for final additional changes to the Contract Sum.

(3) Submit consent of surety to final payment.
B. Re-inspection Procedure: The Owner's Representative will again review the Work upon receipt of notice that the Work, including review list items from earlier reviews, has been completed, except items whose completion has been delayed because of circumstances acceptable to the Owner's Representative.

5. Record Document Submittals

A. General: Do not use record documents for construction purposes; protect from deterioration and loss in a secure, fire-resistive location; provide access to record documents for the Owner's Representative's reference during normal working hours.

B. Record Drawings: Maintain a clean, undamaged set of prints of Contract Drawings and Shop Drawings. Mark the set to show the actual installation where the installation varies substantially from the Work as originally shown. Mark whichever drawing is most capable of showing conditions fully and accurately. Where Shop Drawings are used, record a cross-reference at the corresponding location on the Contract Drawings. Give particular attention to concealed elements that would be difficult to measure and record at a later date.

Mark record sets with red erasable pencil; use other colors to distinguish between variations in separate categories of the Work.

Mark new information that is important to the Owner but was not shown on Contract Drawings or Shop Drawings.

Note related Change Order numbers where applicable.

Organize record drawing sheets into manageable sets, bind with durable paper cover sheets, and print suitable titles, dates, and other identification on the cover of each set.

If digital copies of record drawings in PDF format are used, provide one (1) hard copy set to Owner as well as three (3) digital copies.

C. Record Specifications: Maintain one complete copy of the Project Manual, including addenda, and one copy of other written construction documents such as Change Orders and modifications issued during construction. Mark these documents to show substantial variations in actual Work performed in comparison with the text of the Specifications and modifications. Give particular attention to substitutions, selection of options, and similar information on elements that are concealed or cannot otherwise be readily discerned.
later by direct observation. Note related record drawing information and Product Data.

Upon completion of the Work, submit record Specifications to the Owner’s Representative for the Owner’s records.

D. Record Product Data: Maintain one copy of each Product Data submittal. Mark these documents to show significant variations in actual Work performed in comparison with information submitted. Include variations in products delivered to the site, and from the manufacturer’s installation instructions and recommendations. Give particular attention to concealed products and portions of the Work that cannot otherwise be readily discerned later by direct observation. Note related Change Orders and mark-up of record drawings and Specifications.

E. Maintenance Manuals: Provide three (3) hard copies and two (2) electronic copies of all O&M Manuals for equipment and products installed during the construction or remodeling project. Organize operating and maintenance data into suitable sets of manageable size. All of the close out documents are to be placed in a white three ring binder which has a see-through front panel and binding edge that allows a sheet to be installed as a title sheet.

All information shall be installed in a proper indexed individual heavy-duty 2-inch, 3-ring vinyl-covered binders, with pocket folders for folded sheet information. Mark appropriate identification on front and spine of each binder. Table of Contents is to be typed and installed.

All notebooks are to have divisions for each of the categories as listed below. Include the following types of information.

(1) Provide a copy of all maintenance parts and supplies required to maintain building operations for a year or through normal maintenance cycle. Examples would be filters, lamp schedule, etc.

(2) Provide copies of all shop drawings and product Cut Sheets for all brand names of major items used on the project, such as light fixtures, electrical switch gear, HVAC units, fans, coils, etc.

(3) Provide all Letters of Warranty for installation and project.

(4) Provide a listing of all Sub-Contractors performing work on the project and their responsibility during the project.
(5) Provide any and all Regulatory Documents, i.e., permits, air inspections, waste manifest, etc. that applies to the project, or were part of the project during the construction or remodeling phases, that are required by Federal, State, Local Code, and/or Regulatory Agencies.

(6) Provide a copy of Record Drawings for project.

6. Closeout Procedures

A. Final Cleaning:

(1) General: General cleaning during construction is required.

(2) Cleaning: Clean the site, of rubbish, litter and other foreign substances. Sweep paved areas broom clean; remove stains, spills and other foreign deposits.

(3) Compliance: Comply with regulations of authorities having jurisdiction and safety standards for cleaning. Do not discharge volatile, harmful, or dangerous materials into drainage systems. Remove waste materials from the site and dispose of in a lawful manner.

Where extra materials of value remaining after completion of associated Work have become the Owner’s property, arrange for disposition of these materials as directed.

END OF SECTION

017710 CLEAN-UP

The job site work area shall be clean and orderly at all times. Upon completion, leave work in clean condition. Each subcontractor responsible for removal of debris caused by his work. Contractor shall do the following cleaning:

1. Clean all tire marks off of sidewalks and concrete paving in project area.
2. Glass: Remove putty, stains, etc. and wash and polish all glass, both sides.
3. Painted, Decorated, and Stained Work: Remove all marks, stains, fingerprints, and other soil and dirt. Touch-up as required.
4. Hardware and Metal Surfaces: Clean all hardware and metal surfaces.
5. Tile and plumbing fixtures: Clean and polish; seal tile grout.
6. Clean all finger prints off finished surfaces – walls, ceilings, millwork, etc.
7. Carpet: Vacuum and remove any spots.
8. Concrete floors: Clean and polish.
9. Synthetic Athletic Flooring: Clean per manufacturer’s instructions.
10. Wood Athletic Flooring: Clean and mop per manufacturer’s instructions.

END OF SECTION

017720 ADDITIONAL MATERIALS FOR OWNER MAINTENANCE

Upon completion of the project, the Contractor shall furnish the Owner with containers of each of the following items of material of each color or type used in the job:

1. Paints and stains: 1 unopened gallon, each color.
2. Rubber base: 50 linear feet, each color.
3. Ceramic tile: 1 box, each type and color.

The above materials shall not be utilized by the Contractor for repairs or replacement prior to final acceptance of the project by the Owner.

END OF SECTION

017740 GUARANTEE

Contractor shall guarantee his work for a period of two years, or a longer period when so specified, from date of final acceptance. Should defects develop within guarantee period due to faults in materials and/or workmanship, Contractor shall make all repairs and do all necessary work to Architect's satisfaction without cost to Owner within ten days after notice to Contractor. If Contractor fails to do work so ordered, Owner may have work done and charge cost thereof against monies retained and, if said monies shall be insufficient to pay such cost or money available, Contractor and his sureties agree to pay Owner for such work. Nothing herein intends or implies that guarantee shall apply to work which has been abused or neglected by the Owner.

END OF SECTION
END OF DIVISION
DIVISION 3 - CONCRETE

031000 – CONCRETE FORMWORK

1. GENERAL:

A. Description of Work

(1) Work as evident on drawings and specified herein or required for furnishing all labor, materials, equipment and services necessary for installation of formwork, complete in conjunction with Section 033000 Cast-In-Place Concrete.

B. Related Work

(1) Section 032000: Concrete Reinforcing Steel

(2) Section 033000: Cast-In-Place Concrete.

C. Standards

(1) Formwork shall conform to the latest edition of the following standards and to the drawings and specifications:

a. ACI 347 American Concrete Institute – Recommended Practice for Concrete Formwork.

b. ACI SP-40 American Concrete Institute - Formwork for Concrete.

c. ASTM American Society for Testing and Materials Standards.

D. Formwork Design

(1) The Contractor shall assume all responsibility for the safety of the formwork and shall provide all necessary design, construction, materials, and maintenance to produce the required concrete work safely. Design all formwork to have sufficient camber to maintain the tolerances specified. Strength shall be sufficient to compensate for the weight of the fresh concrete and a construction live load of 50 psf minimum.

2. PRODUCTS:

A. Form Facing Materials

(1) Concrete surfaces to be left exposed at completion of work: PLYFORM Class I or II B-B EXT-DFPA conforming to the U.S.
Product Standard PS I for Softwood Plywood.

(2) Concrete surfaces to be left unexposed at completion of work:
Plywood or boards capable of producing finished surfaces that are reasonably true to line and plan.

B. Form Ties

(1) Continuous single member and internal disconnecting.

C. Form Release Agent

(1) Nonstaining, free from lubricating, conventional form and diesel oils, or kerosene; a chemically active form release agent that will not impair bonding of plaster, paint or cement coatings to concrete surfaces.

D. Metal Dovetail Anchor Slots

(1) Machine fabricated from at least 24 gage steel hot-dip galvanized slot completely filled with removable filler, standard size, and lengths as required by work.

3. EXECUTION:

A. Forms

(1) For plywood formed surfaces to be left exposed at the completion of the work, use 5/8" or thicker plywood with joints true, level and taped or caulked to prevent leakage of cement paste, and locate form ties level and plumb in horizontal rows and vertical tiers.

(2) Concrete surfaces that will remain exposed at completion of the work shall be formed as specified, as shown on Drawings, and in such a manner that the exposed surfaces require a minimum of reworking to be acceptable to the Architect. Forms shall be sufficiently tight to prevent leakage of cement paste. Flashes of concrete that occur between abutting edges of plywood forms shall be removed.

(3) Allowable Tolerances: In accordance with requirements of ACI 347, paragraph 3.3.1; mass concrete in accordance with ACI 347, Paragraph 3.3.
B. Accessories

(1) Install accurately and firmly in forms all inserts and embedded items as shown on Drawings, as required to support or fasten the work of other trades, as provided and located by other trades, and as necessary to complete the work. Secure them against displacement during concreting.

C. Anchors

(1) Install metal dovetail anchor slots vertically in forms, where masonry is not tied to concrete by reinforcing bars, as shown on Drawings.

D. Removal of Forms

(1) Forms shall be removed only with the approval of Architect and in a manner to insure complete safety of the structure. In no case shall the supporting forms or shoring be removed until the members have acquired sufficient strength to support safely their weight and the load thereon. The results of suitable control tests may be used as evidence that the concrete has attained such sufficient strength.

END OF SECTION
032000 – CONCRETE REINFORCING STEEL

1. GENERAL:

A. Description of Work

(1) Work as evident on the drawings and specified herein or required for furnishing all labor, materials, equipment, and services necessary for the installation of reinforcement complete, in conjunction with Section 033000 Cast-In-Place Concrete.

B. Related Work

(1) Section 033000: Cast-In-Place Concrete.

(2) Drawings: General Structural Notes.

C. Submittals

(1) Certificate: Mill certificate of compliance shall be provided for all reinforcing steel.

(2) Shop Drawings: Furnish shop drawings in accordance with Section 013300 Shop Drawings and Samples showing all reinforcing steel bending and assembly diagrams, splicing, laps or rods, shapes, dimensions and details. Shop drawings shall be approved before fabrications.

a. In reviewing shop drawings, the Architect / Engineer will attempt to detect omissions and majors errors, but neither failure of the Architect / Engineer to do this nor the review of the shop drawings shall relieve the Contractor of their responsibility to comply with the Drawings and Specifications.

E. Standards

(1) Detailing, fabrication and placing of all reinforcing steel shall conform to the latest edition of the following standards and to the Drawings and Specifications.

a. IBC International Building Code, Chapter 21, Masonry; and Chapter 19 Concrete.

b. ACI 315 American Concrete Institute-Manual of Standard Practice for Detailing Reinforced Concrete Structures.

c. ACI 318 American Concrete Institute-Building Code Requirements for Reinforced Concrete.
d. ICBO Research Recommendation Report  
e. ASTM American Society for Testing and Materials Standards, latest editions.

2. PRODUCTS:

A. Reinforcement

(1) Reinforcing Steel: ASTM A615 with supplement (SI), marked "S" and as follows: Grade 40 for Numbers 3 thru 4; Grade 60 for Numbers 5 thru 18.

(2) Tie Wire: ASTM A82, 18 gage black annealed wire.

(3) Dowel Bar Splicers and Dowel-Ins: As manufactured by the Richmond Screw Anchor Co., or approved equal, with a minimum rated tensile capacity of 150% of the yield strength for grade 60 steel. Dowel-ins shall have enlarged ends so that the cross-sectional area of bar is not reduced for threading.

B. Accessories

(1) Spacers, ties, chairs and other devices as required for placing spacing, supporting and fastening reinforcement.

3. EXECUTION:

A. Accessories

(1) Contractor shall supply all necessary wiring, chairs, bolsters, supports, and support bars, to put the reinforcement in place, fasten it securely, and keep it in place while concrete is being poured. Spacers, chairs, ties, and other accessories conforming to the American Concrete Institute Standards shall be furnished and installed to hold the bars in position. Chairs in sufficient number to prevent sagging and to support any pedestrian traffic during construction shall be used, but in no case less than that shown in the "Standard Number and Location of Accessories" in ACI 315.

B. Placement

(1) Metal reinforcement shall be free from scale, rust and other coatings which destroy bond. Metal reinforcement shall not be straightened or re-bent in a manner which will injure the material. Bars with kinks or bends not shown on the plans shall not be used.
(2) On any vertical construction joint in the work where horizontal bars extend beyond the construction joint, the forms or head against which the work ends shall be perforated at the proper places to allow the bars to project through.

(3) Unless otherwise indicated on the plans, reinforcement shall be so placed as to provide a protective concrete covering in accordance with ACI 318. The bars shall be cut and bent as required and wired together. All bending shall be accurately done, as shown on the plans and by methods and appliances approved by the Architect. Adjoining bars and splices shall be per drawings but not less than at least 36 diameters in concrete, 48 diameters in masonry, and not less than 2'-0".

(4) Splices and laps shall be in accordance with plans. Necessary splices not shown on the Drawings shall be lapped sufficiently to develop the strength of the bar by bond and securely wired location shall be approved by the Architect.

(5) The clear distance between reinforcing bars shall not be less than 1-1/3 times the maximum size of coarse aggregate or 1-inch absolute minimum.

(6) All horizontal reinforcing in concrete shall be continuous around corners or corner bars shall be provided. Where bars of different sizes intersect at corners, corner bars of the larger size shall be provided.

END OF SECTION
033000 – CAST-IN-PLACE CONCRETE

1. GENERAL:

A. Description of Work

(1) Work as evident on the Drawings and specified herein or required for furnishing all labor, materials, equipment, and services necessary to complete all cast-in-place concrete work.

B. Related Work

(1) Drawings: General Structural Notes
(2) Section 031000: Concrete Formwork
(3) Section 032000: Concrete Reinforcing Steel

C. Submittals

(1) Certificates: Cement will be accepted on the basis of the manufacturer's certification of compliance, accompanied by mill test reports, that cement meets the physical and chemical requirements of the specification under which furnished.

(2) Mix Design: Concrete mix design.

D. Standards

(1) Concrete work shall conform to the latest edition of the following Standards and to the Drawings and Specifications for the construction of Concrete Work:
   a. IBC International Building Code, Chapter 19, Concrete.
   b. ICBO Research Recommendation Report.
   c. ACI 318 American Concrete Institute – Building Code Requirements for Reinforced Concrete.
   d. ASTM American Society for Testing and Materials Standards.

E. Quality Control - Field Tests of Concrete

(1) All quality control testing during construction, if required by the Architect or Engineer, shall be paid for by the Owner and accomplished by the Geotechnical Laboratory of record that prepared the original report. In the event any retesting is required...
due to the failure of materials to meet specifications limits, the Contractor shall pay for all such retesting.

(2) Compressive Strength Tests: ASTM C39; one set of samples of each class of concrete placed each day shall be taken not less than once a day, nor less than once for each 150 cubic yards of concrete, not less than once for each 5,000 square feet of surface area for slabs or walls; one sample tested at 7 days, two samples tested at 28 days. Additional samples for early strength or 56 day testing shall be paid for by the Contractor. Testing of mixes shall be paid for by the Owner and accomplished by an accredited testing laboratory approved by the Architect.

(3) When tests of laboratory cured cylinders fail to meet specified requirements, the Contractor shall change proportions of water-cement ratio to increase the strength to the specified value, as directed by the testing laboratory.

(4) If any strength test of laboratory-cured cylinders falls below required $f'_c$ by more than 300 psi, if there is evidence that quality of concrete is below specification requirements, or if tests of field-cured cylinders indicate deficiencies in protection and curing, steps shall be taken by the Contractor to assure that load-carrying capacity of the structure is not jeopardized.

   a. When load tests indicate that concrete does not meet specifications, measures as prescribed by the Architect shall be taken by the Contractor to correct the deficiency at no additional expense to the Owner.

F. Embedded Items

(1) Full cooperation shall be given other trades to install embedded items. Suitable templates or instructions, or both, will be provided for setting items placed in the forms. Embedded items shall have been completed and approved before concrete is placed.

2. PRODUCTS:

A. Cement

(1) Portland Cement Type II, conforming to ASTM C150 and shall be properly protected from weather.

B. Aggregate

(1) Sand (fine aggregate) shall be hard, clean, screened, and washed...
sand. Gravel (coarse aggregate) shall be sound, clean, and durable particles and graded between the limits for size No. 57. Aggregates shall be free from clay, loam, organic or foreign substances, and shall conform to the requirements of ASTM C33.

C. Water

(1) Clean, fresh and free from harmful acids, alcalis, oils, and organic substances.

D. Expansion Joint Filler

(1) Resin impregnated fiberboard conforming to physical requirements of ASTM D1752, 1/2-inch unless otherwise indicated.

OR

(2) Sponge rubber, preformed, nonextruding, cement gray color; ASTM D1752, Type 1; 1/2-inch thick unless otherwise indicated.

E. Membrane-Forming Curing Compound

(1) Products complying with ASTM C309, Type I include the following:
   a. Burke "Res-X Clear Resin Base: Or equal at floor surfaces to receive paint, resilient floor covering, or other bonded finish to slab.
   b. Burke "Cure Clear Wax Base" or equal at floor surfaces to receive natural concrete finish.

(2) Apply curing compounds in accordance with manufacturer's instructions.

F. Admixtures

(1) Subject to prior approval by the Architect. The admixtures shall be shown capable of maintaining the same composition and performance throughout the work as the product used in establishing concrete proportions in accordance with ACI 318, Section 5. Calcium chloride or any admixture containing chloride ions shall not be used. Fly Ash shall not be allowed in mortar or grout. Fly Ash for concrete shall be Class F conforming to ASTM C618 and shall not replace more than 20% cement by weight.

G. Concrete Water Admixture

Interior concrete floor slabs and second floor south exterior deck shall
have one of the following waterproofing admixtures or an approved equal

(1)  AConcure@ by Concure Corporation (1-800-925-7746)
(2)  ADarapel@ by W.R. Graw & Co. (1-602-233-12976)
(3)  ARheomix 235" by Master Builders Technologies (1-800-628-9990)

H. Chemical Hardener

(1)  Colorless aqueous solution containing a blend of magnesium fluosilicate combined with a wetting agent, containing not less than two pounds of fluosilicates per gallon.

I. Moisture-Retaining Cover

(1)  One of the following, complying with ASTM C171:
   a.  Waterproof paper.
   b.  Polyethylene film CS 238 at least 6 mils thick.
   c.  Polyethylene-coated burlap.

J. Non-Slip Abrasive Aggregate

(1)  Provide fused aluminum oxide grits, or crushed emery, as abrasive aggregate for non-slip finish with emery aggregate containing not less than 40% aluminum oxide and not less than 25% ferric oxide. Use material that is factory-graded, packaged, rust-proof and non-glazing, and is unaffected by freezing, moisture and cleaning materials.

K. Grout-Non-Shrink, Non-Metallic

(1)  Grout for column and beam bearings, "Five Star Grout" as manufactured by U.S. Grout Corp., Old Greenwich, Conn.

L. Drill-In Expansion Anchors

(1)  The anchors shall be a non-drilling type per the general structural notes. Anchors require Special Inspection by Testing Laboratory.

M. Non-Structural Fill Concrete

(1)  Fill Concrete used behind retaining walls shall be 1,000 psi at 28 days, with 8" slump and ½" maximum aggregate.
3. EXECUTION:

A. Concrete Design

(1) Design mixes shall develop the compressive strength within 28 days as indicated on the drawings for the various uses indicated.

(2) Concrete shall be of the specified quality capable of being placed without excessive segregation and, when hardened, of developing all characteristics required by Specifications.

(3) The proportions of ingredients for concrete shall be selected in accordance with ACI 318, Sections 5.2, 5.3, and 5.4, to produce the proper placeability, durability, strength and other required properties. However, total water content, including free moisture in the aggregate and all liquid admixtures shall not exceed 40 gallons per cubic yard, or as specified in the General Structural Notes, whichever is more restrictive.

(4) Limit slump as indicated on the drawings.

(5) All concrete shall be mechanically mixed until uniformly distributed. Each batch shall be mixed at least one minute after all the materials are in the mixer, and the mixer must be completely discharged before recharging. No ready-mix concrete shall be used which has been in the truck more than 90 minutes (60 minutes if air temperature exceeds 85 degrees) from the batch plant. All ready-mix concrete shall be prepared in conformance with ASTM C94

B. Joints

(1) Construction Joints in Structural Members: Location and detail of all construction joints in structural members, including structural slabs, piers, walls, grade beams, and footings shall be subject to the approval of the Engineer of Record.

(2) Joints in Slabs on Grade: Install contraction, construction, and expansion joints as shown in slabs on grade.

a. Provide one layer 30 pound felt at all locations where interior slabs on grade abut a vertical surface, and 1/2 inch preformed joint filler where exterior slabs as shown in slabs on grade.

b. Control (contraction) joints in slabs shall be located as
detailed on the plans.

c. Joints in exterior concrete walks, slabs, etc., shall be placed as follows except as otherwise noted:

1) Expansion Joint - 15'-0" o.c. each way.
2) Cut Joints or Contraction Joints - 5'-0" o.c. each way.

C. Placing Concrete

(1) Inspection: All concrete excavations, trenches, forms, reinforcing miscellaneous steel and anchor bolt placement related items shall by inspected and approved by the Architect's representative prior to pouring any concrete. For this purpose the Architect shall be notified 24 hours in advance by the Contractor of his intention to pour concrete.

(2) Concrete shall be placed in approximately horizontal layers not to exceed 12" in depth and the concrete pour shall be carried on in a continuous operation until the placing in the section or monolith is completed. Concrete shall be deposited at or near its final position to avoid segregation caused by rehandling or flowing. No concrete shall be dropped freely into place from a greater height than five feet. Tremies shall be used for placing concrete where the drop is in excess of such a height.

(3) Concrete shall be placed with the aid of approved mechanical vibrating equipment. Vibration shall be transmitted directly to the concrete, sufficiently intense to cause the concrete to settle readily into place and to visible affect the concrete over a radius of at least 18". Vibrators shall not, however, be used to transport concrete or force concrete to flow horizontally. Vibration shall be supplemented by manual forking or spading adjacent to the forms on exposed faces in order to secure smooth, dense surfaces. If, for any reason, the surfaces or interiors have voids or are in any way defective, such concrete shall be patched or repaired as directed by the Architect, and no defective work shall be patched or repaired without the prior inspection and approval of the Architect.

(4) Concrete placing shall continue without avoidable interruption unless otherwise specified, until the predetermined limit of the placement has been attained.

(5) Placing of concrete in which initial set has occurred or placing of retempered concrete will not be permitted. Concrete which has contained water for more than 90 minutes will not be accepted.

(6) When placing fresh concrete against old concrete, the latter shall
be cleaned of all objectionable matter, and a proper bond shall be made by grouting with neat cement or painting with "Weldcrete".

D. Hot Weather Requirements

(1) Steps shall be taken as necessary to reduce concrete temperatures and water evaporation by proper attention to ingredients, production methods, handling, placing, and curing. During hot weather, concrete pours shall be scheduled for the early morning hours to maximum extent possible, to allow for placing, finishing and protection of the entire monolith poured by a time not later than 12:00 noon. Details of hot weather concrete pours shall be in accordance with ACI 305.

(2) Contractor shall provide fog spraying during placement of slabs-on-grade, or other methods approved by the architect, when the rate of evaporation equals or exceeds 0.2 pounds per square foot per hour as specified on the drawings.

E. Cold Weather Requirements

(1) Protect concrete work from physical damage or reduced strength which could be caused by frost, freezing actions, or low temperatures, in compliance with ACI 306 and as herein specified.

(2) No concrete shall be placed if anticipated temperatures of the surrounding air are to go below 30 degrees F, unless provisions are made for a heated enclosure for protection. Removal of forms during cold weather concreting shall be based on strength tests of field cured cylinders as directed and approved by Architect.

(3) When air temperature has fallen to or is expected to fall below 40 degrees F, uniformly heat all water and aggregates before mixing as required to obtain a concrete mixture temperature of not less than 50 degrees F, an not more than 80 degrees F at point of placement.

(4) Do not use frozen materials or materials containing ice or snow. Do not place concrete or frozen subgrade or on subgrade containing frozen materials.

(5) Do not use calcium chloride, salt or other materials containing antifreeze agents or chemical accelerators.

F. Curing Concrete

(1) Concrete shall be protected against loss of moisture, rapid drying
or temperature changes, mechanical injury or injury from rain or flowing water for a period of at least seven days in accordance with requirements of ACI 308 and ACI 305, as specified herein. Curing shall commence as soon as free water has disappeared from the surfaces after finishing.

(2) Formed Surfaces: Forms in contact with concrete during the curing period shall be kept wet. If forms are removed during the curing period, a curing method and/or materials, approved by the Architect, shall be employed immediately. Such curing shall be continued for the remainder of the curing period.

(3) Curing may be accomplished by any of the following methods:
   a. Moist Curing: Surfaces shall be kept continuously set by covering with burlap, mats or sand, thoroughly saturated with water and covering kept wet by spraying or hosing. Place materials to provide complete surface coverage and lap all joints minimum 3".
   b. Moisture-Retaining Cover Curing: Surfaces shall be thoroughly wetted with a fine spray of water and then covered with waterproof paper, polyethylene sheeting or polyethylene coated waterproof paper. Edges and ends of sheeting shall be overlapped not less than 4" and securely cemented or taped to form a continuous cover. Sheet ing shall be weighted down to prevent displacement and shall be repaired or replaced if torn, damaged, or removed during curing period.
   c. Liquid Membrane Forming Curing Compound: Compound shall not penetrate, stain, or have any deleterious effect on finish. Compound shall not be used on floors to receive dust preventative treatment or on slabs to receive additional concrete fill. Immediately following removal of forms, loose materials and debris shall be removed from surfaces, the surfaces thoroughly moistened with a light spray of water, and expansion joints and other joint openings covered to prevent compound from entering. Compound shall be applied on damp surfaces as soon as moisture film has disappeared. Power spraying equipment shall be used. Material shall be applied in a two-coat, continuous operation at a coverage of not more than 200 square feet per gallon for each coat. Second coat shall be applied in a direction at right angles to application direction of first coat. Compound shall provide a uniform, continuous, adherent film that shall not check, crack, or peel, and shall be free from pinholes or other imperfections. Surfaces subjected to heavy rainfall within 3 hours after compound has been applied or surfaces
damaged by subsequent construction operations within curing period shall be resprayed at specified rate. Coated surfaces shall be kept free of foot and vehicular traffic and other sources of abrasion during curing period. After compound is dry, all surfaces to be subjected to traffic shall be covered with waterproof Kraft Paper, lapped 9", and covered with sand.

G. Finishing After Removal of Forms

(1) Vertical Surfaces:

a. Immediately after removal of forms and before the concrete is dry, all excess projections and loose materials shall be removed; honeycomb, aggregate pockets, voids over 1/2" diameter and holes left by form ties cut back or undercut to solid concrete shall be thoroughly wetted, brush-coated with grout consisting of equal parts of Portland cement to two parts fine aggregate. When dry, mortar shall match concrete in color. Holes extending entirely through the walls shall be filled from back, forcing the mortar through the wall. Patching shall be damp cured for period as specified under CURING. Exposed patchwork shall be finished to match texture of adjacent concrete surfaces. All new surfaces adjacent to existing surfaces shall match existing finishes.

b. Smooth Finish: All exterior and interior exposed surfaces not otherwise noted shall be finished smooth. Mix 1 part Portland cement and 1-1/2 parts fine aggregate with water to produce a grout having the consistency of thick paint. White or light colored Portland cement shall be used to obtain the desire color. Wet surface to prevent absorption of water from grout. Apply grout uniformly, completely, filling air bubbles and holes. Immediately after applying grout, float the surface with cork or wood floats, scouring the wall vigorously. While grout is still plastic, surface shall be finished with a sponge rubber float, removing excess grout. The finishing shall be done at the time when grout will not be pulled from holes or depressions. After the surfaces have dried thoroughly, rub vigorously with dry burlap to completely remove dried grout. There shall be no visible film of grout remaining after rubbing. The entire finishing operation for any area shall be completed the day it is started. Grout shall not be left on the wall overnight. Finished surfaces shall be uniform in color and texture, without lap marks or clouding. Spots or streaks shall be retreated.

(2) Finishing Concrete Slabs:
a. Surface of concrete fill and slabs shall be at elevation to receive finish specified and noted. Finished fill and slabs shall be struck off true and level surfaces with a tolerance of 1/8 inch in 10 feet as measured with a 10 foot straightedge and the Floor flatness and Floor Levelness criteria specified on the drawings. Upon completion of leveling, all screeds shall be removed and spaces filled with concrete. Finished work shall permit the free drainage of water from surface at all points. Finishing may be by hand or power finishing machines. Joints and edges shall be straight and finished with jointing and edging tools.

b. Float Finish for interior slabs shall be obtained by screeding to finish elevation and all surface water and laitance removed. Floating shall commence as soon as screeded surface has sufficiently set. Floating may be performed by hand using a wood float, or by power driven floats to produce a smooth, even textured surface. Slabs in all areas which are to receive ceramic or quarry tile shall be float finished.

c. Monolithic Finish for interior slabs shall be obtained by striking off to true surface at finished elevation, then screeding and floating with straightedges to bring surface to finish level. While concrete is still green but sufficiently hardened to bear a man's weight without deep imprint, it shall be wood-floated to a true, even plane with no coarse aggregate visible. Sufficient pressure shall be used on floats to bring moisture to the surface. After surface moisture has disappeared, surfaces shall be steel-troweled to a smooth, even, impervious finish, free from trowel marks. When the concrete has sufficiently set to ring the trowel, the surface shall receive a second steel-troweling to a burnished finish except that surfaces receiving resilient flooring shall not receive the second steel troweling. All slab areas shall receive a monolithic finish except those specifically excluded under other finishes specified herein. Coordinate efforts where the concrete floor is the exposed surface to control finish and cracks.

d. Broomed Finish for exterior sidewalks, slabs, platforms, stair treads and ramps shall be finished by tamping the concrete to force coarse aggregate away from the surface, screeding and floating to bring surface to finish level, steel troweling to an even, smooth surface and then brooming with a fine hair broom in a direction transverse to that of the principal traffic, or in the patterned direction as indicated on the drawings.

e. Float Finish for exterior sidewalks shall be obtained by screeding to finish elevations and all surface water and
Cast-in-Place Concrete

laitance removed. Floating shall commence as soon as screened surface has sufficiently set. Floating may be performed by hand using a wood float, or by power driven, floats to produce a smooth, even textured surface. All slab edges, including those of formed joints, shall be finished carefully with an edger having a radius of 1/8 inch.

f. Non-Slip Aggregate Finish for interior stair treads, platforms, and elsewhere as shown on the Drawings or in schedules. After completion of float finishing, and before starting trowel finish, uniformly spread 25 lbs. of dampened non-slip aggregate per 100 sq. ft. of surface. Tamp aggregate flush with surface using a steel trowel, but do not force the non-slip aggregate particles below surface. After broadcasting and tamping, apply trowel finishing as herein specified. After curing, lightly work the surface with a steel wire brush, or an abrasive stone, and water to expose the non-slip aggregate.

g. Chemical-Hardener Finish: In addition to finishing as specified for monolithic finish, apply chemical-hardener finish to interior concrete floors where shown on Drawings or on schedules as "exposed concrete".

1) Apply liquid chemical-hardener after complete curing and drying of the concrete surface. Dilute liquid hardener with water, and apply in three coats; first coat, 1/3 strength; second, 1/2 strength; third coat, 2/3 strength. Evenly apply each coat, and allow 24 hours for drying between coats. Apply proprietary chemical hardeners in accordance with manufacturer's printed instructions.

h. Exposed Aggregate Finish: Exposed aggregate exterior sidewalks shall be finished by tamping the concrete to force coarse aggregate away from the surface, screeding and floating to bring surface to finish level, steel troweling to an even, smooth surface. Apply 3/8" round rock (also known as river rock) densely and uniformly over the surface. Then roll the seeded aggregate into the surface to match the required finish elevation. Do the work carefully, avoiding uneven texture. Sample panel is required for the Architect's approval.

i. Rock Salt Finish: Apply non-slip swirl rock salt finish to exterior walks and slabs as indicated.

1) Following completion of the troweling scatter 1/4" to 3/8" size rock salt particles uniformly over the surface, then press or roll the salt particles into the surface only a sufficient amount for the dissolved salt to leave
1/4" to 3/8" side pits or holes in the surface. After the concrete surface has completely hardened sufficiently not be damaged by washing, the salt is washed away by a thorough flooding with water.

H. Cement Mortar or Grout

(1) Cement mortar for the repair of imperfect concrete work, the filling of holes left by form bolts and ties, and the filling of voids, around piping through concrete shall consist of cement and sand mixed in the same proportion as used for the concrete being repaired, with only sufficient water to give the required consistency, but in no case shall the water-cement ratio be more than that specified for Class "A" concrete. Bolt holes shall be filled with dry pack mortar, well tamped down into holes.

(2) Grout for spreading over the surfaces of construction joints shall consist of water and cement mixed in the ratio of not to exceed seven gallons per sack with sufficient sand added to produce the desired workability of the mass.

(3) Cement mortar or grout that has not been placed within 30 minutes after mixing shall be wasted.

I. Inserts

(1) Pipes, anchor bolts, sleeves, reglets, casings and other inserts, as shown on the plans, or as required, shall be encased in the concrete unless otherwise noted.

(2) Contractor shall notify all subcontractors and other prime contractors who have items to be embedded in or pass through the concrete at least five days in advance of the placing of concrete.

(3) The Contractor shall leave any openings through the walls or floors as shown on Mechanical and Electrical drawings and other required openings as directed by the Architect. In case of any conflict with structural members, the Contractor shall notify the Architect and suitable solution resolved before the concrete is placed.

J. Cleaning

(1) After the concrete work is complete, carefully remove all excess concrete and all protective materials and broom the surfaces and remove all mortar and other foreign materials. All concrete inserts, anchors bolts, etc., shall be cleaned of all concrete after forms are
Andrada Polytechnic High School
Presentation Hall

removed.

K. Waste Management

(1) Separate and recycle waste materials to the maximum extent economically feasible.

(2) Before concrete pours, designate locations or uses for excess concrete. Options include:
   a. Additional paving
   b. Post footing anchorage
   c. Swale, riprap reinforcing
   d. Flowable fill
   e. Footing bottom, retaining wall footing ballast
   f. Storm structure covers
   g. Underground utility pipe kickers
   h. Storm pipe flared end section
   i. Toe wash protection, and shoulder and toe outfall restraints for temporary erosion pipes

(3) Before concrete pours designate a location for cleaning out concrete trucks. Options include:
   a. Company-owned site for that purpose (meeting environmental standards)
   b. On-site area to be paved later in project.

END OF SECTION
033300 – ARCHITECTURAL CONCRETE (SITE)

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 DESCRIPTION OF WORK

A. The work covered by this section includes, but is not limited to, the:

1. Broom Finish

1.3 RELATED SECTIONS

A. Cast-In-Place Concrete: Section 033000

1.4 SUBMITTALS

A. General: Submit the following according to the Conditions of the Contract and Division 01 Specification Sections.

B. Shop Drawings: Layout of concrete pavement score lines and expansion joints.

C. Test Panels: One 4’ x 4’ test panel for each paving treatment specified herein.

D. Certification: Written Certificate of Compliance signed by Contractor, that all concrete paving and curb materials and products to be used on this project will comply with Standards referenced in the Specifications.

E. Product data for proprietary materials and items, including reinforcement and forming accessories, admixtures, joint systems, curing compounds, dry-shake finish materials, and others if requested by Architect.

F. Design mixes for each class of concrete. Include revised mix proportions when characteristics of materials, project conditions, weather, test results, or other circumstances warrant adjustments.

G. Laboratory test reports for evaluation of concrete materials and mix design tests.
H. Material certificates in lieu of material laboratory test reports when permitted by Architect. Material certificates shall be signed by manufacturer and Contractor certifying that each material item complies with or exceeds requirements. Provide certification from admixture manufacturers that chloride content complies with requirements.

1.5 QUALITY ASSURANCE

A. Concrete Standards: Comply with provisions of the following standards, except where more stringent requirements are indicated.
   1. American Concrete Institute (ACI) 301, "Specifications for Structural Concrete for Buildings."
   2. ACI 318, "Building Code Requirements for Reinforced Concrete."

B. Concrete Manufacturer Qualifications: Manufacturer of ready-mixed concrete products complying with ASTM C 94 requirements for production facilities and equipment.

C. Concrete Testing Service: Engage a qualified independent testing agency to perform materials evaluation tests and to design concrete mixes.

D. Field-Constructed Mockup: Cast mockup of size indicated or as required to demonstrate typical joints, surface finish, texture, color, and standard of workmanship.
   1. When Architect determines that mockup does not meet requirements, demolish and remove it from the site and cast another until the mockup is accepted.
   2. Keep accepted mockup undisturbed during construction as a standard for judging completed paving. Undamaged mockup may be incorporated into the Work.
   3. Demolish accepted mockup and remove from site when directed by Architect.

E. Do not change source of brands of cement and aggregate materials during course of the work.

F. Maintain accurate field records of time, date of placing, curing and removal of forms for concrete work in each portion of the work. Include in this article prerequisites, standards, limitations, and criteria that establish an overall level of quality for products and workmanship. Include only those quality-assurance
provisions that affect all Work of this Section rather than those that apply only to Part 2 - Products or Part 3 - Execution.

1.6 PROJECT CONDITIONS

A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.

B. Establish and maintain required lines and grade elevations.

C. Do not install concrete work over wet, saturated, muddy or frozen subgrade.

D. Protect adjacent work.
   1. Provide temporary barricades, warning lights and signs as required for protection of work and public safety.
   2. Field Measurements: Verify actual dimensions of finish treatments by field measurements before fabrication.

1.7 WARRANTY

A. The General Conditions and Special Provisions of the Contract apply to work specified in this section.

B. Failures include, but are not limited to, the following:
   1. Spalling
   2. Major cracking

C. Warranty Period: Two years from date of Substantial Completion.

PART 2 - MATERIALS

2.1 FORMS

A. Form Materials: Plywood, metal, metal-framed plywood, or other acceptable panel-type materials to provide full-depth, continuous, straight, smooth exposed surfaces.
   1. Use flexible or curved forms for curves of a 100-foot or less radius.

B. Form Release Agent: Provide commercial formulation form-release agent with a maximum of 350 g/L volatile organic compounds (VOCs) that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.
2.2 REINFORCING MATERIALS

A. Reinforcing Bars and Tie Bars: ASTM A 615, Grade 60, deformed.

B. Epoxy-Coated Reinforcing Bars: ASTM A 775 with ASTM A 615, Grade 60 deformed steel bars.

C. Plain, Cold-Drawn Steel Wire: ASTM A 82.

D. Welded Steel Wire Fabric: ASTM A 185.
   1. Furnish in flat sheets, not rolls, unless otherwise acceptable to Architect.


F. Fabricated Bar Mats: Welded or clip-assembled steel bar mats, ASTM A 184. Use ASTM A 615, Grade 60 steel bars, unless otherwise indicated.

G. Joint Dowel Bars: Plain steel bars, ASTM A 615, Grade 60. Cut bars true to length with ends square and free of burrs.

H. Epoxy-Coated Joint Dowel Bars: ASTM A 775 with ASTM A 615, Grade 60 plain steel bars.

I. Hook Bolts: ASTM A 307, Grade A bolts, internally and externally threaded. Design hook bolt joint assembly to hold coupling against pavement form and in position during concreting operations, and to permit removal without damage to concrete or hook bolt.

J. Supports for Reinforcement: Chairs, spacers, dowel bar supports and other devices for spacing, supporting, and fastening reinforcing bars, welded wire fabric, and dowels in place. Use wire bar-type supports complying with CRSI specifications.

2.3 CONCRETE MATERIALS

A. Portland Cement: ASTM C 150, Type I.
   1. Use one brand of cement throughout Project unless otherwise acceptable to Architect.

B. Fly Ash: ASTM C 618, Type F.

C. Normal-Weight Aggregates: ASTM C 33, Class 4, and as follows. Provide aggregates from a single source.
2. Do not use fine or coarse aggregates that contain substances that cause spalling.
3. Local aggregates not complying with ASTM C 33 that have been shown to produce concrete of adequate strength and durability by special tests or actual service may be used when acceptable to Architect.

D. Water: Potable.

2.4 ADMIXTURES

A. Provide concrete admixtures that contain not more than 0.1 percent chloride ions.

B. Air-Entraining Admixture: ASTM C 260, certified by manufacturer to be compatible with other required admixtures.

C. Water-Reducing Admixture: ASTM C 494, Type A.

D. High-Range Water-Reducing Admixture: ASTM C 494, Type F or Type G.

E. Water-Reducing and Accelerating Admixture: ASTM C 494, Type E.

F. Water-Reducing and Retarding Admixture: ASTM C 494, Type D.

2.5 CURING MATERIALS

A. Absorptive Cover: Burlap cloth made from jute or kenaf, weighing approximately 9 oz. per sq. yd., complying with AASHTO M 182, Class 2.

B. Moisture-Retaining Cover: One of the following, complying with ASTM C 171.

1. Waterproof paper.
2. Polyethylene film.

C. Clear Solvent-Borne Liquid Membrane-Forming Curing Compound: ASTM C 309, Type I, Class A or B, wax free.

D. Clear Waterborne Membrane-Forming Curing Compound: ASTM C 309, Type I, Class B.

1. Provide material that has a maximum volatile organic compound (VOC) rating of 350 g/L.
E. Evaporation Control: Monomolecular film-forming compound applied to exposed concrete slab surfaces for temporary protection from rapid moisture loss.

2.6 RELATED MATERIALS

A. Boiled Linseed Oil Mixture: Combination of boiled linseed oil and mineral spirits, complying with AASHTO M-233.

B. Bonding Agent: Acrylic or styrene butadiene.

C. Epoxy Adhesive: ASTM C 881, two-component material suitable for dry or damp surfaces. Provide material type, grade, and class to suit requirements.

2.7 CONCRETE MIX

A. Prepare design mixes for each type and strength of normal-weight concrete by either laboratory trial batch or field experience methods as specified in ACI 301. For the trial batch method, use a qualified independent testing agency for preparing and reporting proposed mix designs.

1. Do not use the Owner's field quality-control testing agency as the independent testing agency.

2. Limit use of fly ash to 25 percent of cement content by weight.

B. Proportion mixes according to ACI 211.1 and ACI 301 to provide normal-weight concrete with the following properties:


2. Air Content: 2.5 to 4.5 percent.

C. Adjustment to Concrete Mixes: Mix design adjustments may be requested by Contractor when characteristics of materials, project conditions, weather, test results, or other circumstances warrant.

2.8 CONCRETE MIXING

A. Ready-Mixed Concrete: Comply with requirements and with ASTM C 94.

1. When air temperature is between 85 deg F (30 deg C) and 90 deg F (32 deg C), reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F (32 deg C), reduce mixing and delivery time to 60 minutes.
PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions with Owner present for compliance with layout requirements and other conditions affecting performance of the Work.

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

3.2 SURFACE PREPARATION

A. Proof-roll prepared subbase surface to check for unstable areas and verify need for additional compaction. Do not begin paving work until such conditions have been corrected and are ready to receive paving.

B. Remove loose material from compacted subbase surface immediately before placing concrete.

3.3 FOUNDATION COURSE PLACEMENT: PAVEMENT AND WALKS/PADS

A. Place on dry subgrade in lifts from minimum 6” to maximum 12” for pavement, maximum 6” lifts for walks. Remove all subgrade material churned or mixed with foundation course and replace as necessary at Contractor’s expense.

B. Compaction for foundation course shall be 95 percent of standard proctor maximum density.

C. Grades for foundation course shall be +/- .25” of required grades.

3.4 EDGE FORMS AND SCREED CONSTRUCTION

A. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides for paving to required lines, grades, and elevations. Install forms to allow continuous progress of work and so that forms can remain in place at least 24 hours after concrete placement.

B. Check completed formwork and screeds for grade and alignment to following tolerances:

1. Top of Forms: Not more than 1/8 inch in 10 feet.

2. Vertical Face on Longitudinal Axis: Not more than 1/4 inch in 10 feet.

C. Clean forms after each use and coat with form release agent as required to ensure separation from concrete without damage.
3.5 PLACING REINFORCEMENT

A. General: Comply with Concrete Reinforcing Steel Institute's recommended practice for "Placing Reinforcing Bars" for placing and supporting reinforcement.

B. Clean reinforcement of loose rust and mill scale, earth, ice, or other bond-reducing materials.

C. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement. Maintain minimum cover to reinforcement.

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

E. Install fabricated bar mats in lengths as long as practicable. Handle units to keep them flat and free of distortions. Straighten bends, kinks, and other irregularities or replace units as required before placement. Set mats for a minimum 2-inch overlap to adjacent mats.

3.6 JOINTS

A. General: Construct contraction, construction, and isolation joints true to line with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to the centerline, unless indicated otherwise.

1. When joining existing paving, place transverse joints to align with previously placed joints, unless indicated otherwise.

B. Contraction Joints: Provide weakened-plane contraction joints, sectioning concrete into areas as shown on Drawings. Construct contraction joints for a depth equal to at least 1/4 of the concrete thickness, as follows:

1. Tooled Joints: Form contraction joints in fresh concrete by grooving and finishing each edge of joint with a radiused jointer tool.

2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch-wide joints into hardened concrete when cutting action will not tear, abrade, or otherwise damage surface and before development of random contraction cracks.

3. Inserts: Form contraction joints by inserting premolded plastic, hardboard, or fiberboard strips into fresh concrete until top surface of strip is flush with paving surface. Radius each joint edge with a jointer tool. Carefully
remove strips or caps of two-piece assemblies after concrete has hardened. Clean groove of loose debris.

C. Walks/Pads: Use tool that produces “V” joint not over 1/4” wide.

D. Construction Joints: Set construction joints at side and end terminations of paving and at locations where paving operations are stopped for more than 1/2 hour, unless paving terminates at isolation joints.

E. Expansion Joints: Form isolation joints of preformed joint filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, walks, other fixed objects, and where indicated.

1. Locate expansion joints at intervals of 30 feet for curbs and walks, unless otherwise specified on plans, and at all beginnings and ends at radius at curbs.

2. Locate expansion joints at intervals of 50 feet, unless indicated otherwise, for pavement lanes.

3. Extend joint fillers full width and depth of joint, not less than 1/2 inch or more than 1 inch below finished surface where joint sealant is indicated. Place top of joint filler flush with finished concrete surface when no joint sealant is required.

4. Furnish joint fillers in one-piece lengths for full width being placed wherever possible. Where more than one length is required, lace or clip joint filler sections together.

5. Protect top edge of joint filler during concrete placement with a metal, plastic, or other temporary preformed cap. Remove protective cap after concrete has been placed on both sides of joint.

6. Locate expansion joints at a maximum of 150 sq. ft. of walks/pads, except that maximum dimensions between joints in a linear walk to be no more than 30 ft.

F. Installation of joint fillers and sealants is specified in Division 7 Section "Paving Joint Sealants."

G. Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt-coat one half of dowel length to prevent concrete bonding to one side of joint.
3.7 CONCRETE PLACEMENT

A. Inspection: Before placing concrete, inspect and complete formwork installation, reinforcing steel, and items to be embedded or cast in. Notify other trades to permit installation of their work.

B. Moisten subbase to provide a uniform dampened condition at the time concrete is placed. Do not place concrete around manholes or other structures until they are at the required finish elevation and alignment.

C. Comply with requirements and with ACI 304R for measuring, mixing, transporting, and placing concrete.

D. Deposit and spread concrete in a continuous operation between transverse joints. Do not push or drag concrete into place or use vibrators to move concrete into place.

E. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

F. Consolidate concrete by mechanical vibrating equipment supplemented by hand-spading, rodding, or tamping. Use equipment and procedures to consolidate concrete complying with ACI 309R.

   1. Consolidate concrete along face of forms and adjacent to transverse joints with an internal vibrator. Keep vibrator away from joint assemblies, reinforcement, or side forms. Use only square-faced shovels for hand-spreading and consolidation. Consolidate with care to prevent dislocating reinforcing, dowels, and joint devices.

G. Screed paved surfaces with a straightedge and strike off. Use bull floats or darbies to form a smooth surface plane before excess moisture or bleed water appears on the surface. Do not further disturb concrete surfaces prior to beginning finishing operations.

H. Slip-Form Pavers: When automatic machine placement is used for paving, submit revised mix design and laboratory test results that meet or exceed requirements. Produce paving to required thickness, lines, grades, finish, and jointing as required for formed paving.

   1. Compact subbase and prepare subgrade of sufficient width to prevent displacement of paver machine during operations.

I. Cold-Weather Placement: Comply with provisions of ACI 306R and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
1. When air temperature has fallen to or is expected to fall below 40 deg F, uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F and not more than 80 deg F at point of placement.

2. Do not use frozen materials or materials containing ice or snow.

3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise accepted in mix designs.

J. Hot-Weather Placement: Place concrete complying with ACI 305R and as specified when hot weather conditions exist.

1. Cool ingredients before mixing to maintain concrete temperature at time of placement to below 90 deg F. 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. Using 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 embedding in concrete.

3. Fog spray forms, reinforcing steel, and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

3.8 CONCRETE FINISHING

A. Float Finish: Begin floating when bleed water sheen has disappeared and the concrete surface has stiffened sufficiently to permit operations. Float surface with power-driven floats, or by hand-floating if area is small or inaccessible to power units. Finish surfaces to true planes within a tolerance of 1/4 inch in 10 feet as determined by a 10-foot-long straightedge placed anywhere on the surface in any direction. Cut down high spots and fill low spots. Refloat surface immediately to a uniform granular texture.

B. Medium Broom Finish: Provide light to medium finish by striating surface with a stiff bristle broom in straight continuous lines.

C. Exposed Aggregate Finish: Broadcast aggregate upon floated paving while concrete is wet. Coverage shall be at a medium to heavy ratio. Provide sample panel as specified in 1.4 d.

D. Final Tooling: Tool edges of paving, gutters, curbs, and joints formed in fresh concrete with a jointing tool to the following radius. Repeat tooling of edges
and joints after applying surface finishes. Eliminate tool marks on concrete surfaces.

1. Radius: 1/4 inch.

3.9 CONCRETE PROTECTION AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with the recommendations of ACI 306R for cold weather protection and ACI 305R for hot weather protection during curing.

B. Evaporation Control: In hot, dry, and windy weather, protect concrete from rapid moisture loss before and during finishing operations with an evaporation-control material. Apply according to manufacturer’s instructions after screeding and bull floating, but before floating.

C. Begin curing after finishing concrete but not before free water has disappeared from concrete surface.

D. Curing Methods: Cure concrete by moisture curing, moisture-retaining-cover curing, curing compound, or a combination of these as follows:

1. Moisture Curing: Keep surfaces continuously moist for not less than 7 days with the following materials:
   a. Water.
   b. Continuous water-fog spray.
   c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with a 12-inch lap over adjacent absorptive covers.

2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Immediately repair any holes or tears during curing period using cover material and waterproof tape.

3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer’s directions. Recoat areas subjected to heavy rainfall within 3 hours after initial application. Maintain continuity of coating and repair damage during curing period.
3.10 FIELD QUALITY CONTROL TESTING

A. The Owner will employ a qualified testing and inspection agency to sample materials, perform tests, and submit test reports during concrete placement. Sampling and testing for quality control may include the following:

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 placement for each compressive-strength test but no less than one test for each day's pour of each type of concrete. Additional tests will be required when concrete consistency changes.
   b. Air Content: ASTM C 231, pressure method; one test for each compressive-strength test but no less than one test for each day's pour of each type of air-entrained concrete.
   c. Concrete Temperature: ASTM C 1064; one 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 one test for each set of compressive-strength specimens.
   d. Compression Test Specimens: ASTM C 31; one set of four standard cylinders for each compressive-strength test, unless directed otherwise. Mold and store cylinders for laboratory-cured test specimens except when field-cured test specimens are required.
   e. Compressive-Strength Tests: ASTM C 39; one set for each day's pour of each concrete class exceeding 5 cu. yd. but less than 25 cu. yd., plus one set for each additional 50 cu. yd. Test one specimen at 7 days, test two specimens at 28 days, and retain one specimen in reserve for later testing if required.

2. When frequency of testing will provide fewer than five strength tests for a given class of concrete, conduct testing from at least five randomly selected batches or from each batch if fewer than five are used.

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, concrete manufacturer, and Contractor within 24 hours of testing. Reports of compressive strength tests shall contain the Project identification name and number, date of concrete
placement, name of concrete testing agency, concrete type and class, location of concrete batch in paving, design compressive strength at 28 days, concrete mix proportions and materials, compressive breaking strength, and type of break for both 7-day 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 agency will make additional tests of the concrete when test results indicate slump, air entrainment, concrete strengths, or other requirements have not been met, as directed by Architect. Testing agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42, or by other methods as directed.

3.11 REPAIRS AND PROTECTION

A. Remove and replace concrete paving that is broken, damaged, or defective, or does not meet the requirements of this Section.

B. Drill test cores where directed by Architect when necessary to determine magnitude of cracks or defective areas. Fill drilled core holes in satisfactory pavement areas with portland cement concrete bonded to paving with epoxy adhesive.

C. Protect concrete from damage. Exclude traffic from paving for at least 14 days after placement. When construction traffic is permitted, maintain paving as clean as possible by removing surface stains and spillage of materials as they occur.

D. Maintain concrete paving free of stains, discoloration, dirt, and other foreign material. Sweep concrete paving not more than 2 days prior to date scheduled for Substantial Completion inspections.

END OF SECTION
033500 – DENSIFIED CONCRETE FINISH

1. GENERAL:

   A. Description of Work

      (1) Work as evident on the drawings and specified herein or required for furnishing all labor, materials, equipment, and services necessary for the application of concrete densifier, sealer, and water and oil repellant, in conjunction with Section 033000, Cast-In-Place Concrete.

   B. Related Work

      (1) Section 033000: Cast-In-Place Concrete.

      (2) Drawings: General Structural Notes and Room Finish Schedule.

   C. Submittals

      (1) Product data: Submit manufacturer's product data and installation instructions. Include both published data and any specific data prepared for this project.

   D. References and Standards

      (1) American Concrete Institute (ACI):

         a. ACI 302.1 R-15, Guide for Concrete Floor and Slab Construction.

      (2) American Society for Testing and Materials (ASTM):

         a. ASTM C805, Impact Strength.

         b. ASTM 1028, Co-efficient of Friction.

         c. ASTM C150, Type II Portland cement.

   E. Quality Assurance

      (1) Test Area: Test a representative area of 4 feet by 4 feet to confirm surface preparation procedures, coverage rates, reaction time, finished appearance, etc. Use the manufacturer's application instructions. Let test area cure and dry thoroughly before inspection. Keep test area available for comparison throughout the project.
2. PRODUCTS:

A. Acceptable Manufacturers

(1) PROSOCO, Inc., 3741 Greenway Circle, Lawrence, KS 66046. Phone: (800) 255-4255; Fax: (785) 830-9797. E-mail: CustomerCare@prosoco.com.

(2) Approved equal by Architect. Manufacturers must have a complete system of products that match the types and descriptions below.

B. Product Descriptions

This specification is based upon the Consolideck system manufactured by PROSOCO, Inc. Other systems may be approved at the architect’s discretion provided it meets the performance characteristics of the basis system.

(1) Concrete Sealer, Hardener, and Densifier: Consolideck LS lithium silicate treatment or approved equal.

(2) Concrete Protective Treatment: Consolideck LS Guard lithium silicate hardener or approved equal.

3. EXECUTION:

A. Preparation

(1) Surfaces to be treated must be clean and structurally sound. Remove all foreign materials including bond breakers, curing agents, surface grease and oil, and construction debris using the appropriate manufacturer’s surface prep cleaner.

(2) Read “Preparation” and “Safety Information” sections in the manufacturer’s Product Data Sheet for the product.

B. Placement

(1) Apply each product in strict accordance with manufacturer’s instructions. Make note of the placement order, timing and critical interactions between the different products to ensure a properly stained densified concrete finish.

END OF SECTION
DIVISION 4 - MASONRY

042000 – UNIT MASONRY

1. GENERAL

A. Description of Work

(1) Work as evident on the drawings and specified herein or required for completion of the masonry work.

B. Submittals

(1) Certificates: Furnish certificates prior to delivery of the certified materials to the project site for concrete masonry units, brick, lime, and reinforcing bars.

(2) Shop Drawings: Furnish shop drawings in accordance with Section 013000 Shop Drawings and Samples showing reinforcing bar setting plans and bending details for Architect’s review, prior to fabrication of any item.
   a. In reviewing shop drawings, the Architect / Engineer will attempt to detect omissions and major errors, but neither failure of the Architect / Engineer to do this nor the review of the shop drawings shall relieve the Contractor of its responsibility to comply with Drawings and Specifications.

(3) Complete product literature for pre-faced masonry units.

C. Delivery, Storage, and Handling

(1) Handle, store, and protect masonry units in a manner to avoid chipping, breakage, or contact with the soil or contaminating materials and exposure to the elements.

D. Provision for Other Trades

(1) Where any work is to be set under another Section, but built into masonry, the Contractor shall cooperate with other Contractors for that work, and take care not to disturb work set by others. Build in such items as masonry is being constructed to avoid cutting of masonry after erection.

E. Standards

(1) Masonry work shall conform to the latest edition in effect of the following Standards and the Drawings and Specifications for the
engineering design and construction of reinforced grouted masonry:

a. IBC International Building Code, Chapter 21, Masonry.
b. ICBO Research Recommendation Report.
c. ASTM American Society of Testing and Materials Standards.

F. Quality Control (Tests)

(1) Testing of materials or mixes shall be paid for by the Owner and accomplished by an accredited testing laboratory approved by the Architect.

(2) Mortar and grout test cubes shall be prepared and tested in accordance with ASTM C270 and ASTM C1019, respectively. Cubes shall be prepared and tested by an accredited testing laboratory and shall be representative of all materials and mixes to be used in the field. All mixes and materials shall be tested prior to commencing any masonry work with check tests performed during the progress of the work, as indicated below. In the event any retesting is required due to the failure of materials to meet specifications limits, the Contractor shall pay for all such re-testing.

a. Mortar: Provide at least one compressive strength test for mortar on the first day’s work and additional test specimens every three days after, but provide a minimum of one test for each 5,000 square feet of wall.

b. Grout: Provide at least one compressive strength test for grout made on each day of grouting, but not less than one compressive strength test for grout made for every 5,000 SF of wall.

(3) Representative samples of concrete masonry units shall be selected from initial deliveries to the project and shall be tested for conformance to ASTM C90, for both compressive strength and shrinkage requirements. Frequency of additional test or re-test, if any, shall be at the discretion and direction of the Architect's representative.

2. PRODUCTS

A. Concrete Masonry Units

(1) Hollow masonry units, standard plain, shall conform to the latest ASTM Designation C90 with .03 to .045 linear shrinkage percent at 30 percent maximum moisture content. Unit sizes shall be as indicated on the Drawings. Standard accessory shapes shall be
included as required by the work.

(2) All masonry units shall be:
   a. 8 x 8 x 16 smooth faced, natural gray.

B. Mortar

(1) Conform to latest ASTM Designation C270 (type S) and mixed in the following approximate proportions by volume and shall in all cases develop 1800 psi minimum compressive strength in 28 days.
   1 part Portland cement
   1/4 to 1/2 part hydrated lime or lime-putty
   2-1/4 to 3 parts (of combined cement and lime) damp loose sand.
   (No fly ash shall be permitted.)

(2) Commercially prepared premix mortar may be used with concrete masonry units.

C. Grout

(1) Conform to latest ASTM Designation C476 and shall in all cases develop 2000 psi minimum compressive strength in 28 days.
   a. Grout shall be placed in maximum of four foot lifts. No fly ash shall be permitted.
   b. In grout spaces 2” or more in dimension, use coarse type grout. Use fine grout in spaces less than 2” in horizontal dimension.

D. Horizontal Steel Joint Reinforcement

(1) Ladder-type "Dur-O-Wall", with No. 9 gage deformed side rods and cross rods spaced at not more than 16" o.c. Material requirements shall meet ASTM Standards A82.

E. Reinforcing Steel

(1) Conform to ASTM A615, Grade 40 for #4 bars and smaller. Grade 60 for #5 bars and larger. ASTM A706, Grade 60 for bars to be welded.

F. Masonry Control Joints

(1) Extruded polyvinylchloride (PVC), regular type, as required by work and shown on Drawings.

G. Foam Insulation
(1) Foamed-in-place masonry insulation per section 072119.

3. EXECUTION

A. Laying Masonry Units

(1) Masonry for the building shall not be started until the supporting structure has gained its full strength and has been approved by the Architect. All masonry shall be laid in standard "running bond" except as otherwise indicated on the drawings, carefully set true to line level and plumb with full bonded corners and intersection.

(2) Masonry units shall not be wetted before being used but shall be laid dry.

(3) Chipped, cracked or otherwise defective units shall not be laid in the wall where exposed to view.

(4) Chases, offsets, and openings for ducts shall be neatly formed and carefully located as required by other trades so no cutting and patching will be necessary.

(5) All defects in masonry construction, due to poor workmanship or defective or off-color materials, shall be corrected by removal of defective areas and replacement with quality units and workmanship to match adjacent areas, and all corrective work shall be completed to his satisfaction at no additional cost to Owner.

B. Reinforcing

(1) All masonry walls and partitions of concrete masonry units shall be reinforced with reinforcing bars and joint reinforcement at the spacing indicated on plans. All cells at vertical reinforcing bars and at bond beams shall be fully grouted as detailed on the drawings.

(2) All steel reinforcing bars in masonry, laid horizontally or vertically, shall lap a minimum of 48 bar diameters for 1 bar per cell and 63 bar diameters for 2 bars per cell, but not less than 2'-0" at all splices and corners.

C. Joints

(1) All exposed joints, interior and exterior shall be tooled. Untooled joints in areas designated to receive fixed installations of any kind will not be permitted (i.e. cabinets, rigid insulation wall system, or other finishes). Units shall be laid in a full mortar bed with a shove joint, and all joints shall be completely filled with mortar as masonry
work progresses.

(2) Joint widths for concrete masonry units shall be 3/8-inch.

(3) Horizontal joints inside auditorium and gymnasium shall be raked every 48" from finish floor to ceiling/bottom of structure.

D. Grouting

(1) Vertical cells in CMU to be filled shall have vertical alignment sufficient to maintain a clear, unobstructed continuous vertical cell.

(2) All cells containing reinforcement shall be filled solidly with grout. Vertical cells containing reinforcement shall be filled solidly with grout in lifts not exceeding four feet (5') in height, unless approved by the architect.

(3) Cleanout openings shall be provided at the bottoms of all cells to be filled at each lift or pour of grout where such lift or pour of grout is in excess of five feet in height. Any overhanging mortar or other obstructions or debris shall be removed from the insides of such cell walls. The cleanouts shall be sealed before grouting, after inspection.

(4) When the grouting is stopped for one hour or longer, horizontal construction joints shall be formed by stopping the pour of grout one and one-half inches (1-1/2") below the top of the uppermost unit.

E. Work of Other Trades

(1) The Drawings shall be carefully examined so proper provisions will be made for all work of other trades. All metal door frames shall be solidly bedded, grouted, and anchored, and masonry carefully pointed around these frames and projections. All conduit, pipes, grounds, wedges, wall plugs, and all metal anchors and ties required for the proper executing of the work shall be built into the masonry while it is being laid.

F. Insulating of Exterior Masonry Walls

(1) As noted on drawings, exterior CMU walls shall be insulated by completely filling all ungrouted cells of the units with foam fill, except 2-hour rated wall assemblies which will utilize loose perlite fill. Loose fill insulation shall be brought up alternately with the masonry with not more than a 2-foot-height section of wall completed before insulation is poured from the top of each height of wall section completed and allowed to assume its natural
density. Loose fill insulation shall not be tamped.

G. Protection

(1) In freezing weather all masonry work and material shall be protected to maintain its temperature above 40 degrees F., until the mortar has thoroughly set. No frozen mortar shall be used.

(2) In the event of rain during the course of construction, masonry walls shall be protected by placing a 36" wide strip of 4 mil polyethylene ("Visqueen") over the top of wall, adequately weighted to prevent its removal by wind. Said covering may be required at the direction of the Architect's representative if, in his opinion, inclement weather appears probable.

(3) All Masonry construction shall meet the IBC Section 2104.3 for Cold Weather Construction and IBC Section 2104.4 for Hot Weather construction.

H. Clean-Up

(1) Extreme care shall be used to prevent any grout or mortar from staining adjacent materials and shall be immediately removed. Protect all sills, ledges, offsets, and other projections from droppings of mortar and protect door jambs and corners from damage during construction.

(2) Upon completion or when directed by Architect, clean all exposed surfaces of masonry and concrete work, removing all loose mortar, dirt, and other materials as may be necessary to produce a finish in proper condition for natural exposed or painters finish. Care shall be taken with projecting surfaces to avoid chipping and breaking.

I. Waste Management

(1) Separate and recycle waste materials to the maximum extent feasible.

(2) Fold up metal banding; flatten and place in designated area for recycling.

(3) Collect wood packing shims and pallets; place in designated area.

(4) Place unused mixed mortar in designated locations where lower strength mortar meets the requirements for bulk fill; for example, use as retaining wall footing ballast, cavity fill at grade, or underground utility pipe kickers.
(5) Separate masonry waste and place in designated area for use as structural fill or in landscaping of the project.

END OF SECTION

END OF DIVISION
THIS PAGE INTENTIONALLY LEFT BLANK
DIVISION 5 - STEEL

051200 – STRUCTURAL STEEL

1. GENERAL

A. Description of Work

(1) Work as evident of Drawings and specified herein or required to accomplish the structural steel work.

(2) All steel exposed to view in the finished project shall be finished according to architecturally exposed structural steel requirements of ASCI.

B. Related Sections

(1) Section 053100: Steel Roof Deck

(2) Section 055000: Metal Fabrications

(3) Section 033000: Cast-In-Place Concrete; setting of embedded items

C. Submittals

(1) Shop Drawings: Furnish shop drawings in accordance with Section 013300 Shop Drawings and Samples showing all shop and erection details; members and connections for any portion of the structure not shown on the Contract Drawings shall be detailed by the fabricator and indicated on the shop drawings. All welds shall be indicated by standard welding symbols of the AWS. Fabricator shall prepare his own original drawings. Prints made from modified reproductions of project structural drawings will not be allowed. Shop drawings shall be approved before fabrication.

a. Submittals requiring structural design or calculations shall be sealed by a professional civil or structural engineer registered in the State of Arizona.

(2) In reviewing shop drawings, the Architect / Engineer will attempt to detect omissions and majors errors, but neither failure of the Architect / Engineer to do this nor the review of the shop drawings shall relieve the Contractor of their responsibility to comply with the Drawings and Specifications. Approval of shop drawings in no way relieves the Contractor or fabricator of their responsibility for all errors of detailing, fabrication and erection, and for the correct fitting of structural members.
(3) Certification: Certified copies of mill test reports, including names and locations of mills and shops, shall be furnished for all structural steel.

(4) Weld Procedure Specifications: WPS in conformance with AWS requirements shall be submitted for each type of weld to be constructed.

D. Responsibility for Errors

(1) The Contractor shall be responsible for all errors of detailing fabrication, and for the correct fitting of the structural members.

E. Qualification of Welders

(1) Certification that each welder is qualified in accordance with AWS Code D1.1 shall be provided. Any welder shall be retested and recertified when the work of the welder creates a reasonable doubt as to his proficiency. Tests, when required, shall be conducted at no additional expense to the Owner. Recertification of the welder shall be submitted only after the welder has taken and passed the required retest. All welders shall have certificates issued within the previous 12 months and have a copy of the approved weld procedures specifications.

F. Delivery and Storage of Materials

(1) Delivery of items for this work shall be scheduled so as to cause no delay in this work or work of other trades.

(2) Anchor bolts and bolt setting plans shall be delivered to Contractor for setting, following Engineer's review of plans.

(3) All items for this work shall be ready for erection or installation in accordance with the construction schedule established by the Contractor.

(4) All items furnished for this work by this subcontractor shall be delivered to the proper subcontractor for setting.

(5) Materials shall be stored out of contact with the ground in such manner and location as will minimize contamination and deterioration.

G. Standards
(1) Conform to the applicable requirements and recommendation of the latest edition in effect of the following standards and to the Drawings and Specifications for the engineering design, fabrication and erection of structural steel.
   a. IBC International Building Code, Chapter 22.
   b. AISC Specification for Structural Steel for Buildings.
   c. AWS D1.1 Structural Welding Code.

2. PRODUCTS

A. Hot Rolled Structural Steel, Shapes, Plates and Bars
   (1) Wide Flange shapes (“W” sections) shall be ASTM A992, Grade 50 and all other shapes shall be per ASTM Specification A36.

B. Steel Pipe
   (1) ASTM A501 or A53, Type E or S, Grade B.

C. Structural Tubing
   (1) ASTM A500, Grade B.

D. Anchor Rods (Anchor Bolts).
   (1) ASTM F1554 Grade 36 (Fy = 36 KSI).

E. Plain threaded bars.
   (1) A307, Grade A.

F. High Strength Bolts, Nuts, Washers
   (1) ASTM A325-N
   (2) ASTM A409-N when noted on the structural drawings.

G. Unfinished Bolts and Nuts
   (1) ASTM A307, Grade A or ASTM A325N as indicated.

H. Welding Electrodes
(1) AWS A5.1, E70 for manual shielded metal-arc process, and AWS A5.17, E70 for submerged-arc process.

I. Drill-In Expansion Anchors

(1) The anchors shall be a non-drilling type; see drawings for specific anchors to be used. All expansion and drill-in expansion anchors require Special Inspection.

J. Deformed Bar Anchors

(1) ASTM A496, with minimum tensile strength of 70,000 psi as manufactured by Nelson Stud Welding Co., or approved comparable products.

K. Threaded Studs

(1) Cold finished low carbon steel, 50,000 psi minimum yield strength, standard threaded studs with proper ferrules and flux, sizes and spacing as shown on Drawings and required by work. Manufacturers offering a product to comply with the requirements for threaded studs include KSM Products, Inc., Nelson Stud Welding Co., and RB & W Bolt and Nut Co.

L. Grout, Non-Shrink, Non-Metallic

(1) Grout for column and beam bearings, "Five Star Grout" as manufactured by U.S. Grout Corp., Old Greenwich, Conn.

M. Paint for Shop and Field

(1) Primer: SSPC-Paint 25, red iron oxide, zinc oxide, raw linseed oil and alkyd primer.

3. EXECUTION

A. Fabrication

(1) Structural steel work material shall be in accordance with the applicable provisions of the AISC Specification. Fabrication and assembly shall be done in the shop to the greatest extent possible. Structural steelwork, except surfaces of steel to be encased in concrete and surfaces to be field welded, shall be prepared for painting in accordance with the AISC Specification and primed with paint materials here in before listed.

(2) Concrete anchors, shear connectors and deformed bar anchors shall be end welded to steel members with automatically timed stud
welding equipment to produce an effective full penetration weld.

(3) In addition to special care used to handle and fabricate AESS, comply with the following:
   a. Fabricate with exposed surfaces smooth, square, and free of surface blemishes.
   b. Grind sheared, punched, and flame-cut edges smooth.
   c. Fabricate with exposed surfaces free of mill marks.
   d. Fabricate with exposed surfaces free of seams to maximum extent possible.
   e. Remove blemishes by filling or grinding or by welding and grinding, before cleaning, treating, and shop priming.
   f. Fabricate with piece marks fully hidden in the completed structure or made with media that permits full removal after erection.
   g. Fabricate to the tolerances specified in AISC 303 for steel that is not designated AESS.
   h. Seal-weld open ends of hollow structural sections with 3/8-inch (9.5-mm) closure plates.

B. Erection
   (1) The erection of structural steel shall be in accordance with the applicable provisions of the AISC Specification, and shall be installed by mechanics skilled in this type of work.
   (2) Connections: Anchor bolts and other connections between the structural steel and foundations shall be provided and shall be properly located and built into connecting work.
   (3) Provide full bearing contact with non-shrink, non-metallic grout under all steel elements supported directly upon concrete. The grout shall be proportioned, mixed and placed in strict accordance with the manufacturer's published specifications.

C. Welding
   (1) Shop and field welding processes and details, workmanship, quality control, inspection, and the qualification procedures for welders, tackers, and welding operators shall be as prescribed in the Structural Welding Code, AWS D1.1, of the American Welding Society.
   (2) Field Welds shall be done by manual shielded metal-arc process.
(3) Shop and field welds shall be made only by welders, tackers, and welding operators who have been qualified by tests and hold a current valid certificate, issued by an approved Independent Testing Agency, to perform the type of welds required by the work. Copies of certificates shall be furnished upon request of the Architect.

D. High Strength Bolt Installation

(1) Install high strength bolts, nuts, washers, and direct tension indicators for friction-type connections in accordance with the Specification for Structural Joints Using ASTM A325 or A490 Bolts by the Research Council on Riveted and Bolted Structural Joints, and endorsed by the American Institute of Steel Construction and the Industrial Fasteners Institute. Install and tighten bolts in accordance with Section 5 (e) Tightening by Use of a Direct Tension Indicator, and in accordance with the manufacturer's published recommendations and specifications. Use both hardened washers and direct tension indicators as specified, recommended and required. The "turn-of-nut" tightening method is not acceptable.

E. Inspection

(1) Material and workmanship shall be subject to inspection by the Architect at all times. The Contractor and this subcontractor shall cooperate with the Architect permitting access for inspection to all phases of the work.

(2) The Contractor shall notify the Architect in advance, of the start of shop fabrication and field erection.

(3) This work may be inspected in the shop or place of manufacturer. Approval by the Architect in the shop or place of manufacturer of an item, detail, or phase of the work shall exclude it from reinspection in the field. However, subsequent alterations or damage to an approved items, detail, or phase of the work may be cause of approval to become void.

(4) Material and workmanship not conforming to the Specifications may be rejected at any time defects are found during the progress of the project.

(5) The Owner shall engage a testing laboratory, to rigidly inspect, test as required by nondestructive methods, and prepare and submit reports to the Architect and Structural Engineer for compliance with
Specifications and Drawings of the following structural connections and connectors:

a. Field and shop welded structural connections for columns, beams, braces and hangers, as follows:
   i. Visual inspection of all structural field and shop welds of all parts of all joints and connections, and of all other necessary structural welds shall be made by an approved welding inspector.
   ii. Nondestructive testing of structural field complete and partial joint penetration groove welds shall be made by an AWS approved welding inspector. The method of testing shall be complete ultrasonic testing, except radiographic testing shall be used when required by the welding inspector. All complete penetration groove welds require testing.

b. Inspection of A307 and A325-N field bolts, inspection shall be performed as often as is required to verify that at least 10% of all bolts and at least 2 bolts in each connection are properly installed and tightened to a "snug-tight" condition. Snug tight is defined as the tightness attained by a few impacts of an impact wrench or the full effort of a man using an ordinary spud wrench. The same number of bolts shall be inspected that use fully pretensioned bolts as indicated on the structural drawings. It is expected that direct tension indicators will be used on these types of bolted connections.

c. Shear connector studs, workmanship, quality control, testing and inspection shall conform to AWS Code D1.1, 4, Technique, Part F.

d. Metal decking for floors and roof shall have puddle weld quality, number and location per sheet width, and seam connection quality and spacing visually inspected.

F. Painting

(1) One coat of shop paint shall be applied to all structural steel unless noted otherwise. Surface preparation and paint application shall conform to the procedures described in Section M3 of "Specifications for Structural Steel for Buildings", AISC.

(2) Shop painted steel, when marred by welding, bolting or erection shall be touch-up painted by the Erection Contractor in a manner approved by the Architect prior to the field painting.

(3) Touch-up painting of shop painted steel, when marred by the work of Trades or Subcontractors not performing the erection, shall be
touch-up painted by the Trade or Subcontractor causing the damage, and in a manner approved by the Architect.

END OF SECTION
052100 – STEEL JOISTS

1. GENERAL

A. Description of Work

(1) Work as evident on drawings and specified herein or required to accomplish the furnishing and installation of steel joists including but not necessarily limited to the following:
   a. Steel joists, bridging and accessories.
   b. Miscellaneous items as required to complete steel joist work.
   c. Erection, bracing, and connecting of steel joist work, including temporary bracing and connections.
   d. Shop painting and field touch-up painting of work in this section.

B. Related Work

(1) Section 051200: Structural Steel
(2) Section 053100: Steel Roof Deck

C. Standards

(1) Work shall conform to the latest edition in effect of the following standards and the Drawings and Specifications for the engineering design, fabrication and erection of structural steel:
   a. IBC International Building Code, Chapter 16 -General Design requirements, Chapter 22 - Steel and Iron.
   b. ICBO Research Recommendation Report.
   c. ASTM American Society for Testing and Materials Standards.
   d. AISC Specification for Structural Steel for Buildings.
   e. AISI Specification for the Design of Light Gage Cold Formed Steel Structural Members.
   f. AISC Standard Specifications for Open Web Steel Joists, K-Series.

D. Submittals

(1) Shop Drawings: Furnish shop drawings in accordance with Section 013300 Shop Drawings and Samples showing all
fabrication and erection details, specifications for shop painting, and marking of joists. Shop drawings shall be approved before fabrication.

a. Submittals requiring structural design or calculations shall be sealed by a professional civil or structural engineer registered in the State of Arizona.

(2) In reviewing shop drawings, the Architect will attempt to detect omissions and majors errors, but neither failure of the Architect to do this nor the reviewer of the shop drawings shall relieve the Contractor of his responsibility to comply with the Drawings and Specifications. Approval of shop drawings in no way relieves the Contractor or fabricator of his responsibility for all errors of detailing, fabrication and erection, and for the correct fitting of structural members.

(3) Certification: Certified copies of mill test reports, including names and locations of mills and shops, shall be furnished for all structural steel.

(4) Weld Procedure Specifications: WPS in conformance with AWS requirements shall be submitted for each type of weld to be constructed.

E. Quality Assurance

(1) General: Provide joists fabricated in compliance with Steel Joist Institute (SJI) "Standard Specifications, Load Tables, and Weight Tables for Steel Joists and Joists Girders".

(2) Manufacturer is responsible for the complete design and detailing of all joists including joist bridging in accordance with the Arizona State Board and/or the local jurisdiction.

F. Delivery and Storage

(1) Materials shall be delivered to the site in undamaged condition and stored in a manner and at location that will minimum the formation of water-holding pockets, soiling, and deterioration of the paint film.

(2) Delivery of items for this work shall be scheduled so as to cause no delay in this work or work of other trades.

(3) All items for this work shall be ready for erection or installation in accordance with the construction schedule established by the Contractor.
(4) All items furnished for this work by the subcontractor shall be delivered to the proper subcontractor for setting.

2. PRODUCTS

A. Materials

To the greatest extent possible, utilize steel that is certified to be a minimum of 90% recycled content (75% post-consumer steel) by the manufacturer.

(1) Steel: Comply with SJI "Specifications" for chord and web sections.

(2) Steel Prime Paint: Comply with SJI "Specification".

B. Fabrication

(1) General: Fabricate steel joists in accordance with SJI "Specifications".

(2) Ceiling Extension: Provide ceiling extensions in areas having ceilings attached directly to joist bottom chord. Provide either an extended bottom chord element or a separate unit, to suite manufacturer’s standards, of sufficient strength to support ceiling construction. Extend ends to within 1/2” of finished wall surface, unless otherwise indicated.

(3) Bridging: Provide horizontal or diagonal type bridging for joists and joist girders, complying with SJI "Specification".
   a. Provide bridging anchors for ends of bridging lines terminating at walls or beams.

(4) End Anchorage: Provide end anchorages, including steel bearing plates, to secure joists to adjacent construction, complying with SJI "Specifications".

(5) Shop Painting: Remove loose scale, heavy rust, and other foreign materials from fabricated joists and accessories before application of shop paint.
   a. Apply one shop coat of steel prime paint to joists and accessories, by spraying, dipping, or other method to provide a continuous dry paint film thickness of not less than 0.50 mil.
3. EXECUTION

A. Erection

(1) Care shall be exercised at all times to avoid damage through careless handling during unloading, storing and erecting. Dropping of joists shall not be permitted.

(2) Place and secure steel joists in accordance with SJI "Specifications", final shop drawings, and as herein specified.

(3) Anchors: Furnish anchor bolts, steel bearings plates, and other devices to be built into concrete and masonry construction.
   a. Provide unfinished threaded fasteners for anchor bolts, unless high strength bolts are indicated.

(4) Placing Joists: Do not start placement of steel joists until supporting work is in place and secured. Place joists on supporting work, adjust, and align in accurate locations and spacing before permanently fastening.
   a. Provide temporary bridging, connections, and anchors to ensure lateral stability.
   b. Where "open-web" joists lengths are 40' and longer, install a center row of bolted bridging to provide lateral stability before slackening of hoisting lines.

(5) Bridging: Install bridging simultaneously with joist erection, before construction loads are applied. Anchor ends of bridging lines at top and bottom chords where terminating at walls or beams.

(6) Fastening Joists: Comply with the following:
   a. Field weld joists to supporting steel framework and steel bearing plates where indicated in accordance with SJI "Specifications" for type of joists used. Coordinated welding sequence and procedure with placing of joists.

(7) Touch-Up Painting: After joists installation, wire brush welded areas, abraded or rusty surfaces, and clean with solvent. Paint field-applied boltheads and nuts and prepared surfaces on joists and steel supporting members. Use same type of paint as used for shop painting.

(8) Erection plates shall be removed after the decking, and bridging are completely installed as directed by the architect.
B. Welding

(1) Shop and field welding processes and details, and the qualification procedures for welders, tackers, and welding operators shall be as prescribed in The Code for Welding in Building Construction, AWS D1.1, of the American Welding Society.

   a. Field welds shall be done by manual shielded metal-arc process.

   b. Shop and field welds shall be made only by welders, tackers and welding operators who have been qualified by tests, and hold a current valid certificate, issued by an approved Independent Testing Agency, to perform the type of welds required by the work. Copies of certificates shall be furnished upon request of the Architect.

C. Waste Management

(1) Separate and recycle waste materials to the maximum extent economically feasible.

(2) Collect metal cutoffs and scrap and place in designated area for recycling.

END OF SECTION
053100 – STEEL ROOF DECK

1. GENERAL

A. Description of Work

(1) Work as evident on drawings and specified herein or required for the installation of metal decking, complete.

B. Related Work

(1) Section 051200: Structural Steel
(2) Section 052100: Steel Joists

C. Submittals

(1) Shop Drawings: Furnish shop drawings in accordance with Section 013300 Shop Drawings and Samples. The Contractor shall submit shop drawings for review and approval prior to fabrication of any item. These drawings shall include erection drawings and all necessary installation instructions and details of decking required for completion of the work.

a. In reviewing shop drawings, the Architect / Engineer will attempt to detect omissions and majors errors, but neither failure of the Architect / Engineer to do this nor the review of shop drawings shall relieve the Contractor of their responsibility to comply with the Drawings and Specifications. Approval of shop drawings in no way relieves the Contractor or Fabricator of their responsibility for all errors of detailing, fabrication and erection, and for the correct fitting of all decking and accessories.

D. Delivery of Materials

(1) Delivery of items for this work shall be scheduled so as to cause no delay in this work or the work other trades.

(2) Decking shall be ready for erection in accordance with the construction schedule established by the Contractor.

(3) Materials shall be delivered to the site in a dry and undamaged condition, stored out of contact with the ground and under a weathertight covering permitting good air circulation. Finish of decking units shall be maintained at all times, using touch-up paint whenever necessary to prevent the formation of rust. Touch-up paint for shop-painted units shall be of the same type used for the
E. Standards

(1) Work shall conform to the latest edition in effect of the following standards, and the Drawings and Specifications for the engineering design, fabrication, and erection of structural steel.

a. IBC  International Building Code
b. ICC  Research Recommendation Reports
c. ASTM  American Society for Testing and Materials Standards
d. AISI  Specifications for Design of Light Gage Cold-Formed Steel Structural Members
e. AWS D1.3  Structural Welding Code
f. SDI  Basic Design Specifications.

2. PRODUCTS

A. Wide rib roof decking (1-1/2” “B” deck): painted (unless noted on the drawings to be galvanized per ASTM A 653), cold rolled steel sheets conforming to ASTM A611, Grade C having a minimum yield stress of 33,000 psi, and maximum flexural design stress of 22,800 psi. Deck gauge, side lap details and section properties shall be as indicated on the drawings. Decking layup shall provide all sheets of sufficient length to extend continuously over at least 3 spans with the ends of adjoining sheets centered over supports and lapped 2” and shall provide full width sheets at diaphragm boundaries with split sheets not less than 1/2 the width of full sheets used only near the center of the deck between boundaries.

(1) Fasteners: Screws per drawings.

(2) Side Lap Connection: Screws per drawings.

3. EXECUTION

A. Installation

(1) The minimum requirements for the layup of decking sheets shall be as follows:

a. Place sheets with narrow valley of ribbed decking opened upward and corrugation edges of corrugated roof decking up, ribs and corrugations of decking perpendicular to supporting members, end to end allowing 2” minimum end lap or butted ends centered over supports, side lap decking
as required, and adjust to permanently fastening sheets in final position.

b. Layup of sheets shall provide full width sheets (including both formed edges of ribbed decking and both full valley corrugations and upturned edges of corrugated decking) located at diaphragm boundaries (lines of high shear) parallel to sheet span for fastening sheets to perimeter edge supports at these boundaries. Necessary split sheets shall be used only near center of deck between boundaries. Split sheets less than 1/2 the width of full width sheets shall not be allowed.

c. At other supports parallel to sheet span, provide a full valley and upturned edge for ribbed deck and full valley corrugation and upturned edge for corrugated decking for welding sheets to these parallel supporting members. Where ribs or corrugation valley do not fall in proper position to do this, the parallel supporting member shall be modified or adjusted in a manner, approved by the Contracting Officer, to accomplish this; no additional cost shall be allowed.

d. Sheets shall be installed in accordance with Manufacturer's published installation specifications and instructions; reviewed erection drawings, details, and instructions; and Architect's Drawings and Specifications.

(2) The Decking Erection Subcontractor shall be responsible for accuracy of placement of deck sheets.

(3) Decking sheets shall be engineered by Manufacturer to fit conditions at framed openings shown in Drawings and shall be securely fastened to steel framing at openings.

(4) Field cutting for necessary openings shall be done in a workman-like manner by power shears, flame cuttings, or other methods approved by the Architect and shall be made by the respective trade requiring opening. Any additional holes or butting not indicated on the decking Manufacturer's erection drawings, the Contract Drawings, or herein specified shall be done in an approved manner.

(5) Suspended ceilings, light fixtures, ducts or other utilities shall not be supported by the steel deck.

B. Welding
(1) Shop and field welding processes and details, and the qualification procedures for welders, tackers, and welding operators shall be as prescribed in the Code for Welding in Building Construction, AWS D1.0, of the American Welding Society.

(2) Field welds shall be done by manual metal-arc process.

(3) If required, Shop and field welds shall be made only by welders and welding operators who have been qualified by tests and hold a valid certificate, issued by an approved Independent Testing Agency, to perform the type of welds required by the work. Copies of the certificates shall be furnished upon request of the Architect.

(4) Prior to commencing any deck welding, the welders shall demonstrate their ability to the Welding Inspector that they can satisfactorily produce the decking welds as specified and/or shown on Drawings. In order to demonstrate their ability, the welders shall weld a sample of the decking material to steel simulating the framing. The sample specimens shall then be twisted. If the specimens tear off or the weld on shearing in torsion indicated proper fusion area, the weld shall be considered satisfactory.

(5) If required, deck welding shall be inspected by an AWS certified Welding Inspector as hereinafter specified. Deck covering materials shall not be placed until decking welding has been certified by Welding Inspector.

C. Inspection and Certification of Deck Fastening

(1) The deck fastening pattern shall be inspected for compliance with Specifications and Drawings. This inspection shall be made in the presence of the Architect and the Contractor, if possible. It shall be the Contractor’s responsibility to notify the Architect and Inspector, in advance, that an inspection is due.

(2) After final inspection of any portion or all of the deck fastening has been made and approved by the Inspector, the Inspector shall certify in writing to the Architect and Contractor that the inspection was made, that all specific areas were done in accordance with the Specifications and Drawings, and that the decking is ready to receive deck covering materials as shown on Drawings.

(3) A qualified Inspector from an approved testing laboratory shall make deck inspections and certifications as specified above. The Contractor shall pay all laboratory charges for this service.

END OF SECTION
055000 – METAL FABRICATIONS

1. GENERAL

A. Summary

(1) This Section includes the following:

a. Steel ladders
b. Ladder safety cages
c. Loose bearing and leveling plates
d. Loose steel lintels
e. Shelf angles
f. Miscellaneous steel framing and supports
g. Miscellaneous steel trim
h. Structural-steel door frames
i. Extruded nosings and treads
j. Pipe guards
k. Pipe bollards

B. Submittals

(1) Shop Drawings: Furnish shop drawings in accordance with Section 013300 Shop Drawings and Samples showing all plans, elevations, sections, details of installation, and attachments to other Work. Shop drawings shall be approved before fabrication.

(2) In reviewing shop drawings, the Architect / Engineer will attempt to detect omissions and majors errors, but neither failure of the Architect / Engineer to do this nor the review of the shop drawings shall relieve the Contractor of their responsibility to comply with the Drawings and Specifications. Approval of shop drawings in no way relieves the Contractor or fabricator of their responsibility for all errors of detailing, fabrication and erection, and for the correct fitting of structural members.

(3) Templates: For anchor bolts.

(4) Samples: For each type and finish of extruded nosing and tread.

2. PRODUCTS

A. Metals

(1) Metal Surfaces, General: Provide materials with smooth, flat surfaces without blemishes.
B. Ferrous Metals:

1. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

2. Steel Tubing: Cold-formed steel tubing complying with ASTM A500.

3. Steel Pipe: ASTM A 53, standard weight (Schedule 40), unless another weight is indicated or required by structural loads.

4. Slotted Channel Framing: Cold-formed metal channels 1-5/8 by 1-5/8 inches with flange edges returned toward web and with 9/16-inch-wide slotted holes in webs at 2 inches o.c. Channels made from galvanized steel complying with ASTM A 653/A 653M, structural quality, Grade 33 with G90 coating; 0.079-inch nominal thickness.

5. Concrete Inserts: Threaded or wedge type; galvanized ferrous castings, either ASTM A 47 malleable iron or ASTM A 27/A 27M cast steel. Provide bolts, washers, and shims as needed, hot-dip galvanized per ASTM A153/A 153M.

C. Aluminum:


D. Paint

1. Shop Primer for Ferrous Metal: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with performance requirements in FS TT-P-664 and compatible with finish paint systems indicated.

   a. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

      i. Carboline Company; Carboline 621.


(2) Galvanizing Repair Paint: SSPC-Paint 20, high-zinc-dust-content paint for re-galvanizing welds in steel.

E. Miscellaneous Materials

(1) Fasteners: Type 304 or 316 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633, Class Fe/Zn 5, where built into exterior walls, of type, grade, and class required by application indicated.

(2) Nonshrink, Nonmetallic Grout: ASTM C 1107, factory-packaged, nonstaining, noncorrosive, nongaseous grout.

F. Fabrication

(1) Connections, General: Use connections that maintain structural value of joined pieces.

   a. Shear and punch metals cleanly and accurately. Remove burrs.

   b. Weld corners and seams continuously. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals. Obtain fusion without undercut or overlap. Remove welding flux immediately. Finish exposed welds smooth and blended.

   c. Fabricate joints that will be exposed to weather in a manner to exclude water, or provide weep holes.

   d. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible. Locate joints where least conspicuous.

(2) Steel Ladders: Comply with ANSI A14.3, unless otherwise indicated.

   a. Side rails: Continuous, 3” x 5” steel channels, spaced 18 inches apart.

   b. Bar Rungs: 1” diameter steel bars, spaced 12” o.c.

      i. Fit rungs in centerline of side rails; plug-weld and grind smooth on outer rail faces.

   c. Support each ladder at top and bottom and not more than 60 inches o.c. with welded steel angle brackets. Size brackets to support design loads specified in ANSI A14.3.

   d. Fabricate ladder safety cages to comply with ANSI A14.3. Assemble by welding or riveting.
e. Prime and paint exterior ladders and safety cages.

(3) Loose Bearing and Leveling Plates: Fabricate loose bearing and leveling plates for steel items bearing on masonry or concrete construction. Drill plates to receive anchor bolts and for grouting.

(4) Loose Steel Lintels: Fabricate loose structural-steel lintels from steel angles and shapes of size indicated for openings and recesses in masonry walls and partitions at locations indicated.

(5) Miscellaneous Framing and Supports: Fabricate steel framing and supports that are not a part of structural-steel framework as necessary to complete the Work from structural steel of welded construction. Cut, drill, and tap units to receive hardware, hangers, and similar items.
  a. Where indicated to be cast into concrete or built into masonry, equip with integrally welded anchors at 24 in. o.c.
  b. Fabricate steel pipe columns for supporting wood frame construction with steel baseplates and top plates welded to pipe with fillet welds the same size as pipe wall thickness.

(6) Miscellaneous Steel Trim: Fabricate units with continuously welded joints and smooth exposed edges. Miter corners and use concealed splices where possible. Fabricate cutouts, fittings, and anchorages; coordinate assembly and installation with other work.

(7) Structural-Steel Door Frames: Fabricate from structural shapes and bars fully welded together, with 5/8-by-1-1/2-inch steel channel stops secured with countersunk machine screws. Reinforce frames and drill and tap as necessary to accept finish hardware.
  a. Fabricate with steel strap anchors, with a minimum 6-inch embedment, welded to frame jambs no more than 12 inches from both bottom and head of frame, and not more than 30 inches apart.
  b. Extend bottom of frames to floor with steel angle clips welded to frames.
  c. Prime and paint exterior frames.

(8) Pipe Guards: 1-1/2" x 1-1/2" x 1/4" steel pipe, extending from floor to 42 inches above floor, with 3/8-inch steel baseplates for bolting to floor or structure. Connect tops of pipes with 1-1/2" x 1-1/2" x 1/4" steel pipe and anchor to wall or column with 1/4" x 2" steel strap braces welded to pipes and bolted to wall.
(9) Pipe Bollards: Fabricate from Schedule 40 steel pipe.

G. Finishes

(1) Finish metal fabrications after assembly. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes. Shop prime ferrous-metal items not indicated to be galvanized.

(2) Hot-dip galvanize items indicated to be galvanized to comply with ASTM A123 or ASTM A153/A153M as applicable.

(3) Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with SSPC-SP 3, "Power Tool Cleaning."

(4) Apply shop primer to comply with SSPC-PA 1, "Paint Application Specification No. 1," for shop painting.

3. EXECUTION

A. Installation

(1) General: Provide anchorage devices and fasteners for securing metal fabrications to in-place construction. Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, with edges and surfaces level, plumb, and true.

a. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

b. Fit exposed connections accurately together. Weld connections, unless otherwise indicated. Do not weld, cut, or abrade galvanized surfaces.

(2) Set bearing and leveling plates on cleaned surfaces using wedges, shims, or leveling nuts. After bearing members have been positioned and plumbed, tighten anchor bolts and pack with nonshrink, nonmetallic grout.

(3) Bollards:

a. Anchor in place with concrete footings. Support and brace bollards in position in footing excavations until concrete has been placed and cured.

b. Fill bollards solidly with concrete, mounding top surface.
(4) Touch up surfaces and finishes after erection.
   
   a. Painted Surfaces: Clean field welds, bolted connections, and abraded areas and touch up paint with the same material as used for shop painting.
   
   b. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A780.

END OF SECTION

END OF DIVISION
DIVISION 6 – WOOD AND PLASTICS

061000 – ROUGH CARPENTRY

1. SCOPE:
   A. Furnish all labor, materials, and equipment necessary to complete all carpentry work as shown on the drawings and/or specified herein. The quality and design of wood members and their fastenings used for load-bearing purposes shall conform to the provisions of Chapter 23 - Wood, of the International Building Code.
   B. Submittals
      (1) Submit product data on wood preservative materials, including application instructions.

2. PRODUCTS:
   A. Lumber shall be sound, well manufactured, S4S or rough sawn where noted on drawings, free from warp with a moisture content not exceeding 19% graded according to West Coast Lumber Association Inspection Bureau.
   B. All framing lumber: Douglas Fir-Larch, of Grade as indicated on the drawings.
   C. Cant strips: Plywood or fiber cants.
   D. Joist Hangers and Connectors: Simpson Strong-Tie, or equal.
   E. Builders Hardware as required to properly do all carpentry work. Use non-corrosive bolts, nails, and metal fittings for exposed connections.
   F. Adhesives for Field Gluing Panels to Framing: Formulation complying with ASTM D 3498 that is approved for use with type of construction panel indicated by both adhesive and panel manufacturers. The VOC content shall not be more than 70 g/L when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
   G. All wood sill plates resting on concrete slabs on grade, concrete curbs, or masonry stem walls shall be wolmanized by pressure treating or foundation grade redwood.
   H. Roof Sheathing: Plywood or Oriented Strand Board (OSB) as indicated on the drawings.
I. Fire-Treated Plywood (if applicable): 5/8" fire-treated plywood at roof as noted and in communications closets as noted in room finish schedule. Mount with smooth side out. 1/2" fire-treated plywood to support exterior wall mounted light fixtures on metal panel wall locations. Laminate as required to achieve necessary thickness behind panels.

3. WORKMANSHIP:

A. Protect framing and sheathing from moisture during delivery, installation, and use. Allow framing to dry before enclosing in any system – wall, roof, etc.

B. Provide for passage of pipes, ducts, etc., without cutting structural members.

C. Size and set framing to give true surfaces for finish.

D. Accurately locate and secure 2" backing for plumbing fixtures. Use cut-off ends for backing whenever possible to reduce waste.

E. Provide solid blocking at all unsupported edges of each sheet of roof deck sheathing.

F. Sheathing to be laid as per manufacturer's recommendations and nailed at all bearing points and ends. See nailing schedule on drawings.

G. Nailing: All exposed nails to be corrosion resistant. Minimum 2 nails per contact. 10d for 1" material and 16d for 2" material. Conform to IBC Chapter 23. Holes bored where necessary to prevent splitting. All plywood nailing per drawings.

H. Painting: Do not paint fire-treated plywood.

END OF SECTION
064116 – PLASTIC-LAMINATE-FACED ARCHITECTURAL CABINETS

1. GENERAL:

   A. Scope: Furnish and install all millwork and finish carpentry shown on the drawings and specified herein.

   B. The Quality Standards of the Architectural Woodwork Institute (AWI) shall apply to all work covered by this section.

   C. Millwork fabricator shall submit detailed shop drawings to be approved by the architect before fabrication.

2. MATERIALS:

   All products shall be formaldehyde free.

   A. Exposed Cabinet Surfaces: 3/4” laminate-clad medium density particleboard. ½” laminate clad plywood for curved surfaces.

   B. Edge band: 1/8” PVC.

   C. Hardware:

      (1) Grommets - 3” OD molded plastic.

   D. Counter Tops: Counter tops shall be as follows per drawings and schedules:

      (1) Plastic laminate clad, 3/4” moisture resistant MDF with .02” laminate backer sheet.

   E. Plastic laminates shall be as manufactured by Wilson Art, Formica or Nevamar, 1/16” thick standard grade solid colors, unless noted otherwise, as selected by architect. Matte finish. Installation per all manufacturer’s requirements. Science lab counter tops shall be chemical resistant plastic laminate, Wilsonart Chemsurf or equal, unless noted otherwise.

   K. Adhesives per all Manufacturer’s requirements.

3. WORKMANSHIP:

   A. Details and Special Conditions: All cabinetwork shall be flush overlay construction, Section 400G-2, AWI quality standards. No exposed substrate edges. Where details and methods of construction are not specifically shown on the drawings, contractor shall request clarification.
from the architect.

B. Work assembled at mill as far as practical and delivered ready for installation. This contractor responsible for measurements taken at job allowing for cutting and fitting. Doors and drawers shall be aligned and flush, 1/8" maximum space between, Section 400A-T-1, AWI quality standards.

C. All cabinetwork shall be custom grade in accordance with the latest edition of The Architectural Woodwork Institute (AWI).

D. Face frame shall be scribed where cabinetwork abuts walls.

E. This contractor shall install all finish hardware.

END OF SECTION

END OF DIVISION
DIVISION 7 - THERMAL AND MOISTURE PROTECTION

071900 – WATER REPELLENTS AND ANTI-GRAFFITI COATINGS AND STAINS

1. GENERAL

A. Related Documents

Drawing and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this section.

B. Summary

(1) This section includes clear water-repellent and anti-graffiti coatings for the following exposed vertical and non-traffic horizontal surfaces:
   a. CMU-smooth

C. Related Sections include the following:

(1) Division 3 sections for concrete work including floor sealers.

(2) Division 4 section “Unit Masonry”.

(3) Division 7 section “Joint Sealants”.

(4) Division 9 section “Painting” for paints and coatings.

D. Performance Requirements

(1) Provide water repellents with the following properties based on testing manufacturer’s standard products, according to test methods indicated, applied to substrates simulating Project conditions using same materials and application methods to be used for Project.
   a. Absorption: Minimum 90 percent reduction of absorption after 24 hours in comparison of treated and untreated specimens.
      1) Concrete Unit Masonry: ASTM C 140
   
   b. Water-Vapor Transmission: Maximum 10 percent reduction in rate of vapor transmission in comparison of treated and untreated specimen, per ASTM E 96.
c. Water Penetration and Leakage through Masonry: Maximum 90 percent reduction in leakage rate in comparison of treated and untreated specimens, per ASTM C 1389.

d. Durability: Maximum 5 percent loss of water repellency after 2500 hours of weathering, per ASTM G 53.

e. Permeability: Minimum 80 percent breathable in comparison of treated and untreated specimens, per ASTM D 1653.

E. Submittals

(1) Product Data: Include manufacturer’s specifications, surface preparation and application instructions, recommendations for water repellents for each surface to be treated, and protection and cleaning instructions. Include data substantiating that manufacturer recommends materials for applications indicated and comply with requirements.

(2) Samples: Of each substrate indicated to receive water repellent, 300 mm (12 inches) square, with specified repellent treatment applied to half of each sample.

(3) Applicator Certificates: Signed by manufacturer certifying that the applicator complies with requirements.

(4) Material Test Reports: Indicate and interpret test results for compliance of water repellents with requirements indicated.

F. Quality Assurance

(1) Applicator Qualifications: Engage an experienced applicator that employs only persons trained and approved by water repellent manufacturer for application of manufacturer’s products.

(2) Regulatory Requirements: Comply with applicable rules of pollution-control regulatory agency having jurisdiction in Project locale regarding VOCs and use of hydrocarbon solvents.

(3) Field Samples: Architect will select one representative surface for each substrate to receive water repellents. Apply water repellent to each substrate, with either partial or full coverage as directed. Comply with application requirements of this Section.

a. Obtain Architect’s approval of field samples before applying water repellents.
b. Maintain field samples during construction in an undisturbed condition as a standard for judging the completed Work.

G. Project Conditions

(1) Weather and Substrate Conditions: Do not proceed with application of water repellent under any of the following conditions. Except with written instruction of manufacturer:
   a. Ambient temperature is less than 50 degrees F.
   b. Concrete surfaces and mortar have cured for less than 7 days.
   c. Rain or temperatures below 50 degrees F are predicted within 24 hours.
   d. Application is earlier than 24 hours after surfaces have been wet.
   e. Substrate is frozen or surface temperature is less than 50 degrees F.
   f. Windy condition exists that may cause water repellent to be blown onto surfaces not intended to be coated.

H. Warranty

(1) General Warranty: The special warranty specified in the Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.

(2) Special Warranty: Submit a written warranty, executed by the applicator and water repellent manufacturer, covering materials and labor, agreeing to repair or replace materials that fail to provide water repellency within the specified warranty period. Warranty does not include deterioration or failure of coating due to unusual weather phenomena, failure of prepared and treated substrate, formation of new joints and cracks in excess of 1.5 mm (1/16 inch) wide, fire, vandalism, or abuse by maintenance equipment.

   a. Warranty Period: Five (5) years from date of Substantial Completion.
   b. Conduct RILEM Test Method 11.4 on completed project. Perform five (5) tests per one thousand (1000) square feet. Some water must remain in the vertical section of the RILEM tube in a minimum of eighty (80) percent of tests conducted to qualify for warranty consideration.
2. PRODUCTS

A. Manufacturers

(1) Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

a. Water Repellant Proprietary Acrylic Blend: With 145g/L VOC's or less.
   1) OKON PLUGGER, OKON, Inc.,
   2) Or Equal

b. Exterior Acrylic Masonry Flat Paint:
   1) Evershield Exterior Acrylic Wood and Masonry Flat Paint EVSH10
      DUNN EDWARDS PAINTS
   2) Or Equal

c. Anti-graffiti coating:
   1) Dumond Watch Dog SC-101, Dumond Chemicals
   2) Or Equal

B. Water Repellents

(1) Acrylic: Water-based acrylic micro-emulsion containing twenty (20) percent solids minimum by weight.

(2) VOC-Complying Water Repellents: Products complying with local regulations controlling use of VOC's, as certified by manufacturer.

C. Anti-Graffiti Coatings

(1) Sacrificial with U.V. stabilizers, clear, water-based formulation, non-yellowing, anti-graffiti coating.

3. EXECUTION

A. Preparation

(1) Clean substrate of substances that might interfere with penetration or performance of water repellents. Test for moisture content,
according to repellent manufacturer’s written instructions, to ensure surface is sufficiently dry.

(2) Test for pH level, according to water repellent manufacturer’s written instructions, to ensure chemical bond to silicate minerals.

(3) Protect adjoining work, including sealant bond surfaces, from spillage or over spray of water repellent. Cover adjoining and nearby surfaces of aluminum and glass if there is the possibility of water repellent being deposited on surfaces.

(4) Coordination with Sealants: Do not apply water repellent until sealants for joints adjacent to surfaces receiving water repellent treatment have been installed and cured.
   a. Water repellent work may precede sealant application only if sealant adhesion and compatibility have been tested and verified using substrate, water repellent, and sealant materials identical to those used in the Work.
   b. Water-repellent application shall precede anti-graffiti coating application.

(5) Test Application: Before performing water repellent work, including bulk purchase and delivery of products, prepare a small application in an unobtrusive location and in a manner approved by Architect to demonstrate the final effect (visual, physical and chemical) of planned application. Proceed with work only after Architect approves test application or as otherwise directed.
   a. Revisions of planned application, if any, as requested by Architect, will be by Change Order if application method constitutes a departure from requirements of Contract Documents at the time of contracting.
   b. Conduct RILEM Test Method 11.4 on substrate following test application of water repellent sealer. Some water must remain in the vertical section of the RILEM tube after three (3) minutes to be considered properly sealed. The test application, if approved by A/E, shall serve as the standard of quality for the completed water repellent application.

(6) Remove excess mortar tags and smears by sweepblasting. Acid containing cleaners shall not be used.

B. Application

(1) Water Repellent
a. Apply a heavy saturation spray coating of water repellent on surfaces indicated for treatment using low-pressure spray equipment. Comply with manufacturer’s written instructions for using airless spraying procedure, unless otherwise indicated.

b. Apply a second saturation spray coating, repeating first application. Comply with manufacturer’s written instructions for limitations on drying time between coats and after rainstorm wetting of surfaces between coats. Consult manufacturer’s technical representatives if written instructions are not applicable to Project conditions.

(2) Anti-graffiti coating: Apply anti-graffiti coating after application of water repellents. Remove surface laitance and contaminants prior to application. Follow manufacturer’s instructions for application on concrete masonry, applying coating in multiple coats until recommended thickness is attained.

C. Field Quality Control

(1) Manufacturer’s Field Service: Provide services of a factory authorized technical service representative to inspect and approve the substrate before application and to instruct the applicator on the product and application method to be used.

D. Cleaning

(1) Protective Coverings: Remove protective coverings from adjacent surfaces and other protected areas.

(2) Immediately clean water repellent from adjoining surfaces and surfaces soiled or damaged by water repellent application as work progresses. Repair damage caused by water repellent application. Comply with manufacturer’s written cleaning instructions.

E. Finish Schedule

(1) Exterior CMU:
   a. Primer: Eff-Stop Primer ESSLOO
      1st Coat:
Apply Flood Coat of 5 parts Okon Plugger mixed with 1 Part Evershield (EVSH10) 100% Acrylic Exterior Flat Paint

2nd Coat:
Apply Flood Coat of 1 part Okon Plugger mixed with 5 Parts Evershield (EVSH10) 100% Acrylic Exterior Flat Paint

3rd Coat:
Dumond Watch Dog (SC-101) V.O.C. Compliant, Clear Sacrificial Coating

END OF SECTION
THIS PAGE INTENTIONALLY LEFT BLANK
072100 – THERMAL INSULATION

1. GENERAL:
   
   A. SCOPE: Furnish and install insulation as indicated on drawings and specifications.

   B. Work Not Included: Duct and pipe insulation, rigid type roof insulation.

2. MATERIALS:
   
   A. Thermal & Sound Batt Insulation

      (1) Unfaced glass fiber thermal insulation complying with ASTM C665, Type I and ASTM E 136.

      (2) Above ceilings and concealed locations: Reinforced-foil-faced glass fiber thermal insulation complying with ASTM C 665, Type III (reflective faced), Class A (faced surface with a flame-spread index of 25 or less); Category I (membrane is a vapor barrier), faced with foil scrim, foil-scrim kraft, or foil-scrim polyethylene.

      (3) Exposed in all other areas: Polypropylene fiberglass / polypropylene blend fabric facing, GYMGUARD by LAMTEC Corp. or approved equal, complying with ASTM E 84.

         a. Black Film: Metalized polypropylene, .0015 inch.

         b. Fabric: Fiberglass / polyester blend, 75 lbs. / 3000 S.F.

         c. Vapor Retarder Perm Rating: .02 Maximum when tested in accordance with ASTM E 96.

         d. Surface Burning Characteristics:

              1) Maximum flame spread: 5

              2) Maximum smoke developed: 40

         e. Bursting Strength: 250 psi per ASTM D 774.

         f. Puncture Resistance: 650 Beach units per ASTM C 1136.

         g. Tensile Strength: 195 lbs. / inch width per ASTM 1136.

   B. Roof Insulation:

      (1) R-Value 38 when tested in accordance with ASTM C 518. Thickness 12".

   C. Wall Insulation:
(1) R-Value 13 when tested in accordance with ASTM C 518. Thickness 4”.

D. Sound Batt Insulation

(1) Unfaced glass fiber insulation complying with ASTM C 665, Type I and ASTM E 136.
   a. R-Value 11 when tested in accordance with ASTM C 518.
   b. Surface Burning Characteristics:
      1) Unfaced Insulation
      2) Maximum flame spread: 10
      3) Maximum smoke developed: 10
         When tested in accordance with ASTM E 84

3. EXECUTION:

   A. Foam-Plastic Board Insulation: seal joints between units by applying adhesive, mastic, or sealant to edges of each unit to form a tight seal as units are shoved into place. Fill voids in completed installation with adhesive, mastic, or sealant as recommended by insulation manufacturer.

   B. Blankets shall completely cover enclosed building space between exterior walls and roof and shall fit snugly together to form a uniform continuous, leak free, efficient insulative barrier. Care shall be taken to properly cover protrusions and penetrations.

   C. All installations shall be in accordance with the latest edition of the IBC.

   D. Comply with manufacturer’s instructions for particular conditions of installation in each case.

   E. Under Roof Decks

      (1) Apply insulation directly to the interior surface of the underside of roof deck with appropriate anchors per the manufacturer’s recommendations.

   F. Between Studs:

      (1) Friction-fit insulation between studs after cover material has been installed on one side of the cavity. Use wire or metal straps to hold insulation in place in applications without a cover material or where the stud depth is larger than the insulation thickness. When faced
insulation is used, the attachment flanges may be taped to the face of the metal stud prior to applying the interior finish.

(2) Provide supplementary support to hold the product in place until finish surface is applied when insulation is installed in heights over 8 feet.

G. Sound Attenuation Blankets: Install 3” batts in toilet and mechanical room walls and sound rated partitions indicated on drawings. Blankets shall be friction fit and completely fill spaces.

H. Separate and recycle waste materials to the greatest extent possible.

END OF SECTION
072610 – UNDER-SLAB VAPOR BARRIER

1. GENERAL

A. Summary

(1) Products supplied under this section:
   a. Vapor barrier, seam tape, and mastic for installation under concrete slabs.

(2) Related sections:
   a. Section 033000, Cast-in-Place Concrete.

B. References

(1) American Society for Testing and Materials (ASTM):
   a. ASTM E 1745-09 Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill Under Concrete Slabs.
   e. ASTM E 1643-09 Selection, Design, Installation, and Inspection of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs.

(2) American Concrete Institute (ACI):
   a. ACI 302.2R-06 Guide for Concrete Slabs that Receive Moisture-Sensitive Flooring Materials.

C. Submittals

(1) Quality control/assurance:
   a. Summary of test results as per paragraph 8.3 of ASTM E 1745.
   b. Manufacturer’s samples, literature.
c. Manufacturer’s installation instructions for placement, seaming and penetration repair instructions.

2. PRODUCTS

A. Materials

(1) Vapor barrier must have all of the following qualities:
   a. Permeance of less than 0.01 Perms [grains/(ft$^2$ · hr · inHg)] as tested in accordance with ASTM E 1745 Section 7.
   b. Other performance criteria:
      i. Strength: ASTM E 1745 Class A.

(2) Vapor barrier products:

B. Accessories

(1) Seam tape:

(2) Vapor-proofing mastic:

3. EXECUTION

A. Preparation

(1) Ensure that base material is approved by Architect or Geotechnical Engineer.
   a. Level and compact base material.

B. Installation

(1) Install vapor barrier in accordance with manufacturer’s instructions and ASTM E 1643.
   a. Unroll vapor barrier with the longest dimension parallel with the direction of the concrete placement.
b. Lap vapor barrier over footings and/or seal to foundation walls.

c. Overlap joints 6 inches and seal with manufacturer’s tape.

d. Seal all penetrations (including pipes) per manufacturer’s instructions.

e. No penetration of the vapor barrier is allowed except for reinforcing steel and permanent utilities.

(2) Repair damaged areas by cutting patches of vapor barrier, overlapping damaged area 6 inches and taping all sides with tape.

END OF SECTION
075423 – THERMOPLASTIC POLYOLEFIN (TPO) ROOFING

PART 1. GENERAL

A. SECTION INCLUDES

(1) Induction welded TPO membrane roofing system.
(2) Cover board.
(3) Roof insulation.

B. RELATED SECTIONS

(1) Division 07 Section "Sheet Metal Flashing and Trim" for metal roof penetration flashings, flashings, and counter flashings.

C. REFERENCES

(1) Roofing Terminology: Refer to the following publications for definitions of roofing work related terms in this Section:
   c. Roof Consultants Institute “Glossary of BuildingEnvelope Terms.”


D. DESIGN CRITERIA

(1) General: Installed roofing membrane system shall remain watertight; and resist specified wind uplift pressures, thermally induced movement, and exposure to weather without failure.
   i. Material Compatibility: Roofing materials shall be compatible with one another under conditions of service and application required, as demonstrated by roofing system manufacturer based on testing and field experience.

(2) Installer must comply with current code requirements based on authority having jurisdiction.
(3) Wind Uplift Performance: Roofing system shall be identical to systems that have been successfully tested by a qualified testing and inspecting agency to resist wind uplift pressure calculated in accordance with ASCE 7.

(4) Fire-Test-Response Characteristics: Provide roofing materials with the fire-test-response characteristics indicated as determined by testing identical products per test method below by UL, FMG, or another testing and inspecting agency acceptable to authorities having jurisdiction. Materials shall be identified with appropriate markings of applicable testing and inspecting agency.

a. Exterior Fire-Test Exposure: Class A; ASTM E 108, for application and roof slopes indicated.

E. SUBMITTALS

(1) Product Data: Manufacturer’s data sheets for each product to be provided.

(2) Detail Drawings: Provide roofing system plans, elevations, sections, details, and details of attachment to other Work, including:

a. Base flashings and membrane terminations.

b. Tapered insulation, including slopes.

c. Crickets, saddles, and tapered edge strips, including slopes.

d. Insulation fastening patterns.

(3) Verification Samples: Provide for each product specified.

(4) Installer Certificates: Signed by roofing system manufacturer certifying that Installer is approved, authorized, or licensed by manufacturer to install roofing system.


(6) Guarantees: Provide manufacturer’s current guarantee specimen.

(7) Prior to beginning the work of this section, roofing sub-contractor shall provide a copy of the final System Assembly Letter issued by Johns Manville Roofing Systems indicating that the products and system to be installed shall be eligible to receive the specified manufacturer’s guarantee when installed by a certified JM
contractor in accordance with our application requirements, inspected and approved by a JM Technical Representative.

(8) Prior to roofing system installation, roofing sub-contractor shall provide a copy of the Guarantee Application Confirmation document issued by Johns Manville Roofing Systems indicating that the project has been reviewed for eligibility to receive the specified guarantee and registered.

a. Swaim Associates Ltd. must be listed as the Specifier/Consultant of record in the appropriate fields on the Guarantee Application Confirmation.

F. QUALITY ASSURANCE

(1) Installer Qualifications: Qualified firm that is approved, authorized, or licensed by roofing system manufacturer to install manufacturer's product and that is eligible to receive the specified manufacturer's guarantee.

(2) Manufacturer Qualifications: Qualified manufacturer that has UL listing for roofing system identical to that used for this Project.

(3) Testing Agency Qualifications: An independent testing agency with the experience and capability to conduct the testing indicated, as documented according to ASTM E 329.

(4) Test Reports:

a. Roof drain and leader test or submit plumber's verification.

(5) Source Limitations: Obtain all components from the single source roofing manufacturer guaranteeing the roofing system. All products used in the system must be labeled by the single source roofing manufacturer issuing the guarantee.

G. DELIVERY, STORAGE, AND HANDLING

(1) Deliver roofing materials in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, and directions for storage.

(2) Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by roofing system manufacturer.

(3) Protect roof insulation materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources.
Comply with insulation manufacturer’s written instructions for handling, storing, and protecting during installation.

(4) Handle and store roofing materials and place equipment in a manner to avoid permanent deflection of deck.

H. PROJECT CONDITIONS

(1) Weather Limitations: Proceed with installation only when current and forecasted weather conditions permit roofing system to be installed in accordance with manufacturer’s written instructions and guarantee requirements.

I. GUARANTEE

(1) Provide manufacturer’s system guarantee equal to Johns Manville’s Peak Advantage No Dollar Limit Roofing System Guarantee.

a. Single-Source special guarantee includes roofing membrane, base flashings, roofing membrane accessories, roof insulation, fasteners, cover board, walkway products, manufacturer’s edge metal products, and other single-source components of roofing system marketed by the manufacturer.

b. Guarantee Period: 20 years from date of Substantial Completion.

c. Contractor is required to list Swaim Associates Ltd. as the Specifier/Consultant of record in the appropriate fields (“Specifier Account”) when applying for the manufacturer’s warranty.

(2) Installer’s Guarantee: Submit roofing Installer’s guarantee, including all components of roofing system for the following guarantee period:

a. Guarantee Period: Two years from date of Substantial Completion.

(3) Existing Guarantees: Guarantees on existing building elements should not be affected by scope of work.

a. Installer is responsible for coordinating with building owner’s representative to verify compliance.
PART 2. PRODUCTS

J. THERMOPLASTIC POLYOLEFIN ROOFING MEMBRANE - TPO


a. Membrane Thickness: 60 mils (1.52 mm), nominal.

b. Exposed Face Color: White

(2) Equal Product: GAF TRBN160 – Ever Guard TPO – 60 mil/80 mil

(3) Other: Equal products by prior approval prior to bid.

K. AUXILIARY ROOFING MATERIALS – SINGLE PLY

(1) General: Auxiliary materials recommended by roofing system manufacturer for intended use and compatible with membrane roofing.

a. Liquid-type auxiliary materials shall meet VOC limits of authorities having jurisdiction.

(2) Sheet Flashing (Self-Adhered): 60 mil (1.5 mm) thick, manufacturer’s internally reinforced or scrim reinforced with weldable selvage edges on each side of roll, one encapsulated edge and self-adhering capabilities in a wide installation temperature range. Basis of Design: JM TPO SA – Flashing Membrane

a. Serviceable Installation Temperature: 20°F (-7°C) and above.

(3) Self-Adhered Primer: One-part penetrating primer solution to enhance the adhesion of self-adhering membranes. SA Primer

(4) Metal Termination Bars: Manufacturer’s standard predrilled stainless-steel or aluminum bars, with anchors. Basis of Design: JM Termination Systems

(5) Fasteners: Factory-coated steel fasteners and metal or plastic plates meeting corrosion-resistance provisions in FMG 4470, designed for fastening membrane to substrate, and acceptable to membrane roofing system manufacturer. Basis of Design: High Load Fasteners
(6) Induction Welding Plate: A round specially coated Galvalume® plate with a recessed center and raised flat bonding surface specifically designed for induction welding application. Basis of Design: JM TPO RhinoPlates


L. AUXILIARY ROOFING SYSTEM COMPONENTS

(1) Coping System: Manufacturer’s factory fabricated coping consisting of a base piece and a snap-on cap. Provide product from single-source roofing system supplier that is included in the No Dollar Limit guarantee. Basis of Design: Presto-Lock Coping

(2) Fascia System: Manufacturer’s factory fabricated fascia consisting of a base piece and a snap-on cover. Provide product from single-source roofing system supplier that is included in the No Dollar Limit guarantee. Basis of Design: Presto-Tite Fascia

(3) Metal Edge System: Manufacturer’s factory fabricated metal edge system used to terminate the roof at the perimeter of the structure. Provide product from single-source roofing system supplier that is included in the No Dollar Limit guarantee. Basis of Design: JM TPO-Coated Metal

(4) Metal Flashing Sheet: Metal flashing sheet is specified in Division 07 Section "Sheet Metal Flashing and Trim."

M. WALKWAYS

N. COVER BOARD

(1) High-Density Polyisocyanurate: ASTM C 1289, Type II, Class 4, Grade 3, High-density Polyisocyanurate technology bonded in-line to mineral-surfaced, fiber glass reinforced facers with greater than 140 lbs of compressive strength. Basis of Design: Invinsa Roof Board

O. ROOF INSULATION

(1) General: Preformed roof insulation boards that comply with requirements and referenced standards, selected from manufacturer's standard sizes and of thicknesses indicated.

(2) Polyisocyanurate Board Insulation: ASTM C 1289, Type II, Class 1, Grade 2 (20 psi), Basis of Design: ENRGY 3
   a. Provide insulation package with minimum R Value: 10
   b. Provide insulation package with minimum thickness: 2.0"
   c. Provide insulation package in multiple layers.
   d. Minimum Long-Term Thermal Resistance (LTTR): 5.7 per inch.
   e. Determined in accordance with CAN/ULC S770 at 75ºF (24ºC)

P. TAPERED INSULATION

(1) Tapered Insulation: ASTM C 1289, Type II, Class 1, Grade 2 (20 psi), provide factory-tapered insulation boards fabricated to slope of 1/4 inch per 12 inches (1:48), unless otherwise indicated. Basis of Design: Tapered ENRGY 3

Q. INSULATION ACCESSORIES

(1) General: Roof insulation accessories recommended by insulation manufacturer for intended use and compatible with membrane roofing.

(2) Provide factory preformed saddles, crickets, tapered edge strips, and other insulation shapes where indicated for sloping to drain. Fabricate to slopes indicated. Basis of Design: Diamondback Pre-Cut Cricket, Tapered Fesco Edge Strip
(3) Fasteners: Factory-coated steel fasteners and metal or plastic plates meeting corrosion-resistance provisions in FMG 4470, designed for fastening roof insulation to substrate, and furnished by roofing system manufacturer. Basis of Design: UltraFast Fasteners and Plates

(4) Wood Nailer Strips: Comply with requirements in Division 06 Section "Miscellaneous Rough Carpentry."

PART 3. EXECUTION

R. EXAMINATION

(1) Examine substrates, areas, and conditions for compliance with the requirements affecting performance of roofing system.

a. General:
   i. Verify that roof openings and penetrations are in place and set and braced and that roof drains are securely clamped in place.
   ii. Verify that wood cants, blocking, curbs, and nailers are securely anchored to roof deck at penetrations and terminations and that nailers match thicknesses of insulation.

b. Ensure general rigidity and proper slope for drainage.

c. Verify that deck is securely fastened with no projecting fasteners and with no adjacent units more than 1/16 inch (1.6 mm) out of plane relative to adjoining deck.

(2) Unacceptable panels should be brought to the attention of the General Contractor and Project Owner’s Representative and must be corrected prior to installation of roofing system.

(3) Proceed with installation only after unsatisfactory conditions have been corrected.

S. PREPARATION

(1) Clean and remove from substrate sharp projections, dust, debris, moisture, and other substances detrimental to roofing installation in accordance with roofing system manufacturer's written instructions.

(2) Prevent materials from entering and clogging roof drains and conductors and from spilling or migrating onto surfaces of other construction.
(3) Proceed with installation only after unsatisfactory conditions have been corrected.

T. INSULATION INSTALLATION

(1) Coordinate installation of roof system components so insulation and cover board is not exposed to precipitation or left exposed at the end of the workday.

(2) Comply with roofing system manufacturer’s written instructions for installation of roof insulation and cover board.

(3) Install tapered insulation under area of roofing to conform to slopes indicated.

(4) Install insulation boards with long joints in a continuous straight line. Joints should be staggered between rows, abutting edges and ends per manufacturer’s written instructions. Fill gaps exceeding 1/4 inch (6 mm) with like material.

(5) Install 2 or more layers with joints of each succeeding layer staggered from joints of previous layer a minimum of 6 inches (150 mm) in each direction.

(6) Trim surface of insulation boards where necessary at roof drains so completed surface is flush and does not restrict flow of water.

(7) Install tapered edge strips at perimeter edges of roof that do not terminate at vertical surfaces.

(8) Preliminarily Fastened Insulation: Install insulation with fasteners at rate required by roofing system manufacturer or applicable authority, whichever is more stringent.

a. Fasten top layer to resist uplift pressure at corners, perimeter, and field of roof.

(9) Proceed with installation only after unsatisfactory conditions have been corrected.

U. COVER BOARD INSTALLATION

(1) Coordinate installing membrane roofing system components so cover board is not exposed to precipitation or left exposed at the end of the workday.

(2) Comply with membrane roofing system manufacturer’s written instructions for installing roof cover board.
(3) Install cover board with long joints in a continuous straight line. Joints should be staggered between rows, abutting edges and ends per manufacturer’s written instructions. Fill gaps exceeding 1/4 inch (6 mm) with cover board.
   a. Cut and fit cover board within 1/4 inch (6 mm) of nailers, projections, and penetrations.

(4) Trim surface of cover board where necessary at roof drains so completed surface is flush and does not restrict flow of water.
   a. Install tapered edge strips at perimeter edges of roof that do not terminate at vertical surfaces.

(5) Preliminarily Fastened Insulation for Mechanically Fastened Systems: Install cover board with fasteners at rate required by roofing system manufacturer or applicable authority, whichever is more stringent.

(6) Proceed with installation only after unsatisfactory conditions have been corrected.

V. ROOFING MEMBRANE INSTALLATION, GENERAL

(1) Install roofing membrane in accordance with roofing system manufacturer's written instructions, applicable recommendations of the roofing manufacturer and requirements in this Section.

(2) Cooperate with testing and inspecting agencies engaged or required to perform services for installing roofing system.

(3) Coordinate installing roofing system so insulation and other components of the roofing membrane system not permanently exposed are not subjected to precipitation or left uncovered at the end of the workday or when rain is imminent.
   a. Provide tie-offs at end of each day's work to cover exposed roofing membrane sheets and insulation.
   b. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system.
   c. Remove and discard temporary seals before beginning work on adjoining roofing.

(4) Proceed with installation only after unsatisfactory conditions have been corrected.
W. INDUCTION WELDED ROOFING MEMBRANE INSTALLATION

(1) Install roofing membrane over area to receive roofing according to roofing system manufacturer’s written instructions. Unroll roofing membrane and allow to relax before installing.

(2) Accurately align roofing membranes and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.

(3) Always install membrane laps perpendicular to the steel deck flutes. “Picture Frame” installation method is not permitted.

(4) Apply roofing membrane with side laps shingled with roof slope, where possible.

(5) Seams: Clean seam areas, overlap roofing membrane, and hot-air weld side and end laps of roofing membrane according to manufacturer’s written instructions to ensure a watertight seam installation.
   a. Test lap edges with probe to verify seam weld continuity. Apply lap sealant to seal cut edges of roofing membrane.
   b. Verify field strength of seams a minimum of twice daily and repair seam sample areas.
      i. Remove and repair any unsatisfactory sections before proceeding with Work.
   c. Repair tears, voids, and lapped seams in roofing membrane that do not meet requirements.

(6) Spread sealant or mastic bed over deck drain flange at deck drains and securely seal roofing membrane in place with clamping ring.

(7) Induction Welding Installation:
   a. Perform calibration and set-up as detailed by the Induction Welder Owner’s Manual
   b. Center the Induction Welder over the first plate in pattern and activate the weld.
      i. Induction Welder must be centered over the plate to create a 100% bond.
ii. If an error occurs during activation, refer to the induction welder owner’s manual for corrective action.

c. Prior to every use, clean face of Heat Sink Magnet.

d. Place Heat Sink Magnet over the welded plate.

i. Keep Heat Sink Magnet in place at least 45 seconds while the assembly cools.

e. Repeat process for each plate.

(8) Proceed with installation only after unsatisfactory conditions have been corrected.

X. BASE FLASHING INSTALLATION

(1) Install sheet flashings and preformed flashing accessories and adhere to substrates per membrane roofing system manufacturer's written instructions.

(2) Self-Adhere membrane to smooth approved substrates, when substrate temperatures are 40°F (4.5°C) and rising.

a. The use of SA Primer or SA LVOC Primer is required for flashing applications on curbs and parapet walls for temperatures between 40°F (4.5°C) and 20°F (-7°C).

b. The use of SA Primer or SA LVOC Primer is required for flashing applications over approved substrates with a porous or rough surface, including: Dens Deck Prime, Dens Deck, DEXcell, concrete and smooth faces CMU.

(3) Flash penetrations and field-formed inside and outside corners per manufacturer's installation instructions.

(4) Clean seam areas and overlap and firmly roll sheet flashings into the adhesive. Weld side and end laps to ensure a watertight seam installation.

(5) Terminate and seal top of sheet flashings and mechanically anchor to substrate through termination bars.

(6) Proceed with installation only after unsatisfactory conditions have been corrected.
Y. WALKWAY INSTALLATION

(1) Flexible Walkways: Install walkway products in locations indicated. Heat weld and adhere walkway products to substrate according to roofing system manufacturer's written instructions.

(2) Roof-Paver Walkways: Install walkway roof pavers per manufacturer's written instructions in locations indicated, to form walkways. Leave 3 inches (75 mm) of space between adjacent roof pavers.

(3) Proceed with installation only after unsatisfactory conditions have been corrected.

Z. FIELD QUALITY CONTROL

(1) Testing Agency: Owner will engage a qualified independent testing and inspecting agency to perform roof tests and inspections and to prepare test reports.

(2) Final Roof Inspection: Arrange for roofing system manufacturer's Registered Roof Observer (RRO) to inspect roofing installation on completion and submit report to Architect.

   a. Notify Architect or Owner 48 hours in advance of date and time of inspection.

(3) Repair or remove and replace components of roofing system where test results or inspections indicate that they do not comply with specified requirements.

(4) Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

AA. PROTECTION AND CLEANING

(1) Protect roofing system from damage and wear during remainder of construction period.

(2) Correct deficiencies in or remove roofing system that does not comply with requirements, repair substrates, and repair or reinstall roofing system to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.
(3) Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION
076200 – SHEET METAL FLASHING AND TRIM

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Manufactured reglets and counterflashing.
   2. Formed roof drainage sheet metal fabrications.
   4. Formed wall sheet metal fabrications.

1.2 ACTION SUBMITTALS

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

B. Shop Drawings: Show installation layouts of sheet metal flashing and trim, including plans, elevations, expansion-joint locations, and keyed details. Distinguish between shop- and field-assembled work.
   1. Include details for forming, joining, supporting, and securing sheet metal flashing and trim, including pattern of seams, termination points, fixed points, expansion joints, expansion-joint covers, edge conditions, special conditions, and connections to adjoining work.

1.3 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.4 QUALITY ASSURANCE

A. Sheet Metal Flashing and Trim Standard: Comply with SMACNA's "Architectural Sheet Metal Manual" unless more stringent requirements are specified or shown on Drawings.

B. Preinstallation Conference: Conduct conference at Project site.

1.5 WARRANTY

A. Special Warranty on Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace sheet metal flashing and trim that shows evidence of deterioration of factory-applied finishes within 20 years from date of Substantial Completion.
PART 2 - PRODUCTS

2.1 SHEET METALS

A. General: Protect mechanical and other finishes on exposed surfaces from damage by applying a strippable, temporary protective film before shipping.

B. Metallic-Coated Steel Sheet: Restricted flatness steel sheet, metallic coated by the hot-dip process and prepainted by the coil-coating process to comply with ASTM A 755/A 755M.
   1. Exposed Coil-Coated Finish:
      a. Two-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat.
   2. Color: As selected by Architect from manufacturer's full range.

2.2 MISCELLANEOUS MATERIALS

A. General: Provide materials and types of fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation and recommended by manufacturer of primary sheet metal or manufactured item unless otherwise indicated.

B. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads and recommended by manufacturer of primary sheet metal or manufactured item.
   1. General: Blind fasteners or self-drilling screws, gasketed, with hex-washer head.
      a. Exposed Fasteners: Heads matching color of sheet metal using plastic caps or factory-applied coating.

C. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch (13 mm) wide and 1/8 inch (3 mm) thick.

D. Elastomeric Sealant: ASTM C 920, elastomeric polymer sealant; low modulus; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.

E. Butyl Sealant: ASTM C 1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for hooked-type expansion joints with limited movement.
F. Epoxy Seam Sealer: Two-part, noncorrosive, aluminum seam-cementing compound, recommended by aluminum manufacturer for exterior nonmoving joints, including riveted joints.

G. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D 1187.

2.3 REGLETS

A. Reglets: Units of type, material, and profile indicated, formed to provide secure interlocking of separate reglet and counterflashing pieces, and compatible with flashing indicated.
   1. Material: Galvanized steel, 0.022 inch (0.56 mm) thick.
   2. Finish: Mill.

2.4 FABRICATION, GENERAL

A. General: Custom fabricate sheet metal flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, geometry, metal thickness, and other characteristics of item indicated. Fabricate items at the shop to greatest extent possible.
   1. Obtain field measurements for accurate fit before shop fabrication.
   2. Form sheet metal flashing and trim without excessive oil canning, buckling, and tool marks and true to line and levels indicated, with exposed edges folded back to form hems.
   3. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces exposed to view.

B. Sealed Joints: Form nonexpansion but movable joints in metal to accommodate elastomeric sealant.

C. Expansion Provisions: Where lapped expansion provisions cannot be used, form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with butyl sealant concealed within joints.

D. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.

E. Seams: Fabricate nonmoving seams with flat-lock seams. Tin edges to be seamed, form seams, and solder.

2.5 ROOF DRAINAGE SHEET METAL FABRICATIONS

A. Hanging Gutters: Fabricate to cross section indicated, complete with end pieces, outlet tubes, and other accessories as required. Fabricate in minimum
96-inch- (2400-mm-) long sections. Furnish flat-stock gutter spacers and gutter brackets fabricated from same metal as gutters, of size recommended by SMACNA but not less than twice the gutter thickness. Fabricate expansion joints, expansion-joint covers, gutter bead reinforcing bars, and gutter accessories from same metal as gutters.

B. Downspouts: Fabricate from structural steel. See drawings.

C. Parapet Scuppers: Fabricate scuppers of dimensions required with closure flange trim to exterior, 4-inch- (100-mm-) wide wall flanges to interior, and base extending 4 inches (100 mm) beyond cant or tapered strip into field of roof. Fabricate from the following materials:
   1. Galvanized Steel: 0.028 inch (0.71 mm) thick.

D. Conductor Heads: Fabricate conductor heads with flanged back and stiffened top edge and of dimensions and shape indicated complete with outlet tubes, exterior flange trim, and built-in overflows. Fabricate from the following materials:
   1. Galvanized Steel: 0.028 inch (0.71 mm) thick, pre-finished.

E. Splash Pans: Fabricate from the following materials:
   1. Stainless Steel: 0.019 inch (0.48 mm) thick.

2.6 LOW-SLOPE ROOF SHEET METAL FABRICATIONS

A. Roof-Edge Flashing (Gravel Stop) and Fascia Cap: Fabricate in minimum 96-inch- (2400-mm-) long, but not exceeding 10-foot- (3-m-) long, sections. Furnish with 6-inch- (150-mm-) wide, joint cover plates. Fabricate from the following materials:
   1. Galvanized Steel: 0.028 inch (0.71 mm) thick, pre-finished.

B. Copings: Fabricate in minimum 96-inch- (2400-mm-) long, but not exceeding 10-foot- (3-m-) long, sections. Fabricate joint plates of same thickness as copings. Furnish with continuous cleats to support edge of external leg and drill elongated holes for fasteners on interior leg. Miter corners, seal, and solder or weld watertight. Fabricate from the following materials:
   1. Galvanized Steel: 0.040 inch (1.02 mm) thick, pre-finished.

C. Counterflashings and Flashing Receivers: Fabricate from the following materials:
   1. Galvanized Steel: 0.022 inch (0.56 mm) thick.

D. Roof-Penetration Flashing: Fabricate from the following materials:
   1. Galvanized Steel: 0.028 inch (0.71 mm) thick.
PART 3 - EXECUTION

3.1 UNDERLAYMENT INSTALLATION

A. Polyethylene Sheet: Install polyethylene sheet with adhesive for anchorage. Apply in shingle fashion to shed water, with lapped and taped joints of not less than 2 inches (50 mm).

B. Felt Underlayment: Install felt underlayment with adhesive for temporary anchorage. Apply in shingle fashion to shed water, with lapped joints of not less than 2 inches (50 mm).

C. Self-Adhering Sheet Underlayment: Install self-adhering sheet underlayment, wrinkle free. Comply with temperature restrictions of underlayment manufacturer for installation; use primer rather than nails for installing underlayment at low temperatures. Apply in shingle fashion to shed water, with end laps of not less than 6 inches (150 mm) staggered 24 inches (600 mm) between courses. Overlap side edges not less than 3-1/2 inches (90 mm). Roll laps with roller. Cover underlayment within 14 days.

3.2 INSTALLATION, GENERAL

A. General: Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement so that completed sheet metal flashing and trim shall not rattle, leak, or loosen, and shall remain watertight. Use fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.

1. Install sheet metal flashing and trim true to line and levels indicated. Provide uniform, neat seams with minimum exposure of solder, welds, and sealant.

2. Install sheet metal flashing and trim to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.

3. Space cleats not more than 12 inches (300 mm) apart. Anchor each cleat with two fasteners. Bend tabs over fasteners.

4. Install exposed sheet metal flashing and trim without excessive oil canning, buckling, and tool marks.

5. Install sealant tape where indicated.

6. Torch cutting of sheet metal flashing and trim is not permitted.

B. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with
bituminous coating or by other permanent separation as recommended by SMACNA.

1. Underlayment: Where installing metal flashing directly on cementitious or wood substrates, install a course of felt underlayment and cover with a slip sheet or install a course of polyethylene sheet.

C. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet (3 m) with no joints allowed within 24 inches (600 mm) of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently watertight, form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with sealant concealed within joints.

D. Fastener Sizes: Use fasteners of sizes that will penetrate metal decking not less than recommended by fastener manufacturer to achieve maximum pull-out resistance.

E. Seal joints as shown and as required for watertight construction.

F. Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter. Pre-tin edges of sheets to be soldered to a width of 1-1/2 inches (38 mm), except reduce pre-tinning where pre-tinned surface would show in completed Work.
   1. Do not solder metallic-coated steel and aluminum sheet.
   2. Do not use torches for soldering. Heat surfaces to receive solder and flow solder into joint. Fill joint completely. Completely remove flux and spatter from exposed surfaces.

G. Rivets: Rivet joints in uncoated aluminum where indicated and where necessary for strength.

3.3 ROOF DRAINAGE SYSTEM INSTALLATION

A. General: Install sheet metal roof drainage items to produce complete roof drainage system according to SMACNA recommendations and as indicated. Coordinate installation of roof perimeter flashing with installation of roof drainage system.

B. Hanging Gutters: Join sections with riveted and soldered joints or with lapped joints sealed with sealant. Provide for thermal expansion. Attach gutters at eave or fascia to firmly anchored gutter brackets spaced not more than 36 inches (900 mm) apart. Provide end closures and seal watertight with sealant. Slope to downspouts.
   1. Install gutter with expansion joints at locations indicated, but not exceeding, 50 feet (15.24 m) apart. Install expansion-joint caps.
3.4 ROOF FLASHING INSTALLATION

A. General: Install sheet metal flashing and trim to comply with performance requirements, sheet metal manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, set units true to line, and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.

B. Roof Edge Flashing: Anchor to resist uplift and outward forces according to recommendations in SMACNA's "Architectural Sheet Metal Manual" and as indicated. Interlock bottom edge of roof edge flashing with continuous cleat anchored to substrate at staggered 3-inch (75-mm) centers.

C. Copings: Anchor to resist uplift and outward forces according to recommendations in SMACNA’s "Architectural Sheet Metal Manual" and as indicated.
   1. Interlock exterior bottom edge of coping with continuous cleat anchored to substrate at 24-inch (600-mm) centers.
   2. Anchor interior leg of coping with washers and screw fasteners through slotted holes at 24-inch (600-mm) centers.

D. Pipe or Post Counterflashing: Install counterflashing umbrella with close-fitting collar with top edge flared for elastomeric sealant, extending a minimum of 4 inches (100 mm) over base flashing. Install stainless-steel draw band and tighten.

E. Counterflashing: Coordinate installation of counterflashing with installation of base flashing. Insert counterflashing in reglets or receivers and fit tightly to base flashing. Extend counterflashing 4 inches (100 mm) over base flashing. Lap counterflashing joints a minimum of 4 inches (100 mm) and bed with sealant.

F. Roof-Penetration Flashing: Coordinate installation of roof-penetration flashing with installation of roofing and other items penetrating roof. Seal with butyl sealant and clamp flashing to pipes that penetrate roof.

3.5 CLEANING AND PROTECTION

A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.
B. Clean and neutralize flux materials. Clean off excess solder and sealants.

C. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed unless otherwise indicated in manufacturer’s written installation instructions.

END OF SECTION
PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Roof hatches.
   2. Safety railing.
   3. Ladder up safety post.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of roof accessory indicated.
B. Shop Drawings: For roof accessories.
C. Samples: For each exposed product and for each color and texture specified.

1.3 INFORMATIONAL SUBMITTALS

A. Warranty: Sample of special warranty.

1.4 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.5 WARRANTY

A. Special Warranty on Painted Finishes: Manufacturer’s standard form in which manufacturer agrees to repair finishes or replace roof accessories that show evidence of deterioration of factory-applied finishes within 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 METAL MATERIALS

A. Aluminum-Zinc Alloy-Coated Steel Sheet: ASTM A 792/A 792M, AZ50 (AZM150) coated.
   1. Exposed Coil-Coated Finish: Two-coat fluoropolymer finish; AAMA 621; system consisting of primer and fluoropolymer color topcoat containing not less than 70 percent PVDF resin by weight
2.2 MISCELLANEOUS MATERIALS

A. General: Provide materials and types of fasteners, protective coatings, sealants, and other miscellaneous items required by manufacturer for a complete installation.

B. Wood Nailers: Softwood lumber, pressure treated with waterborne preservatives for aboveground use, acceptable to authorities having jurisdiction, containing no arsenic or chromium, and complying with AWPA C2; not less than 1-1/2 inches (38 mm) thick.

C. Fasteners: Roof accessory manufacturer's recommended fasteners suitable for application and metals being fastened. Match finish of exposed fasteners with finish of material being fastened. Provide nonremovable fastener heads to exterior exposed fasteners.

D. Sealants: As recommended by roof accessory manufacturer for installation indicated.

2.3 ROOF HATCH

A. Roof Hatches: Metal roof-hatch units with lids and insulated double-walled curbs, welded or mechanically fastened and sealed corner joints, continuous lid-to-curb counterflashings and weathertight perimeter gasketing, stepped integral metal cant raised the thickness of roof insulation, and integrally formed deck-mounting flange at perimeter bottom.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

2. Basis-of-Design Product: Subject to compliance with requirements, provide J.L. Industries RHG-STH Series or comparable product by one of the following:
   a. AES Industries, Inc.
   b. Babcock-Davis.
   c. Bilco Company (The).
   d. Bristolite Skylights.
   e. Custom Solution Roof and Metal Products.
   f. Dur-Red Products.
   g. Hi Pro International, Inc.
   h. J. L. Industries, Inc.
   i. Metallic Products Corp.
   j. Milcor Inc.; Commercial Products Group of Hart & Cooley, Inc.
   k. Naturallite Skylight Systems; Vistawall Group (The).
   l. Nystrom.
   m. O'Keeffe's Inc.
   n. Pate Company (The).
   o. Precision Ladders, LLC.
B. Type and Size: Single-leaf lid, 30 by 36 inches (750 by 900 mm).

C. Loads: Minimum 40-lbf/sq. ft. (1.9-kPa) internal uplift load.

D. Hatch Material: Aluminum-zinc alloy-coated steel sheet, 0.079 inch (2.01 mm) thick.
   1. Finish: Two-coat fluoropolymer.
   2. Color: As selected by Architect from manufacturer's full range.

E. Construction:
   1. Insulation: Polyisocyanurate board.
   2. Hatch Lid: Opaque, insulated, and double walled, with manufacturer's standard metal liner of same material and finish as outer metal lid.
   3. Curb Liner: Manufacturer's standard, of same material and finish as metal curb.
   4. On ribbed or fluted metal roofs, form flange at perimeter bottom to conform to roof profile.
   5. Fabricate curbs to minimum height of 12 inches (300 mm) unless otherwise indicated.

F. Hardware: Galvanized-steel spring latch with turn handles, butt- or pintle-type hinge system, and padlock hasps inside and outside.
   1. Provide two-point latch on lids larger than 84 inches (2130 mm).

G. Safety Railing System: Roof-hatch manufacturer's standard system including rails, clamps, fasteners, safety barrier at railing opening, and accessories required for a complete installation; attached to roof hatch and complying with 29 CFR 1910.23 requirements and authorities having jurisdiction.

H. Ladder-Assist Post: Roof-hatch manufacturer's standard device for attachment to roof-access ladder. Post locks in place on full extension; release mechanism returns post to closed position.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Verify dimensions of roof openings for roof accessories. Install roof accessories according to manufacturer's written instructions.
   1. Install roof accessories level, plumb, true to line and elevation, and without warping, jogs in alignment, excessive oil canning, buckling, or tool marks.
   2. Anchor roof accessories securely in place so they are capable of resisting indicated loads.
3. Use fasteners, separators, sealants, and other miscellaneous items as required to complete installation of roof accessories and fit them to substrates.

4. Install roof accessories to resist exposure to weather without failing, rattling, leaking, or loosening of fasteners and seals.

B. Metal Protection: Protect metals against galvanic action by separating dissimilar metals from contact with each other or with corrosive substrates by painting contact surfaces with bituminous coating or by other permanent separation as recommended by manufacturer.

   1. Coat concealed side of uncoated aluminum roof accessories with bituminous coating where in contact with wood, ferrous metal, or cementitious construction.

   2. Underlayment: Where installing roof accessories directly on cementitious or wood substrates, install a course of felt underlayment and cover with a slip sheet, or install a course of polyethylene sheet.

C. Seal joints with sealant as required by roof accessory manufacturer.

3.2 REPAIR AND CLEANING

A. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing according to ASTM A 780.

B. Touch up factory-primed surfaces with compatible primer ready for field painting according to Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

C. Replace roof accessories that have been damaged or that cannot be successfully repaired by finish touchup or similar minor repair procedures.

END OF SECTION
079200 – JOINT SEALANTS

1. SCOPE:

A. Sealant shall be installed at all intersections of dissimilar materials and elsewhere to provide an entirely weather-tight building. Color as selected by Architect to blend with surrounding surfaces.

B. Related Sections:

(1) Section 033000: Cast-in-Place Concrete
(2) Section 042000: Unit Masonry
(3) Section 064116: Plastic Laminate Faced Architectural Cabinets
(4) Section 081113: Metal Doors and Frames
(5) Section 084113: Aluminum Entrance and Window Frames
(6) Section 092900: Gypsum Wallboard
(7) Section 099000: Painting

C. Submittals:

(1) Product data for interior sealants including printed statement of VOC content.

2. MATERIALS:

A. General: VOC of interior sealants and sealant primers must comply with the following limits when calculated according to 40 CFR 59, Subpart D (EPA Method 24):

(1) Sealants: Not more than 250 g/L
(2) Sealant Primers for Nonporous Substrates: Not more than 20 g/L
(3) Sealant Primers for Porous Substrates: Not more than 775 g/L

B. Sealants Type A - Silicone

(1) GE - Silpruf 2000
(2) Dow Corning - 795
(3) Tremco - Spectrem 2

C. Sealants Type B – Silicone-Urethane Hybrid (paintable)

(1) Sika – Sika Hi-flex 150 LM

D. Sealants Type C - Siliconized Acrylic

(1) GE
E. Sealants Type D - Tapes
   (1) Norseal V-740 closed cell PVC
   (2) Emseal
   (3) Sonneborn

F. Sealants Type E - Mildew Resistant Silicone
   (1) Dow Corning - 786
   (2) Tremco

G. Polyethylene Foam Backer Rod.

3. INSTALLATION:

A. Install all sealants in strict accordance with manufacturer's requirements.

B. Sealant selected shall be appropriate for materials adjoining joint and for anticipated movement.
   (1) Type A: Storefront weather seals, storefront perimeter seals, joints with up to 50% anticipated movement.
   (2) Type B: Masonry control joints, masonry perimeter joints, concrete joints, joints with up to 25% anticipated movement.
   (3) Type C: Interior door frame perimeter, intersections between millwork and walls, surfaces requiring painting, joints with up to 7.5% anticipated movement.
   (4) Type D: Joints between concrete and aluminum shapes and joints between irregular surfaces and machined surfaces.
   (5) Type E: Provide mildew resistant caulking at all damp areas.

C. Drive compound into joint grooves with enough pressure to force out all air and solidly fill joint. Deep voids shall be filled with backer rod so that the tooled thickness of the caulk is approximately ½ the width of the joint.

D. Exposed sealant shall be free from wrinkles and uniformly smooth. Caulking around openings shall mean entire perimeter.

E. Adjoining surfaces shall be cleaned of any smears of compound.

END OF SECTION

END OF DIVISION
DIVISION 8 - DOORS AND WINDOWS

081113 – METAL DOORS AND FRAMES

1. GENERAL:

   A. Scope:
      (1) Provide all labor and material for a complete installation at locations shown on the drawings and/or as described in the door schedule.

   B. Related Sections:

   C. Submittals
      (1) Shop drawings: Submit shop drawings for approval prior to fabrication.
      (2) Both doors and frames shall be provided by the same manufacturer.

2. MATERIALS:

   A. Hollow Metal Doors & Frames shall be made per NAAMM Standard HMMA 862 (with the modifications listed below) as manufactured by Southwestern Door, Commercial Door and Hardware, or any door company that is a member of the Hollow Metal Manufacturers Association.

   B. Doors:
      (1) Face Sheets; Interior and Exterior Doors: 16 gage.
      (2) Minimum thickness: 1 3/4".
      (3) Stiffeners: 18 gage, 6" spacing, spot-welded to both face sheets 5" O.C. (Alternate #5 - Doors shall be reinforced, stiffened and sound deadened with polystyrene slab core, 1.5 pound per cubic foot density, completely filling the inside of the door and laminated to the inside faces of panels.)
      (4) Vertical Edge: Continuous weld.
      (5) Top and bottom edges: Closed with 14 gauge continuous steel channel. Flush, top and bottom, not recessed.
(6) Glass Molding and Stops: Fixed moldings welded to door on security side, all stops 16 gage. All screws shall be countersunk.

C. Frames:

(1) Interior and Exterior: 14 gauge.

(2) Construction: Welded units with integral stop and trim.

(3) Floor Anchors: 14 gauge weld inside jambs.

(4) Jamb anchors: In masonry 14 gauge steel. For stud partitions 16 gauge steel anchors.

D. Hardware reinforcement:

(1) Door hinges: 3/16" plate.

(2) Lockface, flush bolts and closures L12 gauge steel.

(3) Frame hinge: 3/16" plate.

3. INSTALLATION:

A. Install in accordance with manufacturer's recommendations. Field verify all conditions. Anchor frames with four anchors each side.

B. Grout frames solid in masonry walls.

C. Pack frames solid with monocote in framed walls.

END OF SECTION
083113 – ACCESS DOOR

1. GENERAL:
   A. Scope: Furnish and install access doors at locations shown on the drawings, or as required by code for mechanical, electrical or plumbing access.

2. MATERIALS:
   A. Manufacturers: Access doors shall be manufactured by Williams Brothers, J.L. Industries or equal.
   B. Ceiling access doors below the roof hatch shall be 30"x 36". Others shall be sized as required.

3. INSTALLATION:
   A. Install in strict accordance with manufacturer’s recommendations.

END OF SECTION
087100 DOOR HARDWARE

1. GENERAL:

A. Scope:

(1) Section Includes: Furnish and install Door Hardware as shown on Drawings and as specified herein, unless specifically excluded and specified in other Sections.

B. Definitions:

(1) Door Hardware includes items known commercially as builders hardware which are required for swing, sliding and folding doors, gates and miscellaneous items as indicated, except special types of unique and non-matching hardware specified in the same Section as the door and door frame. Types of items in this Section include, but are not necessarily limited to, the following:

C. System Description:

(1) General Requirements: While the Hardware Schedule is intended to cover doors and other movable parts of the building and establish a type and standard of quality, examine drawings and specifications and furnish proper hardware for openings whether listed or not. Hardware must meet applicable handicapped access standards, ordinances and codes. Omissions or corrections in hardware groups shall be brought to the attention of the Architect prior to bid opening. No extras will be allowed for omissions, changes or corrections necessary to facilitate proper installation.

(2) If an item is not specified but will be required in a similar situation, furnish equal hardware to that specified for similar locations if practicable. If no similar location is specified, then use hardware in keeping with that specified.

(3) The Work of this Section shall be the total responsibility of one firm herein identified as the Supplier/Installer. If the Supplier and Installer are not one firm then the Supplier shall be the responsible party and shall cover the complete coordination of related work in other Sections.

D. Submittals:

(1) General: Submittals requirements are specified in Section 01300 Shop Drawings and Samples.
(2) Materials List: As soon as practical after award of contract, submit a complete listing of materials to be furnished. Submit in quantities as directed by the Architect, showing each item proposed for installation use and quantities to be furnished. Supplier/installer bidders shall state in their bid the delivery date to Contractor.

(3) Product Data: Submit manufacturer's technical information for each item of hardware. Include whatever information may be necessary to show compliance with requirements, and include instructions for installation and maintenance of operating parts and finish.

(4) Hardware Schedule: Submit final hardware schedule in manner indicated below. Hardware schedules are intended for coordination of work. Hardware schedule shall include a summary of individual items of hardware and related material used on the project, complete with the name of the manufacturer of each item. The Hardware Schedule shall be prepared in vertical format.

a. Final Hardware Schedule Content: Based on builders hardware indicated, organize hardware schedule into "hardware sets" indicating complete designations of every item required for each door or opening. Include the following information:

1) Catalog number, type, style, function, size and finish of each hardware item.
2) Name and manufacturer of each item.
3) Fastenings and other pertinent information.
4) Location of hardware set cross-referenced to indications on Drawings both on floor plans and in door and frame schedule.
5) Explanation of abbreviations, symbols, codes, etc. contained in schedule.
6) Mounting locations for hardware.
7) Door and frame sizes and materials.
8) Keying information.
9) Any other pertinent data.

b. Submittal Sequence: Submit schedule at earliest possible date particularly where acceptance of hardware schedule must precede fabrication of other work (e.g., hollow metal frames) which is critical in the project construction schedule. Include with schedule the product data, samples, shop drawings of other work affected by builders hardware, and other information essential to the coordinated review of hardware schedule.
(5) Samples: When requested by the Architect, prior to submittal of the final hardware schedule and prior to final ordering of hardware, submit one sample of each type of exposed hardware unit, finished as required, and tagged with full description for coordination with schedule. Samples will be returned to the supplier/installer. Units which are acceptable and remain undamaged through submittal, review and field comparison procedures may, after final check of operation, be used in the work, within limitations of keying coordination requirements.

(6) Templates: Supply templates to door and frame manufacturers, as required, to enable proper and accurate sizing and locations of cut-outs for hardware and door reinforcement. Delivery of templates shall be timely to prevent delays in construction.

a. Shipment of hardware prepaid to manufacturers requesting that hardware be incorporated in their work.

b. Where cylindrical locks are used in hollow metal doors, furnish lock information to the door manufacturer for reinforcing in the door at the time of manufacture.

E. Quality Assurance:

(1) Qualifications:

a. Manufacturer: Obtain each kind of hardware (latch and lock sets, hinges, closers, etc.) from only one manufacturer, although several may be indicated as offering products complying with requirements. Manufacturer shall have five years experience in manufacture of comparable hardware.

b. The hardware consultant shall be, on a full-time basis, a regular member of the Door and Hardware Institute (DHI) and a registered Architectural Hardware Consultant (AHC) to properly detail work, order and supervise installation.

c. The supplier/installer shall be a recognized architectural finish hardware supplier/installer who has been furnishing hardware within a 300 mile radius of the project for a period of not less than five years, and who is, or employs an experienced hardware consultant who shall be available to the Owner, Architect and Contractor at reasonable times during the course of the work for consultation about the project’s hardware requirements. The supplier/installer shall also be a factory authorized distributor for the items specified.
(2) Regulatory Requirements:
   a. Fire-Rated Openings: Provide hardware for fire-rated openings in compliance with NFPA Standard No. 80 and national or local building code requirements. Provide only hardware which has been tested and listed by UL or FM for types and sizes of doors required and complies with requirements of door and door frame labels.
   b. Where emergency exit devices are required on fire-rated doors, (with supplementary marking on doors UL or FM labels indicating "Fire Door to be Equipped with Fire Exit Hardware") provide UL or FM label on exit devices indicating "Fire Exit Hardware".
   c. Comply with other applicable fire, handicapped and building codes, guidelines and regulations. Hardware supplied and installed shall meet the requirements of Arizona Revised Statutes, Title 34 Handicapped Requirements.

(3) Certifications: At the completion of installation, certify that material is properly installed, according to manufacturer’s printed instructions. Submit certification in duplicate to the Architect after installation of hardware in accordance with Section 01700 Project Close-out.

F. Delivery, Storage and Handling:
   (1) Packaging of hardware is the responsibility of the supplier/installer. As material is received by the hardware supplier/installer from the various manufacturers, sort hardware as necessary. Deliver hardware in original and individual containers, complete with necessary fastenings, keys, instructions and templates for spotting mortising tools. Items particular to a specific door shall be clearly marked by door number and heading number on the package.
   (2) The hardware supplier/installer shall inventory hardware and verify that the count is correct. Each carton of hardware shall be marked with item numbers, corresponding to the item numbers on the Finish Hardware Schedule.
   (3) Provide secure lock-up for hardware delivered to the project, but not yet installed. Control and handling and installation of hardware items which are not immediately replaceable, so that the completion of the work will not be delayed by hardware losses, both before and after installation. Store materials off the ground in dry, protected areas.
(4) The Contractor shall tag and index keys, manuals, schematics, operating instructions and factory diagrams for release and use by the Owner.

(5) Containers holding keyed locks and cylinders shall be marked with the following:
   a. Heading Number
   b. Door Number
   c. Hand of Door (when required)
   d. Key Symbol

G. Maintenance:

(1) Provide Owner with manufacturer’s parts list and maintenance instructions for each type of hardware supplied, including necessary wrenches and tools required for proper maintenance and adjustment of hardware, as supplied with hardware when shipped to General Contractor. The General Contractor shall gather parts lists, tools, etc. as supplied with the hardware at the time of installation and hold these items until close-out.

(2) Tools for Maintenance: Furnish a complete set of specialized tools as needed for Owner’s continued adjustment, maintenance, and removal and replacement of builders hardware.

(3) Maintenance Service: Approximately six months after the acceptance of hardware in each area, the Hardware Installer, accompanied by the representative of the latch and lock manufacturer, shall return to the project and re-adjust every item of hardware to restore proper function of doors and hardware. Consult with and instruct Owner’s personnel in recommended additions to the maintenance procedures.

(4) Replace hardware items which have deteriorated or failed due to faulty design, materials or installation of hardware units. Prepare a written report of current and predictable problems (of substantial nature) in the performance of the hardware. The supplier / installer shall not be responsible for adjustments, corrections or replacements due to abuse, vandalism of lack or required maintenance by the Owner on the hardware.
2. MATERIALS:

A. Manufacturers:

   (1) Acceptable Manufacturers:
      b. Geared Hinges: Ives, Roton, Pemko.
      c. Locksets: Schlage.
      d. Cylinders/Cores: Schlage.
      e. Exit Devices: Von Duprin, Ives VR pulls
      f. Closers: LCN.
      g. Over Head Stop/ Holders: Rixson, Glynn Johnson.
      h. Threshold, Door bottom, Seals: National Guard, Pemko, Reese.
      i. Stops, Kickplates: Ives, Trimco, Rockwood.
      j. Pull, Push Plates, Misc.: Ives, Trimco, Rockwood.
      k. Key Cabinet: Lund, Telkee.

B. Hardware:

   (1) Scheduled Hardware: Requirements for design, grade, function, finish, size and other distinctive qualities of each type of builders hardware is indicated in the Builder's Hardware Data Sheet and Hardware Schedule at the end of this Section. The drawings show the direction of slide, swing or hand of each door leaf. Furnish each item of hardware for proper installation and operation of the door movement as shown. Products are identified by using hardware designation numbers of the following:

      a. Manufacturer's product designations: One or more manufacturers are listed for each hardware type required. Provide either the product designated, or, where more than one manufacturer is listed, the comparable product of one of the other manufacturers which comply with requirements including those specified elsewhere in this section.

   (2) Fasteners: Manufacture hardware to conform to published templates, generally prepared for machine screw installation. Do not provide hardware which has been prepared for self-tapping sheet metal screws, except as specifically indicated.
a. Furnish necessary screws, bolts or other fastenings of suitable size and type to anchor the hardware in position for heavy use and long life, and of compatible material and finish. Furnish fastenings with anchors according to the material to which it is applied, and as recommended by the manufacturer. Fasten closers on wood or mineral core doors with hex nuts and bolts.

b. Provide Phillips flat-head screws except as otherwise indicated. Finish exposed (exposed under any condition) screws to match the hardware finish or, if exposed in surfaces of other work, to match the finish of such other work as closely as possible, including "prepared for paint" in surfaces to receive painted finish.

c. Provide concealed fasteners for hardware units which are exposed when the door is closed, except to the extent no standard units of the type specified are available with concealed fasteners.

(3) Finish: Hardware shall be BHMA-626 (US26D) unless noted otherwise.

C. Hardware Types:

(1) Hinges

a. Geared Hinges: Type as listed in hardware sets.

b. Shall conform to the applicable requirements of Specifications FF-H-116, except as otherwise specified herein. Loose pin hinges for reverse-bevel doors with locks shall be constructed in a manner that will eliminate removal of the pins when the doors are in the closed position. Determine correct clearance from the drawings. Provide non-removable pins on all doors. Provide five knuckle, concealed ball bearing hinges on all doors. Flat Button, top and bottom tips required on all butt hinges. Match existing size where doors or frames are being reused.

1) Butt Hinge Length:

<table>
<thead>
<tr>
<th>Door Thickness</th>
<th>Door Width</th>
<th>Hinge Height</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 3/4&quot; door</td>
<td>Where Req.</td>
<td>4 1/2&quot;</td>
</tr>
<tr>
<td>1 3/4&quot; door</td>
<td>to 38&quot;</td>
<td>4 1/2&quot;</td>
</tr>
<tr>
<td>1 3/4&quot; door</td>
<td>over 38&quot; to 48&quot;</td>
<td>5&quot;</td>
</tr>
<tr>
<td>1 3/4&quot; door</td>
<td>over 48&quot;</td>
<td>6&quot;</td>
</tr>
</tbody>
</table>

2) Number of Butt Hinges Required:

aa) Doors 60" high and under: 2 butt hinges
bb) Doors over 60" high and not over 90" high: 3 butt hinges  
cc) Doors over 90" high and not over 120" high: 4 butt hinges  

3) Hinge Types: Shall conform to the applicable requirement of Specification FF-H-121c, except as specified otherwise herein.  
   a) Interior doors: 5BB1  
   b) Exterior doors: 5BB1  

(2) Door Locks:  
   a. Shall conform to the applicable requirements for Series 161 of Specification FF-H-106, except as otherwise specified herein. The series selected shall, as far as practicable, be used throughout the project. All lock and latch sets of a series shall be the products of a single manufacturer. Lock cylinders shall have not less than six pin tumblers. Accessories such as door coordinator shall conform to the applicable requirements of Specification FF-H-106a (1). Lock and latch design, style and application shall meet handicapped access standards and codes where applicable.  
   b. All locksets to be heavy duty. Cylindrical Type: Schlage “ND” Rhodes design or as listed in hardware sets. Functions as listed in hardware sets.  
   c. Provide locks and latchsets with 2-3/4" backset, unless otherwise noted. Provide strikes with extended lip where required to protect trim from being marked by latch bolt. Provide at wood frames and/or wood doors (when in pairs) wrought boxes.  

(3) Door Closers:  
   a. Door closers shall meet handicapped access standards and codes. Complying with ANSI A117.1 for door opening force and delayed action closing.  
   b. Surface mounted LCN 4041 Series 689 Finish, spray to match other hardware, with three (3) separate control valves (including back check), ANSI Grade I. Closers to be equipped with size adjustment (1 thru 6). All closers shall be mounted on the inside of the room wherever possible. Where parallel arm closers are used extra duty (EDA/CUSH) arms shall be used.  

(4) Kickplates: Shall be .050 (minimum) stainless steel 12 inches high,
by 1 ½" inches less than door width for single doors and one inch less than the width for double doors. Finish, 630.

(5) Stops and Bumpers: Wall type WS401/WS402 series with proper anchor selected for substrate. Floor stops FS18S shall be used on exterior doors where required.

(6) Silencers: Supply 3 each at jambs of single doors and 2 each at pairs of doors.

(7) Flush Bolts:
   a. Flush bolts: Type FB458 series as required.

   Furnish flush bolts with dust proof strikes DP2, not required when used with thresholds.

(8) Weatherstrip and Seals:
   a. Door Bottoms shall be Type 600A or as listed in hardware sets.

   b. Weatherstrip shall be Type 160S or as listed in hardware sets.

(9) Thresholds: Shall be type 425 or as detailed on plans or listed in the Hardware Sets.

(10) Push Plates: Shall be .050 thick (minimum), 6 x 16 type 8200 finish 630 all edges beveled or as listed in hardware sets.

(11) Pull Plates: Shall be .050 thick (minimum), 6 x 16, edges beveled, Type 8302-10. Mount with thru-bolts, or as listed in hardware sets. Solid material finish 630.

D. Hardware Finishes:

(1) Provide matching finishes for hardware units at each door or opening, to the greatest extent possible, except as otherwise indicated. Reduce differences in color and textures as much as commercially possible where the base metal or metal forming process is different for individual units of hardware exposed at the same door or opening. In general, match items to the manufacturer’s standard finish for the latch and lock set (or push-pull units if no latch-lock sets) for color and texture.

(2) Provide finishes which match those established by BHMA or, if none established, match the Architect’s sample.
(3) Provide quality of finish, including thickness of plating or coating (if any), composition, hardness and other qualities complying with manufacturer’s standards, but in no case less than specified for the applicable units of hardware by referenced standards.

(4) Provide protective lacquer coating on exposed hardware finishes or brass, bronze and aluminum, except as otherwise indicated. The suffix "-NL" is used with standard finish designations to indicate "no lacquer".

(5) The designations used in schedules and elsewhere to indicate hardware finishes are those listed in "Materials & Finishes Standard 1301" by BHMA, including coordination with the traditional U.S. finishes shown by certain manufacturers for their products.

E. Lock Cylinders and Keying:

(1) General: All doors this project shall be master keyed as directed by owner. Supplier shall meet with Owner to finalize keying requirements and obtain final instructions in writing. Use Schlage IC Cores, No Substitutions.

(2) Provide construction keying at all doors. Permanent keys shall not be under any circumstance made available to the General Contractor. Furnish 6 construction keys to the Contractor.

(3) Comply with Owner’s Instructions for master keying and, except as otherwise indicated, provide individual change key for each lock which is not designated to be keyed alike with a group of related locks.

(4) Key Quantity: Furnish 3 change keys for each lock; 6 master keys for each master system.

3. INSTALLATION:

A. Examination:

(1) Prior to hardware installation, the supplier/installer shall examine the hollow metal door frames and other surfaces to receive hardware for accuracy of installation and alignment. The supplier/installer shall report in writing to the Contractor with a copy to the Architect, of detrimental conditions. Failure to perform this requirement constitutes a waiver to subsequent claims to the contrary and holds the supplier/installer responsible for corrections the Architect may require. Commencement of Work shall be construed as acknowledgment by the supplier/installer that doors and frames and
other surfaces to receive hardware are in compliance with the requirements of the Contract Documents.

B. Preparation:

(1) The supplier/installer shall meet with the Owner, Architect, and related trades prior to the Commencement of Work. Tag items or packages with identification related to the final hardware schedule, and include basic installation instructions in the package.

(2) Deliver hardware items at the proper times to the proper locations (ship to project site) for installation.

C. Installation:

(1) Install each hardware item in compliance with the manufacturer's instructions and recommendations.

(2) Mount hardware units at heights as recommended per SDI-100, except as specifically indicated or required to comply with governing regulations, and except as may be directed otherwise by Architect.

(3) Application of Hardware: Hardware shall be installed in a neat, workmanlike manner following the manufacturer's instructions. Fasteners, supplied with the hardware, shall be used to secure the hardware in place. Wood screws shall be used for securing hardware to wood surfaces. Machine screws, set in expansion shields, shall be used for securing hardware to concrete or masonry surfaces. Thru-bolts shall be used where specified or where necessary for satisfactory installation.

(4) Install each hardware item in compliance with the manufacturer's instructions and recommendations. Wherever cutting and fitting is required to install hardware onto or into surfaces which are later to be painted or finished in another way, coordinate removal, storage and reinstallation or application of surface protection with finishing work specified in Division 9. Do not install surface-mounted items until finishes have been completed on the substrate. The Supplier/Installer shall be responsible for correct application according to factory installation instructions.

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

(6) Deliver hardware items at the proper times to the proper locations (shop or project site) for installation.

D. Field Quality Control:

(1) Inspection: The supplier/installer shall provide a final inspection with the Owner, and Architect at the completion of the installation.

(2) After hardware is checked, keys shall be tagged, identified and delivered to the Owner by registered mail, or delivered in person after receiving a signed receipt from a responsible representative of the Owner. Errors in cutting or fitting, or damage to adjoining work shall be repaired, as directed.

E. Adjusting:

(1) Check and adjust each operating item of hardware and each door, to ensure proper operation or function for each unit. Replace units which cannot be adjusted to operate freely and smoothly as intended for the application made.

(2) Final Adjustment: Wherever hardware installation is made more than one month prior to acceptance or occupancy of a space or area, return to the work during the week prior to acceptance or occupancy, and make final check and adjustment of hardware items in such space or area. Adjust door control devices to compensate for final operation of heating and ventilating equipment. Instruct Owner's personnel in proper adjustment and maintenance of hardware and hardware finishes, during the final adjustment of hardware.

F. Cleaning:

(1) Insure that after installation, the materials furnished and installed will be free of paint or lacquer as may appear from the Work of other subcontractors. Clean operating items as necessary to restore proper function and finish of hardware and doors.

(2) During the course of the Work and on completion of the Work, remove excess materials, equipment and debris and dispose of away from premises. Leave Work in clean condition in accordance with Section 01500 Temporary Facilities.

G. Protection:
(1) After application, hardware shall be protected from paint, stains, blemishes and damage until acceptance of the Work.

H. Hardware Schedule:

(1) While the following hardware sets are intended to cover doors and establish a type and standard of quality, it shall be the specific duty and responsibility of the hardware supplier to examine the drawings and specifications and furnish proper hardware for openings. The hardware supplier shall compare the specifications with the door schedule and notify the Architect of errors, inconsistencies or omissions during the bid period.

Acceptable Manufacturers:

Hinges: Ives, McKinney, Stanley
Locksets: Schlage
Cylinders/Cores: Schlage
Exit Devices: Von Duprin
Closers: LCN
Over Head Stop/Holders: Rixson, Glynn Johnson
Thresholds, Door bottom, Seals: National Guard, Pemko, Reese
Door Trim, Stops, Kickplates: Ives, Trimco, Rockwood
Gate Hardware: Hoover Fence Company
HARDWARE GROUP NO. 1
100A

Provide each SGL door(s) with the following:

<table>
<thead>
<tr>
<th>QTY</th>
<th>DESCRIPTION</th>
<th>CATALOG NUMBER</th>
<th>FINISH</th>
<th>MFR</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>CONT. HINGE</td>
<td>112HD</td>
<td>628</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>PANIC HARDWARE</td>
<td>CD-XP99-NL-OP-110MD</td>
<td>626</td>
<td>VON</td>
</tr>
<tr>
<td>1</td>
<td>MORTISE CYLINDER</td>
<td>20-061 ICX XQ11-948 (CD)</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>1</td>
<td>RIM CYLINDER</td>
<td>20-057 ICX</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>2</td>
<td>FSIC CORE</td>
<td>23-030 (GMK, MATCH EXISTING KEYWAY))</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>1</td>
<td>DOOR PULL</td>
<td>VR910 NL</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>SURFACE CLOSER</td>
<td>4111 SCUSH</td>
<td>689</td>
<td>LCN</td>
</tr>
<tr>
<td>1</td>
<td>KICK PLATE</td>
<td>8400 10&quot; X 2&quot; LDW B-CS</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>DRIP CAP</td>
<td>16A</td>
<td>A</td>
<td>NGP</td>
</tr>
<tr>
<td>1</td>
<td>SEALS</td>
<td>160S</td>
<td>AL</td>
<td>NGP</td>
</tr>
<tr>
<td>1</td>
<td>DOOR SWEEP</td>
<td>600A</td>
<td>CL</td>
<td>NGP</td>
</tr>
<tr>
<td>1</td>
<td>THRESHOLD</td>
<td>425 MS/LA</td>
<td>AL</td>
<td>NGP</td>
</tr>
</tbody>
</table>

HARDWARE GROUP NO. 2
106

Provide each SGL door(s) with the following:

<table>
<thead>
<tr>
<th>QTY</th>
<th>DESCRIPTION</th>
<th>CATALOG NUMBER</th>
<th>FINISH</th>
<th>MFR</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>CONT. HINGE</td>
<td>112HD</td>
<td>628</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>PANIC HARDWARE</td>
<td>99-EO</td>
<td>626</td>
<td>VON</td>
</tr>
<tr>
<td>1</td>
<td>SURFACE CLOSER</td>
<td>4111 EDX</td>
<td>689</td>
<td>LCN</td>
</tr>
<tr>
<td>1</td>
<td>KICK PLATE</td>
<td>8400 10&quot; X 2&quot; LDW B-CS</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>FLOOR STOP</td>
<td>FS18S</td>
<td>BLK</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>DRIP CAP</td>
<td>16A</td>
<td>A</td>
<td>NGP</td>
</tr>
<tr>
<td>1</td>
<td>SEALS</td>
<td>160S</td>
<td>AL</td>
<td>NGP</td>
</tr>
<tr>
<td>1</td>
<td>DOOR SWEEP</td>
<td>600A</td>
<td>CL</td>
<td>NGP</td>
</tr>
<tr>
<td>1</td>
<td>THRESHOLD</td>
<td>425 MS/LA</td>
<td>AL</td>
<td>NGP</td>
</tr>
<tr>
<td>QTY</td>
<td>DESCRIPTION</td>
<td>CATALOG NUMBER</td>
<td>FINISH</td>
<td>MFR</td>
</tr>
<tr>
<td>-----</td>
<td>------------------------------------------</td>
<td>----------------</td>
<td>--------</td>
<td>-----</td>
</tr>
<tr>
<td>2</td>
<td>CONT. HINGE</td>
<td>112HD</td>
<td>628</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>REMOVABLE MULLION</td>
<td>KR4954 STAB</td>
<td>689</td>
<td>VON</td>
</tr>
<tr>
<td>1</td>
<td>PANIC HARDWARE</td>
<td>CD-XP99-EO</td>
<td>626</td>
<td>VON</td>
</tr>
<tr>
<td>1</td>
<td>PANIC HARDWARE</td>
<td>CD-XP99-NL-OP-110MD</td>
<td>626</td>
<td>VON</td>
</tr>
<tr>
<td>4</td>
<td>FSIC CORE</td>
<td>23-030 (GMK, MATCH EXISTING KEYWAY))</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>1</td>
<td>RIM CYLINDER</td>
<td>20-057 ICX</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>1</td>
<td>MORTISE CYLINDER</td>
<td>20-061 ICX</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>2</td>
<td>MORTISE CYLINDER</td>
<td>20-061 ICX XQ11-948 (CD)</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>1</td>
<td>DOOR PULL</td>
<td>VR910 NL</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>DOOR PULL</td>
<td>VR910 DT</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td>2</td>
<td>SURFACE CLOSER</td>
<td>4111 SCUSH</td>
<td>689</td>
<td>LCN</td>
</tr>
<tr>
<td>2</td>
<td>MOUNTING PLATE/BRKT AS REQUIRED</td>
<td>4110-XX AS REQ'D</td>
<td>689</td>
<td>LCN</td>
</tr>
<tr>
<td>1</td>
<td>DRIP CAP</td>
<td>16A</td>
<td>A</td>
<td>NGP</td>
</tr>
<tr>
<td>2</td>
<td>SEALS</td>
<td>160S</td>
<td>AL</td>
<td>NGP</td>
</tr>
<tr>
<td>1</td>
<td>MULLION SEAL</td>
<td>5100N</td>
<td>BLK</td>
<td>NGP</td>
</tr>
<tr>
<td>2</td>
<td>DOOR SWEEP</td>
<td>600A</td>
<td>CL</td>
<td>NGP</td>
</tr>
<tr>
<td>1</td>
<td>THRESHOLD</td>
<td>425 MS/LA</td>
<td>AL</td>
<td>NGP</td>
</tr>
</tbody>
</table>
**HARDWARE GROUP NO. 4**

102A  103A

Provide each SGL door(s) with the following:

<table>
<thead>
<tr>
<th>QTY</th>
<th>DESCRIPTION</th>
<th>CATALOG NUMBER</th>
<th>FINISH</th>
<th>MFR</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>HINGE</td>
<td>5BB1 4.5 X 4.5 NRP</td>
<td>652</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>PRIVACY LOCK</td>
<td>L9440 06A L583-363-L283-732</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>1</td>
<td>MOP PLATE</td>
<td>8400 10&quot; X 1&quot; LDW B-CS</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>KICK PLATE</td>
<td>8400 10&quot; X 2&quot; LDW B-CS</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>WALL STOP</td>
<td>WS401/402CCV</td>
<td>626</td>
<td>IVE</td>
</tr>
<tr>
<td>3</td>
<td>SILENCER</td>
<td>SR64</td>
<td>GRY</td>
<td>IVE</td>
</tr>
</tbody>
</table>

**HARDWARE GROUP NO. 5**

101  104

Provide each SGL door(s) with the following:

<table>
<thead>
<tr>
<th>QTY</th>
<th>DESCRIPTION</th>
<th>CATALOG NUMBER</th>
<th>FINISH</th>
<th>MFR</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>HINGE</td>
<td>5BB1 4.5 X 4.5 NRP</td>
<td>652</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>ENTRANCE LOCK</td>
<td>ND53PD RHO</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>1</td>
<td>FSIC CORE</td>
<td>23-030 (GMK, MATCH EXISTING KEYWAY))</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>1</td>
<td>OH STOP</td>
<td>90S</td>
<td>630</td>
<td>GLY</td>
</tr>
<tr>
<td>1</td>
<td>KICK PLATE</td>
<td>8400 10&quot; X 2&quot; LDW B-CS</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>WALL STOP</td>
<td>WS401/402CCV</td>
<td>626</td>
<td>IVE</td>
</tr>
<tr>
<td>3</td>
<td>SILENCER</td>
<td>SR64</td>
<td>GRY</td>
<td>IVE</td>
</tr>
</tbody>
</table>

**HARDWARE GROUP NO. 6**

102  103

Provide each SGL door(s) with the following:

<table>
<thead>
<tr>
<th>QTY</th>
<th>DESCRIPTION</th>
<th>CATALOG NUMBER</th>
<th>FINISH</th>
<th>MFR</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>HINGE</td>
<td>5BB1 4.5 X 4.5</td>
<td>652</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>PULL PLATE</td>
<td>8302 10&quot; 6&quot; X 16&quot;</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>PUSH PLATE</td>
<td>8200 6&quot; X 16&quot;</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>SURFACE CLOSER</td>
<td>4011</td>
<td>689</td>
<td>LCN</td>
</tr>
<tr>
<td>1</td>
<td>KICK PLATE</td>
<td>8400 10&quot; X 2&quot; LDW B-CS</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>MOP PLATE</td>
<td>8400 10&quot; X 1&quot; LDW B-CS</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>WALL STOP</td>
<td>WS401/402CCV</td>
<td>626</td>
<td>IVE</td>
</tr>
<tr>
<td>3</td>
<td>SILENCER</td>
<td>SR64</td>
<td>GRY</td>
<td>IVE</td>
</tr>
</tbody>
</table>
HARDWARE GROUP NO. 7
105  105A

Provide each PR door(s) with the following:

<table>
<thead>
<tr>
<th>QTY</th>
<th>DESCRIPTION</th>
<th>CATALOG NUMBER</th>
<th>FINISH</th>
<th>MFR</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>HINGE</td>
<td>5BB1HW 4.5 X 4.5 NRP</td>
<td>652</td>
<td>IVE</td>
</tr>
<tr>
<td>2</td>
<td>MANUAL FLUSH BOLT</td>
<td>FB458</td>
<td>626</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>DUST PROOF STRIKE</td>
<td>DP1/DP2 AS REQD</td>
<td>626</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>STOREROOM LOCK</td>
<td>ND80TD RHO</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>1</td>
<td>FSIC CORE</td>
<td>23-030 (GMK, MATCH EXISTING KEYWAY)</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>2</td>
<td>OH STOP &amp; HOLDER</td>
<td>90H</td>
<td>630</td>
<td>GLY</td>
</tr>
<tr>
<td>2</td>
<td>KICK PLATE</td>
<td>8400 10&quot; X 1&quot; LDW B-CS</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td>2</td>
<td>ASTRAGAL</td>
<td>158NA</td>
<td>CL</td>
<td>NGP</td>
</tr>
<tr>
<td>2</td>
<td>SILENCER</td>
<td>SR64</td>
<td>GRY</td>
<td>IVE</td>
</tr>
</tbody>
</table>

HARDWARE GROUP NO. 8
107

Provide each SGL door(s) with the following:

<table>
<thead>
<tr>
<th>QTY</th>
<th>DESCRIPTION</th>
<th>CATALOG NUMBER</th>
<th>FINISH</th>
<th>MFR</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>HINGE</td>
<td>5BB1 4.5 X 4.5 NRP</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>VANDL STOREEROOM LOCK</td>
<td>ND96TD RHO</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>1</td>
<td>FSIC CORE</td>
<td>23-030 (GMK, MATCH EXISTING KEYWAY)</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>1</td>
<td>LOCK GUARD</td>
<td>LG1</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>OH STOP &amp; HOLDER</td>
<td>90H</td>
<td>630</td>
<td>GLY</td>
</tr>
<tr>
<td>1</td>
<td>KICK PLATE</td>
<td>8400 10&quot; X 2&quot; LDW B-CS</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>DRIP CAP</td>
<td>16A</td>
<td>A</td>
<td>NGP</td>
</tr>
<tr>
<td>1</td>
<td>SEALS</td>
<td>160S</td>
<td>AL</td>
<td>NGP</td>
</tr>
<tr>
<td>1</td>
<td>DOOR SWEEP</td>
<td>600A</td>
<td>CL</td>
<td>NGP</td>
</tr>
<tr>
<td>1</td>
<td>THRESHOLD</td>
<td>425 MS/LA</td>
<td>AL</td>
<td>NGP</td>
</tr>
</tbody>
</table>
Hardware Set No. G-01
Pair Gates panic hardware

<table>
<thead>
<tr>
<th>Item</th>
<th>Model</th>
<th>Quantity</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>8 ea. Gate Hinges</td>
<td>NW6215</td>
<td>600</td>
<td></td>
</tr>
<tr>
<td>2 ea. Exit Device</td>
<td>CDXP98 NL-OP</td>
<td>630</td>
<td></td>
</tr>
<tr>
<td>2 ea. Mortise Cylinder</td>
<td>26-091</td>
<td>626</td>
<td></td>
</tr>
<tr>
<td>2 ea. Rim Cylinder</td>
<td>20-057</td>
<td>626</td>
<td></td>
</tr>
<tr>
<td>4 ea. Perm. Core</td>
<td>23-030</td>
<td>626</td>
<td></td>
</tr>
<tr>
<td>2 ea. Anti-Vandal Pull</td>
<td>VR910NL</td>
<td>630</td>
<td></td>
</tr>
<tr>
<td>2 ea. Closer</td>
<td>4040XP-EDA SRI x Gate Mod</td>
<td>689</td>
<td></td>
</tr>
<tr>
<td>2 ea. Drop Plate</td>
<td>4040XP-18PA</td>
<td>689</td>
<td></td>
</tr>
<tr>
<td>2 ea. Cane Bolt</td>
<td>CBGAP</td>
<td>602</td>
<td></td>
</tr>
</tbody>
</table>

GATE VENDOR TO PROVIDE ANGLE STOP AND FIXED MULLION

END OF SECTION
DIVISION 9 - FINISHES

092216 – NON-STRUCTURAL METAL FRAMING

1. SCOPE:
   A. Include all labor, materials and equipment necessary for a complete installation as shown or specified.
   B. Install all materials in accordance with manufacturer's requirements.
   C. Related Sections: All work in this section shall be coordinated with the following sections:
      (1) 092900 Gypsum Board

2. MATERIALS:
   A. Manufacturer: Milcor, Keene, Western Metal, or approved equal.
   B. Wall track at ceiling and floor shall be 20 gage, as detailed, hot dipped galvanized steel with not less than 1-1/4" flanges and of proper width for studs selected.
   C. Studs shall be 20 gage, as detailed, hot dip galvanized steel. Webs shall be pre-punched at 24" o.c. Contractor shall consult manufacturer's limiting height tables and shall adjust gauge as necessary to be in conformance therewith.
   D. Resilient Furring Channels: RC-1.
   E. Metal Furring Channels: DWC-25 or DWC-20 as required.
   F. 1-1/2" x 16 gauge cold rolled channels.
   G. 1-1/2" x 12" gauge cold rolled channels.
   H. Furring Channel clips.
   I. 8 gauge galvanized tie wire.
   K. Additional accessories, clips, braces, etc. as may be required by the manufacturer.
L. Acoustical Sealant
   (1) Non-hardening, non-drying, non-bleeding, synthetic rubber-based material conforming to ASTM D-217.

3. INSTALLATION:
   A. Attach framing securely to building structure. Fasten partition track at 2'-0" o.c. in accordance with manufacturer's requirements. Use fasteners suitable for material track is fastened to. The use of powder driven anchors is allowed if installed with minimum 1" long shot pins (.145 shank size) used with the correct load. Set partition track in a continuous bead of sealant.
   B. Provide double 20 gauge studs at all openings anchor to structure above, in accordance with the details shown in the drawings. IntegraIy reinforce.
   C. Maximum stud spacing shall be 16" o.c.
   D. Coordinate with other trades for provisions for blocking, metal backing plates, special anchors, etc.
   E. Install all components and accessories in strict accordance with the manufacturer's recommendations.
   F. Some partitions extend to the bottom of the structure above. Refer to drawings. Provide for expansion and deflection of the building structure as recommended by the manufacturer.
   G. Provide 16 gauge studs and solid 2x fire treated wood blocking at all walls supporting shelving or cabinets.
   H. Provide channel bracing at mid-height of all walls, or at 6'-0" o.c. vertically where walls exceed 12'-0" in height. Minimum 3/4" cold rolled channel with clips at each stud.
   I. Framing of Intersections:
      (1) Provide three studs or floating stud at all exterior and interior corners.
      (2) Provide floating corner at ceiling/wall intersections, except at fire rated walls.
J. Provide acoustical sealant around entire perimeter of sound rated partitions.

K. Provide 3 beads sealant. One at the center of the floor or ceiling track and end wall studs, one at the edge of gypsum wallboard at each face.

L. Caulk perimeter of all electrical junction boxes, and pipe penetrations. Coordinate with fire stopping requirements.

M. Separate and recycle waste materials to the greatest extent possible.

END OF SECTION
092900 – GYPSUM BOARD

1. GENERAL:
   A. The Contractor shall furnish all labor and materials to render a complete gypsum wallboard system installation.
   
   B. Submit painted sample of finish texture on 24" x 24" piece for approval prior to commencing work. Finish level shall be Gypsum Association Level 3 on all walls except those receiving graphics. Walls receiving graphics shall have a Level 5 Finish Level.
   
   C. Related Sections: All work described in this Section shall be coordinated with the following Sections:
      
      (1) Section 092216: Non-structural Meal Framing
   
   D. Reference Standards:
      
      

2. MATERIALS:
   
   A. Gypsum Wallboard:
      
      (1) Typical: 5/8" thick, Type 'X'; ASTM C-36, SW tapered edges.
      
      (2) Wet Locations: 5/8" thick, Type 'X', moisture and fire resistant wallboard, mold resistant and paperless, complying with ASTM C1178C and 1178M: National Gypsum Gold Bond eXP Tile Backer, Georgia Pacific DensShield Tile Backer, Certainteed M2 Tech Moisture and Mold Resistant Gypsum Board or similar.
      
      (3) Locker Rooms: 5/8" thick, Type ‘X’, high-impact resistant gypsum board.
   
   B. Gypsum Sheathing: 5/8" DensGlass Gold or equal
   
   
   D. Sound Board: ½” Homasote 440 Sound Barrier
   
   E. Wallboard Casings: (galvanized)
(1) Corner bead: #800 Durabead

(2) "L" metal edge trim #200-B

(3) "U" metal edge trim #200-A

F. Screws: 1-1/4" Type "S" Buglehead.

G. Tape and Cement: Approved manufacturer's materials.

H. Texture: Light hawk and trowel in all other areas except walls receiving graphics.

3. INSTALLATION:

A. Walls: Apply board, in maximum practical lengths, perpendicular to framing with ends occurring over firm bearing, end joints staggered ½ panel, field bearings screwed at 12" centers (5 per 48" width). End bearings screwed on 6" centers. Start at center of boards and work toward ends. Provide full panels over doors, no joints permitted.

B. Screw apply casings per manufacturer's directions and install at all outside edges and at intersections with dissimilar materials.

C. Wallboard panels shall be installed continuous over openings and extend at least one (1) full stud beyond the opening edge.

D. Wallboard corners shall overlap utilizing floating corner and floating stud techniques, as required, with no gaps under corner bead. Corner bead shall be attached with screws, crimping is not permitted.

E. Tape, cement, and sand wallboard surfaces. Apply thin cement layer, set tape into cement, let dry for 24 hours, and sand joints, texture entire area to uniform finish.

F. Complete installed system shall conform to all manufacturer's requirements for support size and spacing and lateral bracing.

G. Separate and dispose of and/or recycle gypsum products to the greatest extent possible.

END OF SECTION

09250 GYPSUM WALLBOARD

2
093013 – CERAMIC TILING

1. GENERAL:
   A. Scope: Furnish and install all labor, materials and accessories as required for a complete waterproof installation. Tile to be installed on floor and walls with patterns as specified.
   B. All materials and workmanship shall be in strict accordance with current American Standard Specifications for installation of ceramic tile of the Tile Council of America.
   C. Submit samples of each type and color tile required.
   D. Provide 20 S.F. of each type and color for surplus material.

2. MATERIALS:
   A. Manufacturers: Tile shall be as manufactured by Dal Tile, American Olean, Florida Tile or approved equal. Floor and base tile shall be by the same manufacturer and shall be modular together.
   B. Floor Tile
      (1) Single use Restrooms: 3” x 3” porcelain tile, Crossville Ceramics, style: Crossville Mosaics w/ sanitary cove wall tile.
   C. Wall Tile
      (1) Ceramic wall tile: Crossville Mosaics, 3” x 3”
   D. Dryset Mortar: ANSI A118.1.
   E. Latex: Portland Cement Mortar - ANSI A118.4
   F. Water: Potable
   G. Bond Coat: Dryset mortar.
   H. Adhesive: ANSI A136.1, Type I.
   I. Tile Backer Board: Acrylic coated mold and moisture resistant gypsum panel substrate complying with ASTM C1178C and 1178M: National Gypsum Gold Bond eXP Tile Backer, Georgia Pacific DensShield Tile Backer, Certainteed M2 Tech Moisture and Mold Resistant Gypsum Board or similar.
J. Metal Lath: Self-furring.

K. Grout: Latex - Portland cement, sanded or non-sanded as appropriate for joint width. Submit color samples for approval. ANSI A118.6.

L. Trim: Satin anodized aluminum or stainless steel finish with profile that is suitable for the application at open edges of tile.

M. Shapes: Form all vertical exterior corners with surface bullnose, intersections of walls and floors with 3/8” radius cove. All trim shapes to be of equal size as field tiles. Use factory manufactured integral angles to form all trim corners.

3. INSTALLATION:

A. All tile installed per Tile Council of North America Standard Specifications over applicable substrate and conditions shown and described below:

   (1) Stud Walls - wet areas: W 244-15

   (2) Stud Walls - dry areas: W 244-15

   (3) Floors - thin set: (level) F 122-15

   (4) CMU Walls - dry areas: W 211-15

B. Tile Backer Board: Install in accordance with manufacturer's recommendations.

C. Align joints in wall tile, vertically and horizontally and align floor joints with wall joints. No staggered joints permitted. Lay out work so that no tile is less than one-half size. Consult with architect before commencing work concerning layout and specific trim shapes.

D. Install waterproofing membrane at all shower walls and bases, pipe protrusions, inside and outside corners, curbs and wet area shower niches.

E. Cleaning and Protection: Tile shall be left clean after grouting and protected with suitable covering. Acid shall not be used on any glazed tile.

F. Seal all grout with penetrating sealant that is colorless, stain-resistant, and will not affect the color and physical properties of ceramic tile and stone surfaces. Use moisture and mildew resistant silicone sealant for floors
and walls in showers.

G. Separate and recycle waste to the greatest extent possible.

END OF SECTION
096513 – RESILIENT AND BASE AND ACCESSORIES

1. GENERAL

A. Scope: Furnish all necessary materials, labor and equipment for the complete installation of rubber base and vinyl composition tile as indicated on the drawings.

B. Maintenance Materials: Upon completion of the work, furnish Owner with 10 linear feet of base for future maintenance.

C. Submittals:

(1) Submit product data and samples.

2. MATERIALS

A. Rubber Base: Base shall be 4" & 6" cove (as indicated on drawings), 1/8" thick type 700 Series TPR rubber compound by Roppe, Flexco, Johnsonite or approved equal. It shall be constructed of 10% post-industrial waste, and shall be smooth and free from imperfections which detract from its appearance. The base shall conform fully to the requirements of Standard Specification F-1861, Group 1 (solid). Use pre-molded outside corners. Color as selected by the Architect.

B. Reducer Strips: Roppe, Flexco or Johnsonite. Color to be selected by Architect.

C. Adhesives: All resilient flooring and cove base shall be installed using Envirotec Healthguard series adhesives as manufactured by W.F. Taylor Co., Inc., Santa Fe Springs, CA; Chicago, IL; Dalton, GA approved equal, or as recommended by the manufacturer.

Adhesives shall be non-toxic, low odor and solvent free with no alcohol, glycol, or ammonia. Adhesives shall be antimicrobial with no hazardous vapors and contain no carcinogenic materials per OSHA Regulation 29 CFR 1910-1200.

Compatibility of W.F. Taylor Envirotec Healthguard adhesives with specified floor covering shall be warranted by W.F. Taylor Company. A written letter of guarantee shall be obtained by Contractor prior to installation of flooring products. Letters of guarantee are required to accompany all flooring submittals.

D. Leveling Compound: Cement based Ardex or Fritz.
3. INSTALLATION

A. Rubber Base:

(1) Install per Asphalt and Vinyl Tile Institute Specifications and manufacturer's directions. Commencing work by this Contractor indicates acceptance of surfaces. Use pre-molded outside corners. Miter inside corners. Minimum length of any run of base shall be 48”.

(2) Install rubber base at all walls and cabinets.

B. Provide reducer strips at all flooring transitions.

C. Separate and recycle waste materials to the greatest extent possible.

END OF SECTION
099000 – PAINTING

1. SCOPE:

   A. Paint all surfaces not factory pre-finished, interior and exterior.

   B. Regulatory requirements: Comply with applicable codes and regulations of governmental agencies having jurisdiction including those having jurisdiction over airborne emissions and industrial waste disposal. Where those requirements conflict with this Specification, comply with the more stringent provisions.

   C. Maintenance Materials:

      (1) Contractor shall furnish to the Owner one (1) full gallon of each color and each finish.

      (2) Containers shall be sealed tight and clearly labeled for identification.

      (3) Maintenance material shall be new material, not opened or used material.

   D. Submittals:

      (1) All materials submitted for approval must be accompanied by product information showing raw material composition.

      (2) Contractor shall submit paint chips for color and texture selections. Three sets to the Architect for approval.

      (3) When requested by the Architect, the Contractor shall submit a 12 inch by 12 inch sample of any paint finish. Paint finish sample shall be applied to identical type of materials to which it will be applied on the job. Identify samples with color name and number and location on the job.

      (4) Paint colors shall be selected by Architect.

   E. Delivery, Storage and Handling:

      (1) All materials shall be delivered to site in manufacturer's unbroken sealed containers. Each container shall be labeled by the manufacturer giving manufacturer's name, type of paint, label analysis, color and instruction for mixing and reducing.
(2) Provide adequate storage facilities. Store paint materials at minimum ambient temperature of 45°F.

(3) Take precautionary measures to prevent fire hazards and spontaneous combustion.

F. Environmental conditions:

(1) Surfaces to receive paint materials shall be dry.

(2) Minimum application temperature for latex paints is 45°F.

G. Protection:

(1) Adequately protect surfaces not being painted. Repair or replace all items and surfaces damaged as a result of inadequate protection.

(2) Place waste which may constitute a fire hazard in closed metal containers and remove daily from site, or more often, if required.

(3) Remove electrical plates, surface hardware, fittings and fastenings prior to painting. These items shall be stored, cleaned and replaced on completion of work in each area. Solvent used to clean hardware shall not remove permanent lacquer finish.

(4) Provide "WET PAINT" signs to protect newly painted surfaces.

(5) At the completion of work of other trades, touch up and restore damaged painted surfaces interior and exterior.

H. Painting at Patched Areas:

(1) Painting at patched and repaired areas designated on the drawings will be limited to the immediate repaired area and extend two feet beyond the repair in all directions unless noted otherwise. Paint color shall match as closely as possible existing colors.

2. MATERIALS:

A. The following manufacturer's top-of-the-line, first quality products are acceptable. If use of equal products manufactured by others is desired, a list of proposed products including technical brochures shall be submitted for prior approval. Contractor will furnish to the Architect manufacturer's numbered invoices showing material types and quantities used on this project.
(1) Dunn-Edwards Corp.

(2) Sherwin-Williams

(3) ICI

(4) Frazee

B. Manufacturer's catalog names and number of paint types in this Section are based on products of Dunn Edwards and is the standard of quality against which the Architect will judge equivalency. The quantity of titanium dioxide, the use of clays, aluminum silicate, talc and the purity of acrylic materials are some of the criteria which will be used by the Architect in evaluating the equivalency of submitted materials. No lead shall be utilized in the composition of any paint products.

3. INSTALLATION:

A. Workmanship: Preparation, application, workmanship, completion, and acceptance in accordance with manufacturer’s recommendations and applicable provisions of "Painting Specification Manual" by P.D.C.A. for Type 1 Standard Job.

B. Preparation of Surfaces:

(1) Wood: Sandpaper to a smooth and even surface and then dust with a cloth dampened with turpentine in order to completely remove all traces of sanding particles. Nail holes puttied, knots or pitch pockets sealed with shellac.

(2) Concrete: Thoroughly clean surfaces of all loose material land form release agents.

(3) Galvanized Metal: Thoroughly clean with solvent and prime with galvanized metal primer.

(4) Ferrous Metal: Scale and rust removed, cleaned, primed with rust-inhibitive metal primer.

(5) Back Priming: Exposed wood frames and trim, back-primed with one coat of Woodlife.

(6) General: Before painting, remove hardware, accessories, plates, lighting fixtures, and similar items or provide ample protection. Replace all items upon completion of the work.
(7) Where surfaces are to receive aliphatic or epoxy coatings, caulk joint between floor and wall and at all intersections of dissimilar materials.

(8) Previously Painted Surfaces: Wash with tri-sodium phosphate. Remove loose paint and rust and apply primer.

(9) Surface Wireways and Conduits: Sand surfaces to remove sheen. Prime with Versaprimet. Apply final coats within 7 days.

(10) Exterior Metal:
   a. Power wash or power sand all areas to be painted, and use a mild detergent solution such as Mi-T-M SURFACE PREP, if required. Then rinse with clear clean water until all residue has been removed from all surfaces.

C. Application:

(1) Manufacturer's representative shall conduct a pre-painting conference to familiarize himself with the work and to verify the compatibility of all products with the substrates.

(2) The manufacturer's representative shall monitor the application of all aliphatic and epoxy coatings and shall provide certification, in writing, that the products have been installed properly.

(3) The application of any painting material on any surface shall constitute an acceptance by the Contractor of such surface.

(4) Apply paint in accordance with manufacturer's directions. Use applicators and techniques best suited for the type of material being applied.

(5) Apply each coat at the proper consistency according to product manufacturer.

(6) All coats shall be thoroughly dry (minimum of 4 hours) before applying succeeding coats.

(7) All necessary repairing of nail holes, cracks, plaster, drywall, doors, etc., shall be done after the prime coat. Patch surface with material of same color as finish. Repairs shall be brought flush with and match adjacent surfaces.
Where clear finishes are required, ensure tint fillers match wood. Work fillers well into grain before set. Wipe off excess.

All edges of doors shall be finished same as the faces after fitting.

Hot spots and suction spots noticeable after application of first coat shall be neutralized and touched up before applying second coat. The last coat shall produce an even result.

Exposed piping, ductwork, conduits, and cable trays generally will be painted color and texture to match walls or ceilings next to it.

Final color coat shall show full coverage regardless of number of coats specified.

Exposed piping, ductwork, conduits, and cable trays generally will be painted color and texture to match walls or ceilings next to it.

Exposed piping, ductwork, conduits, and cable trays generally will be painted color and texture to match walls or ceilings next to it.

Exposed piping, ductwork, conduits, and cable trays generally will be painted color and texture to match walls or ceilings next to it.

Exposed piping, ductwork, conduits, and cable trays generally will be painted color and texture to match walls or ceilings next to it.
(7) Paint exposed dampers to match face panels.

E. Cleaning:

(1) Remove paint where spilled, splashed, or spattered immediately.

(2) During progress of work, keep premises free from any unnecessary accumulation of tools, equipment, surplus materials and debris.

(3) Upon completion of work, leave premises neat and clean to the satisfaction of the Architect.

F. Paint Schedule:

(1) Paint schedule lists minimum coats. Additional coats may be required to obtain color and uniformity and to hide, at no additional cost to the Owner.

(2) Interior Work:

a. Interior Gypsum Drywall (typical):
   1 coat: Vinlyastic Select (VNSL00), low-odor/zero-VOC interior latex prime
   2 coats: SpartaZero Eggshell (SZRO30) Low Sheen, low-odor/zero-VOC interior latex low sheen paint

b. Interior Gypsum Drywall (at wet areas):
   1 coat: Vinlyastic Select (VNSL00-1), low-odor/zero-VOC interior latex primer
   2 coats: Carboline Sanitile 255, Semi-Gloss, interior acrylic-epoxy eggshell paint

c. Interior Metal, Ferrous:
   1 coat: Bloc-Rust Premium (BRPR00-1-WH), interior/exterior waterborne alkyd rust-preventative metal primer
   2 coats: EverShield (EVSH50-3), low-odor / low-VOC interior/exterior acrylic semi-gloss paint

d. Interior Metal, Non-Ferrous:
   1 coat: Ultra-Grip Premium (UGPR00), acrylic multi-purpose primer
   2 coats: EverShield (EVSH50-3) low-odor / low-VOC interior/exterior acrylic semi-gloss paint
e. Interior Wood:
   1 coat: Inter-Kote Premium (IKPROO) Primer, low-odor/zero-VOC interior latex primer
   2 coats: Spartazero Eggshell (SZRO30) Low Sheen, low-odor/zero-VOC interior latex low sheen paint

f. Interior Masonry (DO NOT PAINT GYM INTERIOR):
   1 coat: Ultra-grip Premium (UGPR00), acrylic multi-purpose primer
   2 coats: SpartaShield (SSHL30) low-odor / low-VOC exterior acrylic eggshell paint

g. Interior Masonry (at wet locations and food service areas):
   1 coat: Smooth BLOCFIL Select (SBSL00-1), interior/exterior concrete block filler primer
   2 coats: Carboline Sanitile 255, interior acrylic-epoxy eggshell paint.

(3) Exterior Work:

a. Exterior Metal, Ferrous:
   1 coat: Corrobar (43-5)
   2 coats: SynLustro (10) Alkyd

b. Exterior Metal, Non-Ferrous:
   1 coat: Versaprime (42-44)
   2 coats: SynLustro (10) Alkyd

c. Exterior Stucco/EIFS:
   1 coat: Eff-Stop Premium (ESPR00), acrylic masonry primer/sealer
   2 coats: EverShield (EVSH10-3), low-odor/low-VOC exterior acrylic flat paint

d. Exterior Masonry:
   Refer to Section 071900 Water Repellants and Anti-Graffiti Coatings and Stains

END OF SECTION

END OF DIVISION
101400 – SIGNAGE

1. GENERAL:
   A. Scope: Provide all labor and materials required for a complete installation where shown on the drawing.
   B. Shop Drawings: Submit shop drawings and color samples for approval prior to installation.

2. MATERIALS:
   A. Wall Mounted Signs:
      (1) Wall signs shall be Series 200A sand engraved on ES Plastic and per the details as manufactured by Mohawk Sign Systems, Signsource, Best or approved equal. Colors as selected by the architect from the full line of available colors.
   B. Door Frame Tags:
      (1) Door identification numbers shall be engraved “ES” plastic on all frames.
      (2) Refer to the door schedule sheets for sizes and information.
   C. Building Names and Numbers: Cast aluminum letters and numbers, black anodized finish, Helvetica MEDIUM, flush mount with threaded studs set in adhesive, as manufactured by A.R.K. Ramos, Gemini Inc., Leeds, Mathews, or equal. Sizes as shown on drawing.
   D. Cast Plaques:
      (1) Manufacturer: Andco, ASI, OMC, or A.R.K. Ramos.
      (2) Metal: Aluminum.
      (3) Background: Manufacturer’s standard pebble texture, black.
      (4) Metal Finishes: Comply with NAAMM “Metal Finishes Manual” for finish designations and application recommendations.
      (5) Aluminum Finishes: Class II Clear Anodized AA-M31c21A31 (Fine Satin Mechanical Finish: Chemical etch, fine matte; 0.4 mil min thick anodic coating.)
(6) Produce castings free from puts, scale, and sand holes or other defects. Hand tool and buff borders and raised copy to produce manufacturer's standard satin polished finish.

3. INSTALLATION:

A. Install per manufacturer's recommendations and as shown on the drawings.

B. Letters and Numbers: Concealed mounting: Threaded studs inserted into tapped lugs on back of plaque and set in predrilled holes filled with quick-setting cement.

C. Wall mounted signs and doorframe tags: Mechanical fastening required.

D. Cast Plaques:

(1) Mount cast plaques using manufacturer's standard fastening methods recommended by manufacturer for type of wall surface indicated.

(2) Concealed Mounting: Threaded studs inserted into tapped lugs on back of plaque and set in predrilled holes filled with quick-setting cement.

E. Cleaning and Protection: At completion of installation, clean soiled sign surfaces in accordance with manufacturer's instructions. Protect units from damage until acceptance by Owner.

END OF SECTION
102800 – TOILET, BATH & LAUNDRY ACCESSORIES

1. GENERAL:
   A. Scope: Furnish and install accessories where shown on the drawings.

2. MATERIALS:
   A. Acceptable Manufacturers: Bobrick, Bradley, McKinney / Parker Model numbers reference Bobrick products.
      (1) Grab Bars: B-5806, Lengths as required.
      (2) Recessed Trash Receptacle: B-3644
      (3) Napkin Disposal: B-354
      (4) Mirror: B-165, 24”x36”
      (5) Clothes Hook: B-2116

3. INSTALLATION:
   A. Mount all items per handicap accessibility requirements.
   B. Coordinate with other trades to provide correct blocking and openings. Provide solid blocking for anchorage.
   C. Seal all connections to walls with caulking as required by code.

END OF SECTION
102813.14 – ELECTRIC HAND DRYERS

PART 1 - GENERAL

1.1 CONDITIONS AND REQUIREMENTS
   A. The General Conditions, Supplementary Conditions, and Division 01 – General Requirements apply.

1.2 SECTION INCLUDES
   A. Electric hand dryers.

1.3 RELATED SECTIONS
   A. Division 26 - Electrical: Electrical systems and components.

1.4 SUBMITTALS
   A. Submit under provisions of Section 013300
   B. Product Data: Provide construction details, dimensions, anchoring and mounting requirements, material and finish descriptions, electrical requirements, and manufacturer's warranty.
   C. Operation and Maintenance Data: Provide for electric hand dryers to include in maintenance manuals.
   D. Warranty: Provide sample of manufacturer's standard warranty for parts and labor.

1.5 QUALITY ASSURANCE
   B. Electrical Components, Devices, and Accessories: Listed and labeled in accordance with NFPA 70, by a qualified testing agency, and marked for intended location and application.
1.6 DELIVERY, STORAGE AND HANDLING

A. Deliver, store, and handle electric hand dryers in manufacturer’s protective packaging.

B. Store electric hand dryers off of ground, under cover, and in a dry location. Handle according to manufacturer’s written recommendations to prevent damage, deterioration, or soiling.

1.7 COORDINATION

A. Coordinate locations of electric hand dryers with other work to prevent interference with clearances required for access, and for proper installation, adjustment, operation, cleaning, and servicing of electric hand dryers.

1.8 WARRANTY

A. Manufacturer’s Standard Warranty: Manufacturer’s standard form in which manufacturer agrees to repair, restore, or replace defective electric hand dryer components and labor within specified warranty period.

1. Warranty Period: Five (5) years limited for labor and five (5) years for parts.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide the electric Dyson Airblade V hand dryers manufactured by Dyson Inc., 1330 W. Fulton St., Floor 5, Chicago, IL 60607; 888-397-6622, www.dyson.com/Airblade or comparable product acceptable to the Architect.

B. Substitutions will be considered under provisions of Section 013345.

2.2 ELECTRIC HAND DRYERS

A. Electric Hand Dryers: The electric Dyson Airblade V Electric hand dryer (Model HU02); Item No. 307174-01 (sprayed nickel LV).

1. Mounting: Surface mounted on ABS/PBT plastic backplate/mounting bracket; protrudes four inches from wall, no recessing required; ADA compliant.


4. Filtration: 99.97 percent particulate efficiency HEPA filter with anti-microbial coating.

5. Operation: Touch-free capacitive sensor activation.
   a. Hand dry time: 12 seconds
   b. Airspeed at nozzle: 420 mph
   c. Operating Airflow: Up to 5.28 gal/sec.
   d. Rated Operating Noise Power: 79 db(A)

6. Motor: Dyson Digital Motor (DDM), V4 switched reluctance brushless DC type; 92,000 rpm motor speed; less than 0.5 watt standby power consumption.


8. Operating Temperature Range: 0 - 40 degrees C.

9. Standby Power Consumption: Less than 0.5 W.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify availability and characteristics of electrical power. Drill minimum two (2) inch diameter holes for electrical service entrance through backplate.

B. Do not begin installation until substrates are complete and ready for installation of electric hand dryers.

3.2 INSTALLATION

A. Locate and install mounting bracket in accordance with manufacturer’s written instructions. Use minimum 0.25-inch anchors to mount bracket. Mount electric hand dryer at height above finished floor recommended by manufacturer.

B. Install electric hand dryer in accordance with manufacturer’s written instructions, using fasteners appropriate to substrate indicated and recommended by manufacturer. Install electric hand dryers level, plumb, and firmly anchored in locations and at heights indicated.
3.3 CLEANING AND PROTECTION

A. Adjust electric hand dryers for smooth operation. Replace damaged or defective components.

B. Remove protective coverings from finished surfaces.

C. Clean exposed surfaces using materials and methods recommended by manufacturer.

END OF SECTION
104413 – FIRE PROTECTION CABINETS

PART 1 - GENERAL

1.1 SUMMARY
   A. Section includes fire-protection cabinets for portable fire extinguishers.

1.2 ACTION SUBMITTALS
   A. Product Data: For each type of product.
   B. Shop Drawings: For fire-protection cabinets.

1.3 CLOSEOUT SUBMITTALS
   A. Maintenance data.

1.4 COORDINATION
   A. Coordinate size of fire-protection cabinets to ensure that type and capacity of fire extinguishers indicated are accommodated.
   B. Coordinate sizes and locations of fire-protection cabinets with wall depths.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS
   A. Fire-Rated Fire-Protection Cabinets: Listed and labeled to comply with requirements in ASTM E 814 for fire-resistance rating of walls where they are installed.

2.2 FIRE-PROTECTION CABINET
   A. Cabinet Type: Suitable for fire extinguisher.
      1. Basis of Design: Larsen’s Architectural Series, model 2409-5R and 2409-SM.
      2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
         a. Fire-End & Croker Corporation
         b. Guardian Fire Equipment, Inc.
         c. JL Industries, Inc.
         d. Modern Metal Products
e. Potter roemer LLC

B. Cabinet Construction: Nonrated.

C. Cabinet Material: Cold-rolled steel sheet.

D. Semirecessed Cabinet: One-piece combination trim and perimeter door frame overlapping surrounding wall surface with exposed trim face and wall return at outer edge (backbend).
   1. Rolled-Edge Trim: 2-1/2-inch backbend depth.

E. Surface-Mounted Cabinet: Cabinet box fully exposed and mounted directly on wall with no trim.

F. Cabinet Trim Material: Steel sheet.

G. Door Material: Steel sheet.

H. Door Style: Vertical duo panel with frame.

I. Door Glazing: Acrylic sheet.
   1. Acrylic Sheet Color: Clear transparent acrylic sheet.

J. Door Hardware: Manufacturer’s standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.

K. Accessories:
   1. Door Lock: Cam lock that allows door to be opened during emergency by pulling sharply on door handle.
   2. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location.
      a. Identify fire extinguisher in fire-protection cabinet with the words “FIRE EXTINGUISHER.”
         1) Location: Applied to cabinet door.
         3) Lettering Color: Red.
         4) Orientation: Vertical.

L. Materials:
1. Cold-Rolled Steel: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B.
   a. Finish: Baked enamel or powder coat.
   b. Color: As selected by Architect from full range of industry colors and color densities.

2. Transparent Acrylic Sheet: ASTM D 4802, Category A-1 (cell-cast sheet), 3 mm thick, with Finish 1 (smooth or polished).

2.3 FABRICATION
   A. Fire-Protection Cabinets: Provide manufacturer's standard box (tub) with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated.

PART 3 - EXECUTION

3.1 INSTALLATION
   A. Prepare recesses for semi-recessed fire-protection cabinets as required by type and size of cabinet and trim style.
   B. Install fire-protection cabinets in locations and at mounting heights indicated or, if not indicated, at heights acceptable to authorities having jurisdiction.
   C. Fire-Protection Cabinets: Fasten cabinets to structure, square and plumb.
   D. Adjust fire-protection cabinet doors to operate easily without binding. Verify that integral locking devices operate properly.

END OF SECTION
104416 – FIRE EXTINGUISHERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes portable, hand-carried fire extinguishers and mounting brackets for fire extinguishers.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.3 INFORMATIONAL SUBMITTALS

A. Warranty: Sample of special warranty.

1.4 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.5 COORDINATION

A. Coordinate type and capacity of fire extinguishers with fire-protection cabinets to ensure fit and function.

1.6 WARRANTY

A. Special Warranty: Manufacturer’s standard form in which manufacturer agrees to repair or replace fire extinguishers that fail in materials or workmanship within specified warranty period.

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

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Portable Fire Extinguishers."

B. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.
2.2 PORTABLE, HAND-CARRIED FIRE EXTINGUISHERS

A. Fire Extinguishers: Type, size, and capacity for each fire-protection cabinet and mounting bracket indicated.


2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Amerex Corporation
   b. Ansul Incorporated
   c. Guardian Fire Equipment, Inc.
   d. JL Industries, Inc.
   e. Larsens Manufacturing Company
   f. Potter Roemer LLC.

3. Instruction Labels: Include pictorial marking system complying with NFPA 10, Appendix B.

B. Multipurpose Dry-Chemical Type: UL-rated nominal capacity, with monoammonium phosphate-based dry chemical in manufacturer's standard enameled container.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Examine fire extinguishers for proper charging and tagging.

1. Remove and replace damaged, defective, or undercharged fire extinguishers.

B. Install fire extinguishers and mounting brackets in locations indicated and in compliance with requirements of authorities having jurisdiction.

1. Mounting Brackets: 54 inches above finished floor to top of fire extinguisher.

C. Mounting Brackets: Fasten mounting brackets to surfaces, square and plumb, at locations indicated.

END OF SECTION
115213 – PROJECTION SCREENS

PART 1 - GENERAL

1.1 SUMMARY
A. Section Includes:
   1. Electrically operated, front-projection screens and controls.

1.2 ACTION SUBMITTALS
A. Product Data: For each type of product.
B. Shop Drawings: Show layouts and types of front-projection screens. Include the following:
   1. Location of seams in viewing surfaces.
   2. Anchorage details, including connection to supporting structure for suspended units.
   3. Location of wiring connections for electrically operated units.
   4. Wiring diagrams for electrically operated units.

PART 2 - PRODUCTS

2.1 ELECTRICALLY OPERATED, FRONT-PROJECTION SCREENS
A. General: Manufacturer's standard units consisting of case, screen, motor, controls, mounting accessories, and other components necessary for a complete installation.
   1. Controls: Remote, key-operated, three-position control switch.
      a. Provide locking cover plates for switches.
      b. Provide key-operated, power-supply switch.
      c. Provide video interface control for connecting to projector. Projector provides signal to raise or lower screen.

   2. Motor in Roller: Instant-reversing motor of size and capacity recommended by screen manufacturer; with permanently lubricated ball bearings, automatic thermal-overload protection, and positive-stop action to prevent coasting.
3. **Screen Mounting:** Top edge securely anchored to rigid metal roller and bottom edge formed into a pocket holding a 3/8-inch- (9.5-mm-) diameter metal rod with ends of rod protected by plastic caps.

4. **Tab Tensioning:** Provide units that have a durable low-stretch cord, such as braided polyester, on each side of screen that is connected to edge of screen by tabs to pull screen flat horizontally.

**B. Suspended, Electrically Operated Screens with Automatic Ceiling Closure and with Tab Tensioning:** Motor-in-roller units designed and fabricated for suspended mounting; with bottom of case composed of two panels, fully enclosing screen, motor, and wiring; one panel hinged and designed to open and close automatically when screen is lowered and fully raised, the other removable or openable for access to interior of case.

1. **Products:** Subject to compliance with requirements, provide one of the following:
   a. **Da-Lite Screen Company;** Tensioned Large Advantage Deluxe Electrol or equal by the following:
   b. **Draper Inc.**
   c. **Stewart Filmscreen Corporation.**

2. Provide screen case constructed to be installed with ceiling finish applied to underside.

**2.2 FRONT-PROJECTION SCREEN MATERIAL**

**A. Da-Lite HD Progressive:** Peak gain of not less than 0.9, and half-gain angle of at least 85 degrees from the axis of the screen surface.

1. **Products:** Subject to compliance with requirements, provide the following:
   a. **Da-Lite Progressive 0.9.**

**B. Seamless Construction:** Provide screens, in sizes indicated, without seams.

**C. Edge Treatment:** Black masking borders.

**D. Size of Viewing Surface:** 144 by 192 inches.
PART 3 - EXECUTION

3.1 INSTALLATION

A. Install front-projection screens with screen cases in position and in relation to adjoining construction indicated. Securely anchor to supporting substrate in a manner that produces a smoothly operating screen with vertical edges plumb and viewing surface flat when screen is lowered.

1. Install low-voltage controls according to NFPA 70 and complying with manufacturer’s written instructions.

   a. Wiring Method: Install wiring in raceway except in accessible ceiling spaces and in gypsum board partitions where unenclosed wiring method may be used. Use UL-listed plenum cable in environmental air spaces, including plenum ceilings. Conceal raceway and cables except in unfinished spaces.

2. Test electrically operated units to verify that screen controls, limit switches, closures, and other operating components are in optimum functioning condition.

END OF SECTION 115213
116143 – STAGE CURTAINS

PART 1 - GENERAL

1.1 SUMMARY
   A. Section Includes:
      1. Back Curtain.
      2. Draw-curtain tracks.

1.2 ACTION SUBMITTALS
   A. Product Data: For each type of product.
   B. Shop Drawings: For each installation and for special components not dimensioned or detailed in manufacturer's product data.
   C. Samples: For each exposed product and for each color and texture specified.

1.3 INFORMATIONAL SUBMITTALS
   A. Coordination Drawings: Reflected ceiling plans and other details, drawn to scale, and coordinated with each other, using input from installers of the items involved.
   B. Product certificates.
   C. Sample warranty.

1.4 CLOSEOUT SUBMITTALS
   A. Operation and maintenance data.

1.5 QUALITY ASSURANCE
   A. Installer Qualifications: Manufacturer of stage curtains.
1.6 WARRANTY

A. Manufacturer's Special Warranty: Manufacturer agrees to repair or replace components of stage-curtain systems that fail in materials or workmanship within specified warranty period.

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

PART 2 - PRODUCTS

2.1 STAGE-CURTAIN SYSTEMS

A. Description: Complete stage-curtain systems, including stage curtains and tracks; with necessary accessories for support and operation.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   b. Janson Industries.
   c. LuXout Stage Curtains.
   d. Mainstage Theatrical Supply, Inc.
   e. NorthEast Stage.
   f. Rose Brand.
   g. S&K Theatrical Draperies, Inc.
   h. Stagecraft Industries, Inc.
   i. Texas Scenic Company, Inc.

2.2 PERFORMANCE REQUIREMENTS

A. Structural Performance: Stage-curtain systems and attachments to structure shall withstand the effects of gravity and operational loads.

B. Fire-Test-Response Characteristics: Provide stage curtains meeting the following requirements as determined by testing identical products by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.


   a. Permanently attach label to each fabric of curtain assembly indicating whether fabric is inherently and permanently flame resistant or is treated with flame-retardant chemicals and whether it requires retreatment after cleaning or after a designated time period of use.
b. Permanently attach 12-inch- (300 mm-) square swatch of same fabric and dye lot for each fabric of a curtain assembly to the back of assembly for use as fire-resistance test strip.

2.3 CURTAIN FABRICS

A. General: Provide fabrics inherently and permanently flame resistant or chemically flame resistant by immersion treatment according to performance requirements indicated. Provide fabrics of each type and color from same dye lot.

B. Back Drape Duvetyn, Heavy Weight: 100 percent cotton, short-napped fabric weighing not less than 16 oz./linear yd. (495 g/linear m); twill weave with soft uniform texture; 54-inch (1372-mm) minimum width; black.

1. Products: Subject to compliance with requirements, provide one of the following:
   a. Dazian LLC; Supercote Heavyweight.
   c. Rose Brand; Black Commando.
   d. Valley Forge Fabrics, Inc.; Commando.

2.4 LINING

A. Cotton Lining: Yarn-dyed denim cloth of 100 percent cotton; woven in a warp-faced twill; 54-inch (1372-mm) minimum width; black.

2.5 CURTAIN FABRICATION

A. General: Affix permanent label, stating compliance with requirements of authorities having jurisdiction, in accessible location on fabric not visible to audience. Provide vertical seams unless otherwise indicated. Arrange vertical seams so they do not fall on faces of pleats. Do not use fabric cuts less than one-half width.

B. Vertical and Top Hems: Machine sew hems as follows unless otherwise indicated:

   1. Vertical Hems: Minimum 2 inches (50 mm) wide, with not less than a 1-inch (25-mm) tuck and with no selvage material visible from front of curtain. Sew open ends of hems closed.
   2. Turnbacks: Provide leading- and trailing-edge turnbacks for traveler curtains, formed by folding back not less than 12 inches (300 mm) of face
fabric, with not less than a 1-inch (25-mm) tuck, and vertically secured by sewing.

3. Top Hems: Reinforced by double-stitching 3-1/2-inch- (89-mm-) wide, heavy, jute or laminated synthetic webbing to top edge on back side of curtain with not less than 2 inches (50 mm) of face fabric turned under.

C. Fullness:

1. Flat: Provide 15 percent fullness in curtains.

D. Grommets: Brass, No. 3, or No. 4. For black curtains, provide brass or aluminum grommets with black finish.

E. Bottom Hems: Machine sew hems as follows unless otherwise indicated:

1. For flat curtains: 4-inch (100-mm) lined hem with pocket for sliding pipe or conduit weight and stiffener into bottom of curtain, and with a concealing flap of same fabric in front of pocket made 2 inches (50 mm) longer than bottom edge of pocket.

2. For curtains with fullness:

   a. Floor-Length Curtains: Hems not less than 6 inches (150 mm) deep, with 1-inch (25-mm) weight tape sewn to top seam of the bottom hem, clear of the finished bottom edge, and with open ends of hems sewn closed.

2.6 ALUMINUM CURTAIN TRACK

A. Aluminum Track: Extruded aluminum, ASTM B 221 (ASTM B 221M); alloy and temper as recommended by manufacturer for strength and corrosion resistance; mill finish; complete with necessary accessories for support and operation.

1. Products: Subject to compliance with requirements, provide one of the following:

   a. H & H Specialties Inc.; 500 series.

2. Aluminum Thickness: 0.125 inch (3.1 mm).

B. Curtain Rails: Provide end stops for track rails.

C. Curtain Carriers: Standard carriers, with a quantity of carriers sufficient for track length, to suit curtain fabrication. Include one master carrier for each leading curtain edge.
D. Clamp and Bracket Hangers: Steel clamps and brackets of sufficient strength required to support loads for attaching track to overhead support.

E. Track-Lap Clamp: Metal to match track channel for attaching two tracks at center overlap.


PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Install stage-curtain system according to curtain and track manufacturer's written instructions.

3.2 TRACK INSTALLATION

A. Rear Drape. Ceiling-Mounted Track: Drill track at intervals not greater than manufacturer's written instructions for spacing, and fasten directly to structure.

3.3 CURTAIN INSTALLATION

A. Track Hung: Secure curtains to track carriers with snap hooks.

3.4 CURTAIN SCHEDULE

A. Back Drapes: As indicated on Drawings and as follows:

1. Size and configuration: As shown on drawings.
2. Heavy weight: Durety.
3. Fabric: Flat curtain.
4. Bottom weight:
5. Track: Aluminum.

END OF SECTION 116143
116153 – PORTABLE RISER

PART 1 - GENERAL

1.1 SUMMARY
A. Section Includes:
   1. Portable Riser / Staging System.

1.2 ACTION SUBMITTALS
A. Product Data: For each product.
B. Shop Drawings: For each installation and for special components not dimensioned or detailed in manufacturer’s product data.
C. Samples: For each exposed product and for each color and texture specified.

1.3 INFORMATIONAL SUBMITTALS
A. Coordination Drawings: Reflected ceiling plans and other details, drawn to scale, and coordinated with each other, using input from installers of the items involved.
B. Product certificates.
C. Sample warranty.

1.4 CLOSEOUT SUBMITTALS
A. Operation and maintenance data.

1.5 QUALITY ASSURANCE
A. Installer Qualifications: Manufacturer of portable riser.

1.6 WARRANTY
A. Manufacturer’s Warranty: Manufacturer agrees to repair or replace components of stage-curtain systems that fail in materials or workmanship within specified warranty period.
1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PORTABLE RISER / STAGING SYSTEM

A. Description: Complete portable stage system.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Wenger or approved equal
      1) Stage Tek Staging System

2.2 PERFORMANCE REQUIREMENTS

A. Size of Panel: 4’ x 8’, ¾ thick Group 1, Veneer Plywood with protective laminate both sides.

B. Surface Option: Black standard

C. Dynamic Loading: 10,000 cycles of 400lb-force

D. Standard Uniform Load: 125lbs/sf

E. Aluminum frame and edging.

F. Standard Unit to Unit connectors

G. Standard Legs: 2½” Aluminum

H. Riser Heights: 7”, 14”, 21”, and 28” AFF

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Install stage system according to manufacturer’s written instructions.

END OF SECTION 116153
116163 – PORTABLE DANCE FLOOR

PART 1 - GENERAL

1.1 SUMMARY
   A. Section Includes:
      1. Portable Dance Floor.

1.2 ACTION SUBMITTALS
   A. Product Data: For each product.
   B. Shop Drawings: For each installation and for special components not
dimensioned or detailed in manufacturer's product data.
   C. Samples: For each exposed product and for each color and texture specified.

1.3 INFORMATIONAL SUBMITTALS
   A. Product certificates.
   B. Sample warranty.

1.4 CLOSEOUT SUBMITTALS
   A. Operation and maintenance data.

1.5 QUALITY ASSURANCE
   A. Installer Qualifications: Manufacturer of portable dance floor.

1.6 WARRANTY
   A. Manufacturer's Warranty: Manufacturer agrees to repair or replace components
   of stage-curtain systems that fail in materials or workmanship within specified
   warranty period.
      1. Warranty Period: Two years from date of Substantial Completion.
PART 2 - PRODUCTS

2.1 DANCE FLOOR

A. Description: Semi-Permanently installed sprung floor panel system.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Harlequin Flexity with Harlequin reversible Pro surface or approved equal.

2.2 PERFORMANCE REQUIREMENTS

A. Floor Panel Size: 44" x 88"
B. Floor Thickness: 1½"
C. Floor Weight: 2.4lbs/sf
D. Testing: BS EN 14904:20096
E. Average shock Absorption: 67%

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Lay panels in brickwork fashion for a semi-permanent installation.
B. Joint panels are tongue and groove

END OF SECTION 116163
210500 – COMMON WORK RESULTS FOR FIRE SUPPRESSION

PART 1 GENERAL

1.1 RELATED WORK

A. General Conditions

B. Special Conditions

C. Supplementary General Conditions

D. Architectural, Structural, Civil, Electrical and Mechanical Drawings & Specifications

1.2 SCOPE OF WORK

A. The work covered by the Specifications shall include the furnishing of all materials, labor, transportation, tools, permits, fees, inspections, utilities and incidentals necessary for the complete installation of all mechanical and plumbing work required in the Contract Drawings.

B. It is the intent of the Contract Documents to provide an installation complete in every respect. In the event that additional details or special construction is required for work indicated or specified in this Section or work specified in other sections, it shall be the responsibility of the Contractor to provide all material and equipment which is usually furnished with such systems in order to complete the installation, whether mentioned or not.

C. The Contractor shall visit the premises and thoroughly familiarize himself with all the details of the work and working conditions and to verify all dimensions in the field. The Contractor shall advise the Architect of any discrepancy prior to bidding. The submission of bids shall be deemed evidence of the Contractor's site visit, the coordination of all existing conditions, and the inclusion of all considerations for existing conditions.

1.3 PLANS AND SPECIFICATIONS

A. These Specifications are accompanied by drawings of the building and details of the installations indicating the locations of equipment, piping, ductwork, outlets, etc. The drawings and these specifications are complementary to each other, and what is required by one shall be as binding as if required by both.

B. If departures from the drawings are deemed necessary by the Contractor, details of such departures and the reasons therefore shall be submitted to the Architect for review. No departures shall be made without prior written acceptance of the Architect.
C. The interrelation of the specifications, the drawings, and the schedules is generally as follows: The specifications determine the nature and setting of the materials, the drawings establish the quantities, dimensions, and details, and the schedules give the performance characteristics.

D. Should the drawings disagree in themselves or with the specifications, the contractor shall immediately notify the architect and shall perform and/or furnish the better quality or greater quantity of work or materials unless otherwise directed by the architect in writing. In case the specifications should not fully agree with the schedules, the latter shall govern. Figures indicated on drawings govern scale measurements and large scale details govern small scale drawings. In case of disagreement between specifications and drawings, see Division I of these specifications for clarifications.

E. Items specifically mentioned in the specifications but not shown on the drawings and/or items shown on the drawings but not specifically mentioned in the specifications shall be installed by the Contractor under the appropriate section of work as if they were both specified and shown.

1.4 QUALITY ASSURANCE

A. All work shall comply with the applicable rules of the following:

1. 2018 International Building Code
2. 2018 International Mechanical Code
3. 2018 International Plumbing Code
4. 2018 International Fire Code
5. 2018 International Energy Conservation Code
6. National Fire Protection Association Codes
7. State Fire Marshall
8. All applicable city, county, state, and federal rules, codes, and ordinances.

B. In any instance where these specifications call for materials for construction of a better quality or larger size than required by the codes, the provisions of these specifications shall take precedence. None of the terms or provisions of this specification shall be construed as waiving any rules, regulations, or requirements of these authorities. The codes shall govern in case of direct conflict between the codes and the Drawings.
1.5 SUPERVISION

A. A competent foreman or superintendent, initially approved by the Architect, shall be assigned to the project to receive instructions and to act for the Contractor. Once this superintendent has been approved, no change shall be made without approval of the Architect. Architect's authorized representative and/or owner's observer shall have the right to observe the work at any time. The Contractor shall have a representative present when his work is being observed, and he shall give assistance, as may be required, to the Architect's representative. Recommendations made by the observer shall be promptly carried out, and all unsatisfactory material and/or workmanship shall be replaced at once, to the satisfaction of the Architect.

1.6 GUARANTEE

A. The Contractor shall guarantee all materials and workmanship for a period of two (2) years after the final acceptance of work.

1.7 UTILITIES

A. The contract documents reflect the general location, size, and elevations of sewer line, location, size and pressure of water and other lines and manner of routing for all utilities known to be required on this project. It shall be the responsibility of the Contractor to visit the site, meet with the local utility companies in order to coordinate and confirm the exact requirements for each utility to provide a complete and operative system. The bid submitted by the Contractor shall include costs for all such utility company charges and/or fees.

1.8 BUILDING CONSTRUCTION AND LAYOUT OF WORK

A. It shall be the responsibility of the Contractor to consult the architectural and engineering drawings and details so as to thoroughly familiarize himself with the type and quality of construction to be provided on this project.

B. The Drawings are diagrammatic in character and cannot show every connection in detail or every pipe and duct in its exact location. These details are subject to the requirements of ordinances and also structural and architectural conditions. The Contractor shall carefully investigate structural and finish conditions and shall coordinate the separate trades in order to avoid interference between the various phases of work. Work shall be laid out so that it will be concealed in furred chases or above suspended ceilings, etc., in finished portions of the building, unless specifically noted or indicated to be exposed. Work shall be installed to avoid crippling of structural members; therefore, inserts to accommodate hangers shall be set before concrete is poured, and proper openings through floor, walls, beams, etc., shall be provided as hereinafter specified or as otherwise indicated or
required before concrete is poured. All work shall be run parallel or perpendicular to the lines of the building unless otherwise noted.

C. The approximate location of each item is indicated on the drawings. These drawings are not intended to give complete and exact details in regard to location. Exact locations are to be determined by actual measurements at the building and will in all cases be subject to the approval of the Architect, and he reserves the right to make any reasonable changes in the locations indicated without additional cost.

1.9 SHOP DRAWINGS AND BROCHURES

A. After the Contract is awarded, but prior to proceeding with the Work, the Contractor shall obtain, check, certify, and submit complete Shop Drawings and Brochures from Manufacturers, Suppliers, Vendors, etc., for all materials and equipment specified herein. Submit Shop Drawings and Brochures in sufficient time so as not to impede the progress of work. At least two weeks will be required for the processing of Shop Drawings and Brochures in the Engineer’s office, exclusive of transmittal time. This time shall be considered by the Contractor when scheduling submittal data.

B. The Engineer’s review of Shop Drawings and Brochures shall not relieve the Contractor of the responsibility for dimensions, errors that may be contained therein, or deviations from Contract Document requirements. It shall be clearly understood that the Engineer’s noting some errors but overlooking others does not grant the Contractor permission to proceed in error. Regardless of any information contained in the Shop Drawings, the requirements of the Contract Documents shall govern and are not waived or superseded in any way by the submittal data review.

C. Each Shop Drawing shall indicate in the lower right hand corner and each Brochure shall indicate on the front cover the following: the Title of the Sheet or Brochure; name and location of the building; names of the Architect, Engineer, Contractor, Manufacturer, Supplier, Vendor, etc., the date of submittal; and the date of each correction and revision. So far as is practical, each Shop Drawing and/or Brochure shall bear a cross-reference note to the sheet number or numbers of the Contract Drawings and/or Specifications showing the same work. Shop Drawings and Brochures shall be prepared as follows:

I. Shop Drawings: Drawings shall be drawn to a scale that can be easily read and shall contain sufficient plans, elevations, sections, and isometrics to describe clearly the items in question. Drawings shall be prepared by skilled technicians experienced in this type of work. All piping, equipment layouts, ductwork and similar Shop Drawings shall be drawn to at least 1/4" = 1'0" scale.
2. Brochures: Brochures shall be published by the Manufacturers and shall contain complete and detailed engineering and dimensional information to show that the equipment will fit into the allotted space. Brochures not compiled in the manner described below shall be returned for resubmittal.

3. Brochures submitted shall contain only information which is relevant to the particular equipment or materials to be furnished. Do not submit catalogs that describe several different items other than those items to be used unless all irrelevant information is marked out or relevant information is clearly marked.

D. The submittal format shall follow the Specifications format with a submittal required for each section of Division 21. Each major category of equipment such as fans or pumps or air devices being submitted under a separate cover letter. The first submittal shall be accompanied by a three-ring hard back binder for the A/E to use in retaining copies of the submittals. Copies of each submittal shall be three-hole punched and arranged (or folded if required) for the A/E's filing convenience. Provide one copy of updated TABLE OF CONTENTS and progressive-tabbed manila index sheets also for the A/E’s filing convenience.

E. Submit Shop Drawings and Brochures for review and approval in accordance with the Division 1 – General Requirements.

F. Minimum size of submittal data shall be 8-1/2” x 11”.

G. Any submittal that is disapproved must be resubmitted within two (2) weeks following notification of such disapproval. If no satisfactory material is submitted within the two-week period, the Architect reserved the right to require the Contractor to furnish items exactly as described in the Contract Documents.

H. No allowances will be made for submittals which are not made in a timely fashion or which are turned down because they are not equal. Should delivery problems arise due to the above, affecting the completion time of the project, the Contractor will furnish and install acceptable alternates until the proper materials arrive and then replace the alternate materials with the approved materials, all at no cost to the Owner. If the Contractor is not able to furnish an acceptable alternate until the proper materials arrive, he will assume all costs for furnishing and installing all alternates as directed by the Architect and/or will pay a suitable penalty for the inconvenience experienced by the Owner. This penalty will be set by the Architect based on the particular circumstances.

1.10 SUBSTITUTIONS

A. The listing of product manufacturers, catalog numbers, etc., in the various sections of the specifications is intended to establish a standard of quality only, and is not intended to preclude open, competitive bidding. The Contractor may at his option
submit substitute materials or methods which he feels are equal or superior to those specified. If the Contractor does submit alternate materials or methods, it shall be understood that the Contractor:

1. Has personally investigated the proposed substitute product and determined that it has all the same accessories and is equal or superior in all respects to the item specified.

2. Will provide the same guarantee for the substitution that he would for that specified.

3. Has coordinated the installation of the equipment which he proposes to substitute with all other trades especially in regard to electrical requirements and to operating weights trades and includes the costs for any changes required for the work to be complete in all respects. The Contractor will prepare shop drawings where required by the Architect or where dimensions vary.

4. Waives any and all claims for additional costs related to the substitution.

1.11 SPARE PARTS DATA

A. As soon as practicable after approval of materials and equipment, and, if possible, not later that one months prior to the date of beneficial occupancy, the Contractor shall furnish spare parts data for each different item of equipment listed. The data shall include a complete list of parts and supplies, with current unit prices and sources of supply; a list of parts and supplies that are either normally furnished at no extra cost with the purchase of the equipment or specified hereinafter to be furnished as part of the contract. The foregoing shall not relieve the Contractor of any responsibilities under the guarantee specified.

1.12 RECORD DRAWINGS

A. The Contractor shall keep a set of Drawings of the job, noting daily all changes made in the Drawings in connection with the final installation including exact dimensioned locations of all new and uncovered existing active and inactive utilities outside the building and shall turn over a clean, neatly marked set of sepias reproducible Drawings showing "as-built" work to the A/E for delivery to the Owner. All underground utilities and services and systems shall be accurately located by the Contractor and dimensioned on the "as-built" Drawings.

1.13 OPERATING AND MAINTENANCE MANUAL

A. Prepare and submit to the Architect for delivery to the Owner an indexed manual with complete technical data for every piece of equipment and material installed under this contract.
1. Complete fire suppression submittals as approved by Architect.

2. Manufacturer's installation instruction brochures.

3. Manufacturer's local representative and/or Distributor's name, address and phone number.

4. Manufacturer's operating and maintenance brochures.

B. This manual shall include all of the listed data bound into a permanent hard-back binder identified on the cover as "Operating and Maintenance Manual" with additional cover display of the names and location of the Building, the Owner, the Architect, the Engineers, the General Contractor, and the Sub-Contractors installing equipment represented in the brochure.

C. Contents of the Manual shall be grouped in sections according to the various sections of Division 21 and shall be listed in a Table of Contents.

PART 2 PRODUCTS

2.1 STANDARDS FOR MATERIALS

A. All materials, in general, shall conform to the requirements of all agencies of publications hereinbefore specified under the paragraph QUALITY ASSURANCE and shall be listed, inspected, and approved by the Underwriters Laboratories and shall bear the U.L. label where labeling service is available. The label or listing of the Underwriters Laboratories, Inc. will be accepted as evidence that the materials or equipment conform to the applicable standards of that agency. In lieu of this listing, the Contractor may submit a statement from a nationally recognized testing agency indicating that the items have been tested in accordance with required procedures, and that the materials and equipment comply with all contract requirements.

2.2 STANDARD PRODUCTS

A. Materials and equipment to be provided shall be the standard catalog products of manufacturers regularly engaged in the manufacture of products conforming to these specifications, and shall essentially duplicate materials and equipment that have been in satisfactory use at least two years.

2.3 MANUFACTURERS INSTRUCTIONS

A. The responsibility for the furnishing of the proper equipment and/or material and the responsibility for seeing that it is installed as intended by the manufacturer, rests entirely upon the Contractor. If needed for proper installation, operation, or
startup, the Contractor shall request advice and supervisory assistance from the representative of the specific manufacturer. The manufacturers’ published instructions shall be followed for preparing, assembling, installing, erecting, and cleaning manufactured materials or equipment, unless otherwise indicated. The Contractor shall promptly notify the Architect in writing of any conflict between the requirements of the contract documents and the manufacturers’ directions and shall obtain the Architect's instructions before proceeding with the work. Should the Contractor perform any such work that does not comply with the manufacturers’ directions or such instructions from the Architect, he shall bear all costs arising in connection with the deficiencies.

2.4 RUST PREVENTION

A. All metallic materials shall be protected against corrosion. Exposed metallic parts of outdoor apparatus made of ferrous metals but not of corrosion-resistant steel, shall be zinc-coated in accordance with ASTM A123 or A153, except where other equivalent protective treatment is specifically approved in writing.

2.5 STORAGE ON SITE

A. The Contractor shall not receive material or equipment at the job site until ready for installation or until there is a suitable space provided to properly protect equipment from rust, weather, humidity, dust, or physical damage.

2.6 CAPACITIES

A. Capacities shall be not less than those indicated and shall be such that no component or system becomes inoperative or is damaged because of startup or other overload conditions.

2.7 NAMEPLATES

A. Each major component of equipment shall have the manufacturer's name, address, and catalog number on a plate securely attached to the item of equipment. All data on nameplates shall be legible at the time of final inspection.

2.8 CONDITION OF MATERIAL AND APPURTENANCES

A. All pipe, fittings, appurtenances, and other material required for complete installation of these systems shall be new to conform to manufacturer's recommendations, unless otherwise specified. All equipment injured or damaged in transit from factory, during delivery to premises, while in storage on premises, while being erected and installed, and while being tested, until time of substantial completion, shall be replaced by the Contractor without extra cost to Owner.
PART 3 EXECUTION

3.1 INSTALLATION OF SYSTEMS

A. Provide and install unions at proper points to permit removal of pipe and various equipment items without injury to other parts of system. No union will be required in welded lines or lines assembled with solder joint fittings, except at equipment items, and other special pieces or apparatus. Companion flanges on lines at various items of equipment, machines and pieces of apparatus, shall serve as unions to permit removal of the particular items. Unions connecting ferrous pipe to copper or brass pipe shall be dielectric type.

3.2 SPACE AND EQUIPMENT ARRANGEMENT

A. All equipment shall be installed in a manner to permit access to parts requiring service without disassembly of other equipment.

B. Any large piece of apparatus which is to be installed in any space in the building, and which is too large to permit access through stairways, doorways, or shafts shall be brought to the job and placed in the space before the enclosing structure is completed. Following placement in the space, such apparatus shall be thoroughly protected against damage.

3.3 PRECEDENCE OF WORK

A. This contract includes many different systems furnished and installed by different trades. Each trade shall coordinate their work with that of all other trades so that it may be installed in the most direct and workmanlike manner without hindering or handicapping any other trades.

3.4 EXCAVATION AND BACKFILL

A. The Contractor shall perform all excavation of every description required in the execution of his work. Excavation shall be through whatever substance encountered, to the depths indicated on the drawings, or as required. Excavated material suitable for backfill shall be piled in an orderly manner a sufficient distance from the trench to prevent overloading sides and causing cave-ins. Excavated materials not suitable for backfill shall be removed or stored as directed. Such grading shall be done as is necessary to protect the excavation from surface water. Trenches shall be maintained in a dry condition by bailing, pumping, or other approved methods. Pipe shall not be laid in wet trenches. Sheeting and shoring shall be provided as required for the protection of the work and the safety of personnel.

B. Trenches shall be of the necessary width and depth to provide for proper laying of pipe and appurtenances, with banks as nearly vertical as possible. Bottoms of
trenches shall be excavated to the grade and depth indicated or required, and barrel of pipe shall be laid on firm and undisturbed soil. Bell holes, of a size to permit proper grading, shall be provided as required. Over-depth excavations shall be backfilled to proper level with sand. When rock or other soil not suitable for bedding the pipe is encountered, it shall be removed to a depth of not less than 1' below grade, and backfilled with sand to grade, to provide a suitable bed for pipe. Existing underground piping shall be protected from damage during excavation and backfilling, and if damaged, shall be repaired to the Architect's satisfaction, at the Contractor's expense.

C. Trenches shall not be backfilled until all required tests have been performed. This requirement does not preclude sectional testing and backfilling of the various systems. Trenches shall be carefully backfilled with a minimum 6" sand cover over piping then backfilled with material (free from large earth clods, rocks, and/or foreign materials), laid in 6" layers, compacted to 90 percent of maximum dry density as determined by ASTM D698 (compaction shall be to 95 percent below structures, including sidewalks and roadways).

D. Open trenches abutting foundation or basement excavations, building walls, and grade beams, will not be permitted, but shall be backfilled and completed, for as distance of not less than 10' from the above features, as soon as possible. All damage resulting from flooding due to open trenches shall be paid for by the Contractor.

E. Where excavation requires, existing walks, street, drives, or other existing pavement shall be cut to install new lines and to make new connections to existing lines. The size of the cut shall be held to a minimum, consistent with the work to be accomplished. After the installation of the new materials is completed and the excavation has been backfilled, the paving shall be patched, using materials to match those cut out. The patches shall be thoroughly bound with the original surfaces, and shall be level with them.

3.5 CUTTING AND PATCHING

A. Where it becomes necessary to cut through any wall, floor, or ceiling to permit installation of any work under this section of the specifications or to repair any defects that may appear, up to the expiration of the guarantee period, such cutting shall be done under the observation of the Architect by the Contractor. The Contractor shall not be permitted to cut or modify any structural members without the written direction of the Architect.

B. Patching of all openings cut by the Contractor, or repairing of any damage to the work of other trades occasioned by the cutting operations, or occasioned by the failure of any part of work installed under this contract, shall be performed by the trade whose work is involved, but shall be paid for by the Contractor.
C. Any openings cut through exterior walls or roofs shall be provided with suitable covers, while they are left open, to protect the property or materials involved. Any openings cut through walls below grade shall be properly protected to prevent entrance of water or other damaging elements.

3.6 HOISTING, SCAFFOLDING, AND TRANSPORTATION

A. The Contractor shall provide his own hoisting facilities to set his materials and equipment in place in the building, as indicated on drawings and for subsequent cleaning, testing, and adjusting.

B. The Contractor shall provide necessary transportation to facilitate the delivery of all materials, equipment, tools, and labor to the job, in accordance with intent of these documents.

3.7 CLEANING

A. The Contractor shall, at all times, keep the premises free from accumulations of waste material or rubbish caused by him, his employees, or his work. This debris shall be removed, not only from the building, but also from the project site.

B. At completion of the job, the Contractor shall remove all of his tools, scaffolding, and surplus materials. He shall leave the area "broom clean."

3.8 ELECTRICAL WIRING OF MOTORS AND EQUIPMENT

A. Unless specifically shown, indicated, or specified to the contrary, each item shown or required by the Mechanical Drawings or specified in the Mechanical Specifications shall be accompanied by all motors and starting and controlling equipment necessary for the items' proper operations. These motors shall be integrally attached to and/or installed with their associated equipment item and electrically connected as specified in Electrical Specifications. Equipment controlled from motor control centers shall be supplied with motors only. Motor control centers are specified in the Electrical Specifications and shown on the Electrical Drawings.

END OF SECTION
210523 - VALVES FOR FIRE SUPPRESSION

PART 1   GENERAL

1.1  WORK INCLUDED

A.  Ball Valves
B.  Check Valves
C.  Butterfly Valves

1.2  RELATED WORK

A.  Section 210500 – Common Work Results For Fire Suppression
B.  Section 211313 - Wet Pipe Sprinkler Systems

1.3  SHOP DRAWINGS

A.  Submit product data in accordance with Section 210500 Common Work results For Fire Suppression.

PART 2   PRODUCTS

2.1  ACCEPTABLE MANUFACTURERS

A.  Valves as manufactured by KITZ, Nibco, Crane, Apollo, Watts or approved equal are acceptable provided they meet or exceed these specifications.
B.  Provide valve types of same manufacturer throughout where possible.
C.  Provide valves with manufacturer's name and pressure rating clearly marked on outside of body.
D.  Provide factory-fabricated valves recommended by manufacturer for use in service indicated. Provide valves of types and pressure ratings indicated; provide proper selection as determined by installer to comply with installation requirements. Provide sizes as indicated, and connections, which properly mate with pipe, tube and equipment connections. Where more than one type is indicated, selection is Installer's option. Valves shall be of same make for all these services.

2.2  VALVE CONNECTIONS

A.  Provide valves suitable for connection to adjoining piping as specified for pipe joints. Use pipe size valves unless otherwise indicated.
B. Provide threaded valves for pipe sizes 2 inches and smaller.
C. Provide flanged valves for pipe sizes 2 1/2 inches and larger.
D. Solder or screw to solder adaptors for copper tubing.
E. Use valve body suitable for mechanical coupling jointed piping.
F. Provide butterfly valves with full tapped lug bodies.

2.3 BALL VALVES
A. Select with full port opening, blow out proof stem, hard chrome plated forged brass vented ball, adjustable packaging nut, rated not less than 600# W.O.G., 150 W.S.P.
B. Comply with the following standards:

Ball Valves: MSS SP - 110
C. Threaded ends 3" and smaller: 600# W.O.G., 150 W.S.P., bronze two piece body, hard chrome plated full port forged brass ball, true adjustable packing nut, blow-out proof stem: Kitz #68, Nibco T-585-70, Apollo 77-100 Series, Watts B-6080 or equal.
D. Solder ends 3" and smaller: 600# W.O.G., 150 W.S.P., bronze two piece body, hard chrome plated full port forged brass ball, true adjustable packing nut, blow-out proof stem: Kitz #68, Nibco T-585-70, Apollo 77-200 Series, Watts B-6081 or equal.

2.4 BUTTERFLY VALVES
A. Where butterfly valves are used as shut-off for termination, or equipment removal or repair, select ductile iron lug type valves, bi-directional, dead-end service rated to the full working pressure of the valve. Provide gear operators on butterfly valves 8" and larger. Valve bodies to have extended necks to provide for 2-1/2" insulation as needed. Butterfly valves 12 inch and smaller rated to 200 psi, 14 inch and larger to 150 psi.
B. Comply with the following standards:

Butterfly Valves: MSS SP - 67
C. Lug type 2" and larger: Ductile iron body, lever operated, 10-position throttling handle 2-6 inch, 8 inch and larger gear operated, bronze disc, type 400 Series
stainless steel stem, EPDM seat. Butterfly valves 12 inch and smaller rated to 200 psi, 14 inch and larger 150 psi.

D. Manufacturer subject to compliance with requirements, provide butterfly valves with one of the following: Kitz #6122E (Lug type), Milwaukee, ML233E (Lug), Nibco LD2000 (Lug) or equal.

2.5 CHECK VALVES

A. Comply with the following standards for design, workmanship, material and testing:

   Bronze Valves: MSS SP - 80
   Cast Iron Valves: MSS SP - 71

B. Construct valves of pressure casting free of any impregnating materials

C. Threaded ends 2" and smaller: Class 125, bronze body, screwed cap, "Y" pattern swing, Teflon disc: Kitz #22T, Nibco T-413Y, Crane 141 or equal.

D. Soldered ends 2" and smaller: Class 125, bronze body, screwed cap, "Y" pattern swing, Teflon disc: Kitz #23T, Nibco T-433Y, Crane 37 or equal.

E. Flanged ends 2-1/2" and larger: Class 125, iron body, bronze mounted, horizontal swing, cast-iron disc: Kitz #78, Nibco F918-B, Crane 373 or equal.

2.6 VALVE FEATURES

A. Provide valves with features indicated and where not otherwise indicated, provide proper valve features as outlined in this specification. Comply with ANSI B31.1.


C. Threaded valve ends comply with ANSI B2.1.

D. Solder Joint valve ends complying with ANSI B16.18.

E. Fabricate pressure-containing components of valves, including stems and seats from brass or bronze materials; of standard alloy recognized in valve manufacturing that resist de-zincification.

F. Butterfly valve designed for flow regulation and manufactured to be tight in closed position. Test pressures in accordance with MSS SP-67 as follows: Seat 2-12" 220 psi. No leakage permitted under test.

2.7 VALVE OPERATORS
A. Provide suitable handwheels for gate, globe and butterfly valves.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install valves with stems upright or horizontal, not inverted.

B. Install ball valves for shut-off and isolating service, to isolate equipment, part of systems, or vertical risers.

C. Install check valves in horizontal position with pin horizontally perpendicular to center line of pipe. Install for proper direction of flow. Installations on any vertical piping must be up flow only.

D. Use U.L. approved butterfly valves in fire protection systems.

E. All valves shall be located so that the bonnets can be removed.

F. Where valves are installed concealed in pipe chases provide Zurn Z-1460-4 or approved equal access doors with concealed hinge and key operated locks. Door shall be large enough to service valves and shall be installed flush with finished walls.

G. Provide brass tag for each valve labeling the fluid in the pipe, the area served, and the normal operating position.

END OF SECTION
PART 1 GENERAL

1.1 WORK INCLUDED
A. Pipe Hangers and Supports

1.2 RELATED WORK
A. Section 210500 – Common Work Results For Fire Suppression
B. Section 211313 - Wet Pipe Sprinkler System

1.3 SUBMITTALS
A. Submit shop drawings in accordance with Section 210500 Common Work Results For Fire Suppression.

1.4 REFERENCES

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS
A. Products shall be as manufactured by Grinnell, Elcen, Fee and Mason, Unistrut or approved equal.

2.2 PIPE HANGERS AND SUPPORTS
A. Hangers: Pipe sizes 1/2 inch to 1-1/2 inch: adjustable wrought steel ring.
B. Hangers: Pipe sizes 2 inches to 4 inches: adjustable wrought steel clevis.
C. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
D. Vertical Support: Steel riser clamp.
E. Steel Beam Clamps: Elcen Figure 33, Type 3 or approved equal.
F. Expansion Anchors: Phillips Red Head or approved equal.
G. Design hangers to impede disengagement by movement of supported pipe.

2.3 HANGER RODS

A. Provide cadmium plated steel hanger rods, threaded both ends, threaded one end, or continuous threaded.

2.4 SLEEVES

A. Pipes through Walls, Fire Proofing, Footings, Potentially Wet Floor: Form with schedule 40 PVC pipe for all non-rated areas. Use black steel pipe for rated areas.

B. Size large enough to allow for movement due to expansion and to provide for continuous installation.

PART 3 EXECUTION

3.1 PIPE HANGERS AND SUPPORTS

A. All structures and appurtenances employed for the purpose of supporting the pipe and guiding it properly shall be carefully fabricated in such a manner as to preserve the true grade of the pipe without subjecting either the pipe or the supporting and guidance members to any undue strain.

B. Support horizontal piping as follows:

C. Space hangers and furnish rods as follows:

<table>
<thead>
<tr>
<th>Nominal Pipe Size (in.)</th>
<th>Span (ft.) Steel</th>
<th>Span (ft.) Copper</th>
<th>Hanger Rod Diameter (in.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/2</td>
<td>5</td>
<td>5</td>
<td>3/8</td>
</tr>
<tr>
<td>3/4</td>
<td>6</td>
<td>6</td>
<td>3/8</td>
</tr>
<tr>
<td>1</td>
<td>7</td>
<td>6</td>
<td>3/8</td>
</tr>
<tr>
<td>1-1/2</td>
<td>9</td>
<td>8</td>
<td>3/8</td>
</tr>
<tr>
<td>2</td>
<td>10</td>
<td>9</td>
<td>3/8</td>
</tr>
<tr>
<td>3</td>
<td>10</td>
<td>10</td>
<td>1/2</td>
</tr>
<tr>
<td>4</td>
<td>10</td>
<td>10</td>
<td>5/8</td>
</tr>
</tbody>
</table>

D. Install hangers to provide minimum 1/2 inch clear space between finished covering and adjacent work.

E. Place a hanger within one foot of each horizontal elbow.
F. Use hangers which are vertically adjustable 1-1/2 inch maximum after piping is erected.

G. Support piping at each change or direction, at ends of branches, at base and top of riser pipes and drops, and wherever necessary to prevent sag, bending or vibration, in addition to above-listed hanger spacing.

3.2 PRIMING

A. Prime coat non-galvanized steel hangers and supports.

3.3 SLEEVES

A. Set sleeves in position in advance of concrete work. Provide suitable reinforcing around sleeves.

B. Extend sleeves through potentially wet floors 1 inch above finished floor level. Caulk sleeves full depth and provide floor plate.

C. Where piping passes through floor, ceiling or wall close off space between pipe or duct and construction with non-combustible insulation. Provide tight fitting metal caps on both sides and caulk.

D. Install chrome plated escutcheons where piping passes through finished surfaces.

E. Provide pipe sleeves for all piping.

F. Size pipe sleeves to permit placing pipe.

G. Sleeves for pipes through floor slabs shall be schedule 40 PVC pipe or black steel pipe.

H. Sleeves for pipe through walls shall be schedule 40 PVC pipe or black steel pipe with ends flush with wall surface.

I. Seal pipes passing through walls or slabs. Use mastic or oakum seal in the annular space in non-fire-rated walls; use Dow-Corning 3-6548 silicone RTV foam firestop sealant or equal in the annular space in fire-rated walls or other envelopes.

J. Seal exposed pipe passing through floor slabs with Dow-corning 3-6548 silicone RTV foam firestop sealant or equal and point with caulking compound. Strike off flush at top of sleeve.

K. Sleeves penetrating exterior walls below grade shall be standard weight, black steel pipe with 1/4" thick steel plate secured to the pipe with a continuous fillet weld. The plate shall be located in the middle of the wall and shall be 4" wider all
around than the sleeve it encircles. The entire assembly shall be hot dipped galvanized after fabrication. The pipe passing through the sleeve shall be centered within the sleeve and the annulus opening sealed with "Link Seal" casing seals manufactured by Thunderline Corporation, Wayne, Michigan. Series 300 for pipe sizes 1/2" through 10" and series 400 or 500 for larger pipe sizes or equal.

L. All piping shall be installed with due regard to expansion and contraction. Type of hanger, methods of support, location of supports, etc., shall be governed in part by this consideration.

END OF SECTION
211313 - WET PIPE SPRINKLER SYSTEMS

PART 1   GENERAL

1.1   RELATED DOCUMENTS

   A. All work performed under this Section of the Specifications shall be in strict accordance with the provisions of the General Conditions and Requirements, and Section 210500 Common Work Results For Fire Suppression.

1.2   WORK INCLUDED

   A. The design and installation of a complete wet pipe automatic sprinkler system including fire riser, exterior and interior water piping, sprinkler heads, valves, hangers and supports, sleeves, Fire Department connections and accessories.

   B. Verification of all design criteria stated within these documents (including but not limited to Hazard Occupancy Classification, Design Density and Availability of Water) prior to bidding. If a conflict is found between the stated design criteria and any governing agency, the contractor shall notify the Architect prior to bidding.

1.3   RELATED WORK

   A. Section 210500 – Common Work Results For Fire Suppression

   B. Section 210523 – Valves For Fire Suppression

   C. Section 210529 – Supports, Anchors and Sleeves For Fire Suppression

1.4   REFERENCE STANDARDS

   A. NFPA No. 13: Sprinkler Systems

   B. NFPA No. 24: Fire Department Connections

   C. Local Fire Code and State Fire Marshal Requirements

1.5   QUALITY ASSURANCE

   A. Sprinkler equipment, design and installation shall meet the requirements, recommendations of the local authority having jurisdiction and the Owner's Insurance Underwriters.

   B. The design, equipment furnished and installation shall meet the requirements of NFPA No. 13, "Standard for the Installation of Sprinkler Systems."
C. Systems shall be tested in accordance with NFPA-13. Test shall be witnessed by Architect and approved in writing prior to activation.

D. The system shall be designed and installed by a firm regularly engaged in the design and installation of automatic fire protection systems, in accordance with the requirements of the National Fire Protection Association, or by an authorized Agent of such firm. Evidence to support the above requirements may be requested, and any proposed installer who cannot show suitable experience will be rejected.

E. Standard Products: Materials and equipment shall be standard products of the manufacturer's latest design, and suitable to perform the functions intended. The name of the manufacturer, and the serial numbers, shall appear on all major components and shall bear the UL or FM label or marking. Equipment added to an existing system shall function in the same manner as similar components of the existing system.

F. Conformance to Agency Standards: Submit evidence of conformance of the entire system to the requirements of NFPA 13 standards, and of the Arizona State Fire Marshal and the Authorities having Jurisdiction. Required changes to meet code, insurance or jurisdictional authority requirements are to be made by the sprinkler contractor at no additional cost to the Owner.

1.6 SUBMITTALS

A. Submit shop drawings in accordance with Section 210500.

B. Fire sprinkler system shop drawings shall be submitted to the Architect prior to any submittals to any AHJ. The Architect's comments shall be incorporated into revised plans as required, shall be revised and resubmitted to the Architect for verification of compliance with design intent, and after Architect approval shall be submitted to the AHJ. If the AHJ makes revisions, the plans shall again be submitted to the Architect for review prior to re-submittal to the AHJ. No installation shall proceed without plans approved by both the Architect and the AHJ.

C. The shop drawings shall include detailed plans of sprinkler systems, calculations, sections and plot plan indicating the locations of underground supply connections, control valves, fire department connections, and other equipment to be used. Submit manufacturer's data on materials and equipment.

1.7 SYSTEM DESCRIPTION

A. System shall provide full coverage for all of the buildings.
B. Provide a complete hydraulically designed system to meet NFPA 13 standards and occupancy requirements and hazard classifications as indicated on the drawings. Contractor shall be responsible for pressure and flow verification with the jurisdiction having authority prior to final design and system installation.

C. The location of equipment and piping mains shall conform as closely as possible to that shown on the plans. Contractor is advised, however, that the information shown on the plans is intended to indicate the general intent and scope of the project for bidding purposes only. Contractor shall use the drawings for reference only during bidding, and shall be fully responsible for the actual final arrangement of piping, head locations, and spacing and other system details as required to conform to the requirements of authorities having jurisdiction. Required changes to meet code, insurance, or jurisdictional authority requirements are to be made by the Sprinkler Contractor at no additional cost to the Owner.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Products manufactured by Automatic Sprinkler, ITT Grinnell, Viking, Central or approved equal meeting these specifications are acceptable.

B. All materials and equipment used in the installation of the fire protection system shall be listed as approved by the underwriters Laboratories, Inc., list of inspected Fire Protection Equipment and Materials, and the Factory Mutual Testing Laboratories list of approved equipment. Fire protection devices and devices involving fire hazard shall be the latest design of the manufacturer.

2.2 SPRINKLER PIPING AND PIPE FITTINGS

A. Piping Systems:

1. Exterior Water Pipe within 5'-0": Pipe shall be as shown on detail on the drawings. Refer to the Civil plans and specifications for piping outside of 5'-0" from building.

2. Interior Water Pipe: Piping, fitting, valves, and installation shall be as specified in NFPA 13.

2.3 SPRINKLER HEADS

A. Unless otherwise specified or indicated on the drawings, sprinkler heads shall be regular automatic closed-type except that sprinkler heads to be installed in the vicinity of heating equipment and lights, shall be of the temperature rating required for such locations by National Fire Protection Association Standard No. 13.
B. In finished or suspended ceiling areas, provide recessed type sprinklers to Gem Model FR948 with chrome plated finish and white escutcheon.

C. In the Mechanical rooms, or exposed areas, provide upright sprinklers equal to Gem Model F950 in bronze finish.

D. For sidewall application, provide sidewall sprinklers equal to Gem F950/Q46 type with chrome plated finish and escutcheon.

2.4 VALVES

A. Provide ball valves, butterfly valves and check valves in accordance with Section 210523.

B. The fire riser shall have a main indicating butterfly valve for shut off control in accordance with Section 210523.

2.5 ALARM DEVICES

A. Riser water flow indicator switch shall be U.L. listed. Potter Model VSR-A or approved equal. Flow switch shall have two sets of contacts.

B. Sprinkler system control valves, riser butterfly valve indicator, and other valves required by NFPA-13 or the local authority shall be furnished with a tamper switch. Tamper switch shall have two sets of contacts.

C. Furnish and install a 6" electric alarm equal to Central Sprinkler Corp.

2.6 SIAMESE FIRE DEPARTMENT CONNECTION

A. Provide two-way standard siamese fire department connection with chrome plated finish and local Fire Department thread. Fire Department Connection shall be marked "Automatic Sprinkler -Fire Department Connection". Fire Department Connection shall be provided with Knox caps. Contact Golder Ranch Fire Department for specific model and approval.

PART 3 EXECUTION

3.1 PREPARATION

A. Coordinate the work of this Section with other affected work. This installation shall not cause interference with that of other trades.

B. All openings for piping should be anticipated and indicated on the approved and accepted shop drawings. Any additional cutting of openings must have the written approval of the Architect/Engineer.
3.2 INSTALLATION

A. Locate the fire department connection with sufficient clearance from walls or obstructions to allow full swing of fire department wrench handle.

B. Place pipe runs to avoid obstruction and interference with other work. Run piping in concealed spaces above finished ceilings. In exposed areas, piping will be kept at a minimum distance from the ceiling.

C. Piping shall allow for drainage at the riser. Trapped areas, if unavoidable, shall be provided with drains as required by NFPA 13.

D. Extend discharge of inspectors test valve, alarm valve and drains to curb or other point to avoid discharge across walks or into occupied areas.

E. Provide signs as required by Code to identify all items.

F. The fire protection system shall be tied into the building fire alarm system if a fire alarm system is required.

G. Support sprinkler piping from building structure with hangers and supports in accordance with NFPA Standard No. 13. All hangers shall be spaced per NFPA No. 13. Furnish and install intermediate steel supports as required. Attach hangers or rods to roof structures with devices compatible with the structural types as approved by architect. Weight of piping and valves must be supported in a manner which does not impose eccentric loads on structural elements.

H. Actual number, spacing and location of heads, size and routes of piping shall be provided in accordance with the applicable Specifications and acceptable Shop Drawings.

I. All layouts, head spacing, coverage, etc., as may be required by the referenced authorities and/or Architectural and Structural conditions, shall be made without increase in cost to the Owner or the Architect. Pay careful attention to NFPA beam rules in laying out heads. Ducts, conduit bundles and other building items fall under the beam rules.

J. Heads shall be located in a symmetrical pattern related to ceiling features such as beams, light fixtures, diffusers, etc., and where applicable, heads shall be located symmetrical with the grid ceiling. Heads shall be centered (both directions) in a 2 x 2 ceiling tile or arranged in a manner acceptable to the Architect prior to installation. Heads protruding below escutcheon are not acceptable. Heads shall be semi-recessed. Carefully coordinate with other trades to avoid conflict with ducts, conduit, lights and structural items.
K. The Contractor shall provide spare heads equal to one percent of the total number of heads installed under the Contract, but not less than 10.

L. The heads shall be packed in a suitable sprinkler cabinet and shall be representative of, and in proportion to, the number of each type and temperature rating of heads installed.

M. In addition to the spare heads, the Contractor shall provide not less than one special sprinkler head-wrench for each type of head. The cabinet shall be located where directed by the Architect, or on the wall near sprinkler valve. One per building.

N. Run piping above furred ceiling and in joists to avoid obstructions. Coordinate with other trades to insure there are no conflicts or interferences.

O. Protect sprinkler heads in exposed areas against mechanical injury with standard guards.

P. Locate outside alarms on the wall of the building above the Fire Department connection.

Q. Fire sprinkler subcontractor shall be responsible for defining the required electrical connection to the Fire Alarm Panel with the electrical subcontractor. Electrical subcontractor will perform electrical installation of conduit and wire. Fire sprinkler subcontractor shall be responsible for coordinating work with the electrical subcontractor.

R. The service line entering the building shall have all joints strapped flange to flange for kickout protection. The building structure shall not be used as a kick block and full clearance through the building wall or floor shall be maintained.

3.3 ACCEPTANCE AND TESTING

A. During the fabrication and assembly of all piping, prior to testing and before connection is made to any equipment, the piping shall be blown with dry, oil-free compressed air to clear the pipe of dirt, welding slag and other materials which may be harmful to sprinkler heads and other equipment.

B. Prior to connecting to the overhead sprinkler piping, the underground main shall be flushed in the presence of the Architect and a representative of the authorities having jurisdiction and meet with their approval.

C. After completion of the installation, the entire system shall be tested by the contractor for acceptance by the authorities having jurisdiction.
D. The contractor shall provide and complete all forms required for testing and acceptance of the system. Copies of these documents shall be provided to the authorities having jurisdiction, the owner and the Architect, in accordance with Section 210500 Common Work Results for Fire Suppression.

END OF SECTION
220500 – COMMON WORK RESULTS FOR PLUMBING

PART 1 GENERAL

1.1 RELATED WORK

A. General Conditions

B. Special Conditions

C. Supplementary General Conditions

D. Architectural, Structural, Civil, Electrical and Mechanical Drawings & Specifications

1.2 SCOPE OF WORK

A. The work covered by the Mechanical and Plumbing Sections of the Specifications shall include the furnishing of all materials, labor, transportation, tools, permits, fees, inspections, utilities and incidentals necessary for the complete installation of all mechanical and plumbing work required in the Contract Drawings.

B. It is the intent of the Contract Documents to provide an installation complete in every respect. In the event that additional details or special construction is required for work indicated or specified in this Section or work specified in other sections, it shall be the responsibility of the Contractor to provide all material and equipment which is usually furnished with such systems in order to complete the installation, whether mentioned or not.

C. The Contractor shall visit the premises and thoroughly familiarize himself with all the details of the work and working conditions and to verify all dimensions in the field. The Contractor shall advise the Architect of any discrepancy prior to bidding. The submission of bids shall be deemed evidence of the Contractor's site visit, the coordination of all existing conditions, and the inclusion of all considerations for existing conditions.

1.3 PLANS AND SPECIFICATIONS

A. These Specifications are accompanied by drawings of the building and details of the installations indicating the locations of equipment, piping, ductwork, outlets, etc. The drawings and these specifications are complementary to each other, and what is required by one shall be as binding as if required by both.

B. If departures from the drawings are deemed necessary by the Contractor, details of such departures and the reasons therefore shall be submitted to the Architect for review. No departures shall be made without prior written acceptance of the Architect.
C. The interrelation of the specifications, the drawings, and the schedules is generally as follows: The specifications determine the nature and setting of the materials, the drawings establish the quantities, dimensions, and details, and the schedules give the performance characteristics.

D. Should the drawings disagree in themselves or with the specifications, the contractor shall immediately notify the architect and shall perform and/or furnish the better quality or greater quantity of work or materials unless otherwise directed by the architect in writing. In case the specifications should not fully agree with the schedules, the latter shall govern. Figures indicated on drawings govern scale measurements and large scale details govern small scale drawings. In case of disagreement between specifications and drawings, see Division I of these specifications for clarifications.

E. Items specifically mentioned in the specifications but not shown on the drawings and/or items shown on the drawings but not specifically mentioned in the specifications shall be installed by the Contractor under the appropriate section of work as if they were both specified and shown.

1.4 QUALITY ASSURANCE

A. All work shall comply with the applicable rules of the following:

1. 2018 International Building Code
2. 2018 International Mechanical Code
3. 2018 International Plumbing Code
4. 2018 International Fire Code
5. 2018 International Energy Conservation Code
6. National Fire Protection Association Codes
7. State Fire Marshall
8. All applicable city, county, state, and federal rules, codes, and ordinances.

B. In any instance where these specifications call for materials for construction of a better quality or larger size than required by the codes, the provisions of these specifications shall take precedence. None of the terms or provisions of this specification shall be construed as waiving any rules, regulations, or requirements of these authorities. The codes shall govern in case of direct conflict between the codes and the Drawings.
1.5 SUPERVISION

A. A competent foreman or superintendent, initially approved by the Architect, shall be assigned to the project to receive instructions and to act for the Contractor. Once this superintendent has been approved, no change shall be made without approval of the Architect. Architect's authorized representative and/or owner's observer shall have the right to observe the work at any time. The Contractor shall have a representative present when his work is being observed, and he shall give assistance, as may be required, to the Architect's representative. Recommendations made by the observer shall be promptly carried out, and all unsatisfactory material and/or workmanship shall be replaced at once, to the satisfaction of the Architect.

1.6 GUARANTEE

A. The Contractor shall guarantee all materials and workmanship for a period of two (2) years after the final acceptance of work.

1.7 UTILITIES

A. The contract documents reflect the general location, size, and elevations of sewer line, location, size and pressure of water and other lines and manner of routing for all utilities known to be required on this project. It shall be the responsibility of the Contractor to visit the site, meet with the local utility companies in order to coordinate and confirm the exact requirements for each utility to provide a complete and operative system. The bid submitted by the Contractor shall include costs for all such utility company charges and/or fees.

1.8 BUILDING CONSTRUCTION AND LAYOUT OF WORK

A. It shall be the responsibility of the Contractor to consult the architectural and engineering drawings and details so as to thoroughly familiarize himself with the type and quality of construction to be provided on this project.

B. The Drawings are diagrammatic in character and cannot show every connection in detail or every pipe and duct in its exact location. These details are subject to the requirements of ordinances and also structural and architectural conditions. The Contractor shall carefully investigate structural and finish conditions and shall coordinate the separate trades in order to avoid interference between the various phases of work. Work shall be laid out so that it will be concealed in furred chases or above suspended ceilings, etc., in finished portions of the building, unless specifically noted or indicated to be exposed. Work shall be installed to avoid crippling of structural members; therefore, inserts to accommodate hangers shall be set before concrete is poured, and proper openings through floor, walls, beams, etc., shall be provided as hereinafter specified or as otherwise indicated or
required before concrete is poured. All work shall be run parallel or perpendicular to the lines of the building unless otherwise noted.

C. The approximate location of each item is indicated on the drawings. These drawings are not intended to give complete and exact details in regard to location. Exact locations are to be determined by actual measurements at the building and will in all cases be subject to the approval of the Architect, and he reserves the right to make any reasonable changes in the locations indicated without additional cost.

1.9 SHOP DRAWINGS AND BROCHURES

A. After the Contract is awarded, but prior to proceeding with the Work, the Contractor shall obtain, check, certify, and submit complete Shop Drawings and Brochures from Manufacturers, Suppliers, Vendors, etc., for all materials and equipment specified herein. Submit Shop Drawings and Brochures in sufficient time so as not to impede the progress of work. At least two weeks will be required for the processing of Shop Drawings and Brochures in the Engineer’s office, exclusive of transmittal time. This time shall be considered by the Contractor when scheduling submittal data.

B. The Engineer’s review of Shop Drawings and Brochures shall not relieve the Contractor of the responsibility for dimensions, errors that may be contained therein, or deviations from Contract Document requirements. It shall be clearly understood that the Engineer’s noting some errors but overlooking others does not grant the Contractor permission to proceed in error. Regardless of any information contained in the Shop Drawings, the requirements of the Contract Documents shall govern and are not waived or superseded in any way by the submittal data review.

C. Each Shop Drawing shall indicate in the lower right hand corner and each Brochure shall indicate on the front cover the following: the Title of the Sheet or Brochure; name and location of the building; names of the Architect, Engineer, Contractor, Manufacturer, Supplier, Vendor, etc., the date of submittal; and the date of each correction and revision. So far as is practical, each Shop Drawing and/or Brochure shall bear a cross-reference note to the sheet number or numbers of the Contract Drawings and/or Specifications showing the same work. Shop Drawings and Brochures shall be prepared as follows:

I. Shop Drawings: Drawings shall be drawn to a scale that can be easily read and shall contain sufficient plans, elevations, sections, and isometrics to describe clearly the items in question. Drawings shall be prepared by skilled technicians experienced in this type of work. All piping, equipment layouts, ductwork and similar Shop Drawings shall be drawn to at least 1/4" = 1’0” scale.
2. Brochures: Brochures shall be published by the Manufacturers and shall contain complete and detailed engineering and dimensional information to show that the equipment will fit into the allotted space. Brochures not compiled in the manner described below shall be returned for resubmittal.

3. Brochures submitted shall contain only information which is relevant to the particular equipment or materials to be furnished. Do not submit catalogs that describe several different items other than those items to be used unless all irrelevant information is marked out or relevant information is clearly marked.

D. The submittal format shall follow the Specifications format with a submittal required for each section of Division 22. Each major category of equipment such as plumbing fixtures, pipe, etc. shall be submitted under a separate cover letter. The first submittal shall be accompanied by a three-ring hard back binder for the A/E to use in retaining copies of the submittals. Copies of each submittal shall be three-hole punched and arranged (or folded if required) for the A/E’s filing convenience. Provide one copy of updated TABLE OF CONTENTS and progressive-tabbed manila index sheets also for the A/E’s filing convenience.

E. Submit all Shop Drawings and Brochures for review and approval in accordance with Division 1 – General Requirements.

F. Minimum size of submittal data shall be 8-1/2” x 11”.

G. Any submittal that is disapproved must be resubmitted within two (2) weeks following notification of such disapproval. If no satisfactory material is submitted within the two-week period, the Architect reserved the right to require the Contractor to furnish items exactly as described in the Contract Documents.

H. No allowances will be made for submittals which are not made in a timely fashion or which are turned down because they are not equal. Should delivery problems arise due to the above, affecting the completion time of the project, the Contractor will furnish and install acceptable alternates until the proper materials arrive and then replace the alternate materials with the approved materials, all at no cost to the Owner. If the Contractor is not able to furnish an acceptable alternate until the proper materials arrive, he will assume all costs for furnishing and installing all alternates as directed by the Architect and/or will pay a suitable penalty for the inconvenience experienced by the Owner. This penalty will be set by the Architect based on the particular circumstances.

1.10 SUBSTITUTIONS

A. The listing of product manufacturers, catalog numbers, etc., in the various sections of the specifications is intended to establish a standard of quality only, and is not intended to preclude open, competitive bidding. The Contractor may at his option
submit substitute materials or methods which he feels are equal or superior to those specified. If the Contractor does submit alternate materials or methods, it shall be understood that the Contractor:

1. Has personally investigated the proposed substitute product and determined that it has all the same accessories and is equal or superior in all respects to the item specified.

2. Will provide the same guarantee for the substitution that he would for that specified.

3. Has coordinated the installation of the equipment which he proposes to substitute with all other trades especially in regard to electrical requirements and to operating weights trades and includes the costs for any changes required for the work to be complete in all respects. The Contractor will prepare shop drawings where required by the Architect or where dimensions vary.

4. Waives any and all claims for additional costs related to the substitution.

1.11 SPARE PARTS DATA

A. As soon as practicable after approval of materials and equipment, and, if possible, not later than one month prior to the date of beneficial occupancy, the Contractor shall furnish spare parts data for each different item of equipment listed. The data shall include a complete list of parts and supplies, with current unit prices and sources of supply; a list of parts and supplies that are either normally furnished at no extra cost with the purchase of the equipment or specified hereinafter to be furnished as part of the contract. The foregoing shall not relieve the Contractor of any responsibilities under the guarantee specified.

1.12 RECORD DRAWINGS

A. The Contractor shall keep a set of Drawings of the job, noting daily all changes made in the Drawings in connection with the final installation including exact dimensioned locations of all new and uncovered existing active and inactive utilities outside the building and shall turn over a clean, neatly marked set of sepias reproducible Drawings showing "as-built" work to the A/E for delivery to the Owner. All underground utilities and services and systems shall be accurately located by the Contractor and dimensioned on the "as-built" Drawings.

1.13 OPERATING AND MAINTENANCE MANUAL

A. Prepare and submit to the Architect for delivery to the Owner an indexed manual with complete technical data for every piece of equipment and material installed under this contract.
1. Complete submittals as approved by Architect.

2. Manufacturer’s installation instruction brochures.

3. Manufacturer’s local representative and/or Distributor’s name, address and phone number.

4. Manufacturer’s operating and maintenance brochures.

5. Replacement part number listings and/or descriptions.


7. Valve tag list.

B. This manual shall include all of the listed data bound into a permanent hard-back binder identified on the cover as "Operating and Maintenance Manual" with additional cover display of the names and location of the Building, the Owner, the Architect, the Engineers, the General Contractor, and the Sub-Contractors installing equipment represented in the brochure.

C. Contents of the Manual shall be grouped in sections according to the various sections of the specifications and shall be listed in a Table of Contents.

PART 2 PRODUCTS

2.1 STANDARDS FOR MATERIALS

A. All materials, in general, shall conform to the requirements of all agencies of publications hereinbefore specified under the paragraph QUALITY ASSURANCE and shall be listed, inspected, and approved by the Underwriters Laboratories and shall bear the U.L. label where labeling service is available. The label or listing of the Underwriters Laboratories, Inc. will be accepted as evidence that the materials or equipment conform to the applicable standards of that agency. In lieu of this listing, the Contractor may submit a statement from a nationally recognized testing agency indicating that the items have been tested in accordance with required procedures, and that the materials and equipment comply with all contract requirements.

2.2 STANDARD PRODUCTS

A. Materials and equipment to be provided shall be the standard catalog products of manufacturers regularly engaged in the manufacture of products conforming to these specifications, and shall essentially duplicate materials and equipment that have been in satisfactory use at least two years.
2.3 MANUFACTURERS INSTRUCTIONS

A. The responsibility for the furnishing of the proper equipment and/or material and the responsibility for seeing that it is installed as intended by the manufacturer, rests entirely upon the Contractor. If needed for proper installation, operation, or startup, the Contractor shall request advice and supervisory assistance from the representative of the specific manufacturer. The manufacturers’ published instructions shall be followed for preparing, assembling, installing, erecting, and cleaning manufactured materials or equipment, unless otherwise indicated. The Contractor shall promptly notify the Architect in writing of any conflict between the requirements of the contract documents and the manufacturers’ directions and shall obtain the Architect's instructions before proceeding with the work. Should the Contractor perform any such work that does not comply with the manufacturers’ directions or such instructions from the Architect, he shall bear all costs arising in connection with the deficiencies.

2.4 RUST PREVENTION

A. All metallic materials shall be protected against corrosion. Exposed metallic parts of outdoor apparatus made of ferrous metals but not of corrosion-resistant steel, shall be zinc-coated in accordance with ASTM A123 or A153, except where other equivalent protective treatment is specifically approved in writing.

2.5 STORAGE ON SITE

A. The Contractor shall not receive material or equipment at the job site until ready for installation or until there is a suitable space provided to properly protect equipment from rust, weather, humidity, dust, or physical damage.

2.6 CAPACITIES

A. Capacities shall be not less than those indicated and shall be such that no component or system becomes inoperative or is damaged because of startup or other overload conditions.

2.7 NAMEPLATES

A. Each major component of equipment shall have the manufacturer's name, address, and catalog number on a plate securely attached to the item of equipment. All data on nameplates shall be legible at the time of final inspection.

2.8 CONDITION OF MATERIAL AND APPURTENANCES

A. All pipe, fittings, appurtenances, and other material required for complete installation of these systems shall be new to conform to manufacturer's recommendations, unless otherwise specified. All equipment injured or damaged
in transit from factory, during delivery to premises, while in storage on premises, while being erected and installed, and while being tested, until time of substantial completion, shall be replaced by the Contractor without extra cost to Owner.

PART 3 EXECUTION

3.1 INSTALLATION OF SYSTEMS

A. Provide and install unions at proper points to permit removal of pipe and various equipment and machinery items without injury to other parts of system. No union will be required in welded lines or lines assembled with solder joint fittings, except at equipment items, machinery items, and other special pieces or apparatus. Companion flanges on lines at various items of equipment, machines and pieces of apparatus, shall serve as unions to permit removal of the particular items. Unions connecting ferrous pipe to copper or brass pipe shall be dielectric type.

3.2 SPACE AND EQUIPMENT ARRANGEMENT

A. All equipment shall be installed in a manner to permit access to parts requiring service without disassembly of other equipment.

B. Any large piece of apparatus which is to be installed in any space in the building, and which is too large to permit access through stairways, doorways, or shafts shall be brought to the job and placed in the space before the enclosing structure is completed. Following placement in the space, such apparatus shall be thoroughly protected against damage.

3.3 PRECEDENCE OF WORK

A. This contract includes many different systems furnished and installed by different trades. Each trade shall coordinate their work with that of all other trades so that it may be installed in the most direct and workmanlike manner without hindering or handicapping any other trades.

3.4 EXCAVATION AND BACKFILL

A. The Contractor shall perform all excavation of every description required in the execution of his work. Excavation shall be through whatever substance encountered, to the depths indicated on the drawings, or as required. Excavated material suitable for backfill shall be piled in an orderly manner a sufficient distance from the trench to prevent overloading sides and causing cave-ins. Excavated materials not suitable for backfill shall be removed or stored as directed. Such grading shall be done as is necessary to protect the excavation from surface water. Trenches shall be maintained in a dry condition by bailing, pumping, or other approved methods. Pipe shall not be laid in wet trenches. Sheeting and
shoring shall be provided as required for the protection of the work and the safety of personnel.

B. Trenches shall be of the necessary width and depth to provide for proper laying of pipe and appurtenances, with banks as nearly vertical as possible. Bottoms of trenches shall be excavated to the grade and depth indicated or required, and barrel of pipe shall be laid on firm and undisturbed soil. Bell holes, of a size to permit proper grading, shall be provided as required. Over-depth excavations shall be backfilled to proper level with sand. When rock or other soil not suitable for bedding the pipe is encountered, it shall be removed to a depth of not less than 1' below grade, and backfilled with sand to grade, to provide a suitable bed for pipe. Existing underground piping shall be protected from damage during excavation and backfilling, and if damaged, shall be repaired to the Architect’s satisfaction, at the Contractor’s expense.

C. Trenches shall not be backfilled until all required tests have been performed. This requirement does not preclude sectional testing and backfilling of the various systems. Trenches shall be carefully backfilled with a minimum 6" sand cover over piping then backfilled with material (free from large earth clods, rocks, and/or foreign materials), laid in 6" layers, compacted to 90 percent of maximum dry density as determined by ASTM D698 (compaction shall be to 95 percent below structures, including sidewalks and roadways).

D. Open trenches abutting foundation or basement excavations, building walls, and grade beams, will not be permitted, but shall be backfilled and completed, for a distance of not less than 10' from the above features, as soon as possible. All damage resulting from flooding due to open trenches shall be paid for by the Contractor.

E. Where excavation requires, existing walks, street, drives, or other existing pavement shall be cut to install new lines and to make new connections to existing lines. The size of the cut shall be held to a minimum, consistent with the work to be accomplished. After the installation of the new materials is completed and the excavation has been backfilled, the paving shall be patched, using materials to match those cut out. The patches shall be thoroughly bound with the original surfaces, and shall be level with them.

3.5 CUTTING AND PATCHING

A. Where it becomes necessary to cut through any wall, floor, or ceiling to permit installation of any work under this section of the specifications or to repair any defects that may appear, up to the expiration of the guarantee period, such cutting shall be done under the observation of the Architect by the Contractor. The Contractor shall not be permitted to cut or modify any structural members without the written direction of the Architect.
B. Patching of all openings cut by the Contractor, or repairing of any damage to the work of other trades occasioned by the cutting operations, or occasioned by the failure of any part of work installed under this contract, shall be performed by the trade whose work is involved, but shall be paid for by the Contractor.

C. Any openings cut through exterior walls or roofs shall be provided with suitable covers, while they are left open, to protect the property or materials involved. Any openings cut through walls below grade shall be properly protected to prevent entrance of water or other damaging elements.

3.6 HOISTING, SCAFFOLDING, AND TRANSPORTATION

A. The Contractor shall provide his own hoisting facilities to set his materials and equipment in place in the building, as indicated on drawings and for subsequent cleaning, testing, and adjusting.

B. The Contractor shall provide necessary transportation to facilitate the delivery of all materials, equipment, tools, and labor to the job, in accordance with intent of these documents.

3.7 CLEANING

A. The Contractor shall, at all times, keep the premises free from accumulations of waste material or rubbish caused by him, his employees, or his work. This debris shall be removed, not only from the building, but also from the project site.

B. At completion of the job, the Contractor shall remove all of his tools, scaffolding, and surplus materials. He shall leave the area "broom clean."

3.8 ELECTRICAL WIRING OF MOTORS AND EQUIPMENT

A. Unless specifically shown, indicated, or specified to the contrary, each item shown or required by the Mechanical Drawings or specified in the Mechanical Specifications shall be accompanied by all motors and starting and controlling equipment necessary for the items' proper operations. These motors shall be integrally attached to and/or installed with their associated equipment item and electrically connected as specified in Division 16 - Electrical. Equipment controlled from motor control centers shall be supplied with motors only. Motor control centers are specified in the Electrical Specifications and shown on the Electrical Drawings.

END OF SECTION
PART 1   GENERAL

1.1  WORK INCLUDED

A.  Ball Valves
B.  Check Valves
C.  Balancing Valves

1.2  RELATED WORK

A.  Section 220500 – Common Work Results For Plumbing
B.  Section 221100 – Plumbing Piping

1.3  SHOP DRAWINGS

A.  Submit product data in accordance with Section 220500 Common Work Results for Plumbing.

PART 2   PRODUCTS

2.1  ACCEPTABLE MANUFACTURERS

A.  Valves as manufactured by KITZ, Nibco, Crane, Apollo, Watts or approved equal are acceptable provided they meet or exceed these specifications.
B.  Provide valve types of same manufacturer throughout where possible.
C.  Provide valves with manufacturer’s name and pressure rating clearly marked on outside of body.
D.  Provide factory-fabricated valves recommended by manufacturer for use in service indicated. Provide valves of types and pressure ratings indicated; provide proper selection as determined by installer to comply with installation requirements. Provide sizes as indicated, and connections, which properly mate with pipe, tube and equipment connections. Where more than one type is indicated, selection is Installer's option. Valves shall be of same make for all these services.

2.2  VALVE CONNECTIONS

A.  Provide valves suitable for connection to adjoining piping as specified for pipe joints. Use pipe size valves unless otherwise indicated.
B. Provide threaded valves for pipe sizes 2 inches and smaller.

C. Provide flanged valves for pipe sizes 2 1/2 inches and larger.

D. Solder or screw to solder adaptors for copper tubing.

2.3 BALL VALVES

A. Select with full port opening, blow out proof stem, hard chrome plated forged brass vented ball, adjustable packaging nut, rated not less than 600# W.O.G., 150 W.S.P.

B. Comply with the following standards:

Ball Valves: MSS SP - 110

C. Domestic Water Service

1. Threaded ends 3" and smaller: 600# W.O.G., 150 W.S.P., bronze two piece body, hard chrome plated full port forged brass ball, true adjustable packing nut, blow-out proof stem: Kitz #68, Nibco T-585-70, Apollo 77-100 Series, Watts 6080 or equal.

2. Solder ends 3" and smaller: 600# W.O.G., 150 W.S.P., bronze two piece body, hard chrome plated full port forged brass ball, true adjustable packing nut, blow-out proof stem: Kitz #69, Nibco T-585-70, Apollo 77-200 Series, Watts B-6081 or equal.

D. Natural Gas Service

1. Threaded ends 2" and smaller: 175# W.O.G., bronze two piece body, hard chrome plated full port forged brass ball, true adjustable packing nut, blow-out proof stem, U.L. listed for natural gas service: Kitz #60, Nibco GB, Watts GBV or equal.

2.4 SWING CHECK VALVES

A. Comply with the following standards for design, workmanship, material and testing:

Bronze Valves: MSS SP - 80
Cast Iron Valves: MSS SP - 71

B. Construct valves of pressure casting free of any impregnating materials
C. Threaded ends 2" and smaller: Class 125, bronze body, screwed cap, "Y" pattern swing, bronze disc: Kitz #22, Nibco T-413B, Crane 37 or equal.

D. Soldered ends 2" and smaller: Class 125, bronze body, screwed cap, "Y" pattern swing, bronze disc: Kitz #23, Nibco T-413B, Crane 1342 or equal.

E. Flanged ends 2-1/2" and larger: Class 125, iron body, bronze mounted, horizontal swing, cast-iron disc: Kitz #78, Nibco F918-B, Crane 373 or equal.

2.5 BALANCING VALVES

A. Manual Balance Valve: Furnish and install as shown on plans, a calibrated (bronze with bronze disc) balance valve equipped with readout valves to facilitate the connecting of a differential pressure meter. Each readout valve shall be fitted with an integral check valve designed to minimize system fluid loss during the monitoring process. The balancing valve shall have an indexing pointer and calibrated nameplate to indicate the degree of closure of the precision machined orifice. Each balancing valve is to be constructed with internal O-ring seals to prevent leakage around the rotating element.

2.6 VALVE FEATURES

A. Provide valves with features indicated and where not otherwise indicated, provide proper valve features as outlined in this specification. Comply with ANSI B31.1.


C. Threaded valve ends comply with ANSI B2.1.

D. Solder Joint valve ends complying with ANSI B16.18.

E. Fabricate pressure-containing components of valves, including stems and seats from brass or bronze materials; of standard alloy recognized in valve manufacturing that resist de-zincification.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install valves with stems upright or horizontal, not inverted.

B. Install ball valves for shut-off and isolating service, to isolate equipment, part of systems, or vertical risers.
C. Install check valves in horizontal position with pin horizontally perpendicular to center line of pipe. Install for proper direction of flow. Installations on any vertical piping must be up flow only.

D. Valves used for natural gas shall be listed for such use.

E. All valves shall be located so that the bonnets can be removed.

F. Where valves are installed concealed in pipe chases provide Zurn Z-1460-4 access doors with concealed hinge and key operated locks. Door shall be large enough to service valves and shall be installed flush with finished ceilings or walls.

G. Provide brass tag for each valve labeling the fluid in the pipe, the area served, and the normal operating position.

END OF SECTION
220529 - SUPPORTS, ANCHORS AND SLEEVES FOR PLUMBING

PART 1 GENERAL

1.1 WORK INCLUDED
   A. Pipe Hangers and Supports

1.2 RELATED WORK
   A. Section 220500 – Common Work Results For Plumbing
   B. Section 221100 – Plumbing Piping

1.3 SUBMITTALS
   A. Submit shop drawings in accordance with Section 220500 Common Work Results For Plumbing.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS
   A. Products shall be as manufactured by Grinnell, Elcen, Fee and Mason, Unistrut or approved equal.

2.2 PIPE HANGERS AND SUPPORTS
   A. Hangers: Pipe sizes 1/2 inch to 1-1/2 inch: adjustable wrought steel ring.
   B. Hangers: Pipe sizes 2 inches to 4 inches: adjustable wrought steel clevis.
   C. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
   D. Steel Beam Clamps: Elcen Figure 33, Type 3 or approved equal.
   E. Design hangers to impede disengagement by movement of supported pipe.
   F. Provide copper plated hangers and supports for copper piping or two layers Scotch 33 PVC tape or equal.

2.3 HANGER RODS
   A. Provide cadmium plated steel hanger rods, threaded both ends, threaded one end, or continuous threaded.
2.4 SLEEVES

A. Pipes through Walls, Fire Proofing, Footings, Potentially Wet Floor: Form with schedule 40 PVC pipe.

B. Size large enough to allow for movement due to expansion and to provide for continuous installation.

PART 3 EXECUTION

3.1 PIPE HANGERS AND SUPPORTS

A. All structures and appurtenances employed for the purpose of supporting the pipe and guiding it properly shall be carefully fabricated in such a manner as to preserve the true grade of the pipe without subjecting either the pipe or the supporting and guidance members to any undue strain.

B. Support horizontal piping as follows:

C. Space hangers and furnish rods as follows:

<table>
<thead>
<tr>
<th>Nominal Pipe Size (in.)</th>
<th>Span (ft.)</th>
<th>Hanger Rod Diameter (in.)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Steel</td>
<td>Copper</td>
</tr>
<tr>
<td>1/2</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>3/4</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>1</td>
<td>7</td>
<td>6</td>
</tr>
<tr>
<td>1-1/2</td>
<td>9</td>
<td>8</td>
</tr>
<tr>
<td>2</td>
<td>10</td>
<td>9</td>
</tr>
<tr>
<td>3</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>4</td>
<td>10</td>
<td>10</td>
</tr>
</tbody>
</table>

D. Install hangers to provide minimum 1/2 inch clear space between finished covering and adjacent work.

E. Place a hanger within one foot of each horizontal elbow.

F. Use hangers which are vertically adjustable 1-1/2 inch maximum after piping is erected.

G. Support piping at each change or direction, at ends of branches, at base and top of riser pipes and drops, and wherever necessary to prevent sag, bending or vibration, in addition to above-listed hanger spacing.
H. Pipe hangers on insulated lines shall be sized to fit the outside of the insulation.

I. Where several pipes can be installed in parallel and at the same elevation, provide multiple or trapeze hangers, designed to support loads per ANSI B31.1.

J. Where practical, support riser piping independently of connected horizontal piping.

3.2 EQUIPMENT BASES AND SUPPORTS

A. Provide for major equipment minimum four inch thick reinforced concrete house-keeping bases poured directly on structural floor slab pinned in place and extended 6 inches minimum beyond machinery bedplates. Provide templates, anchor bolts and accessories required for mounting and anchoring equipment. Coordinate with other trades.

B. Construct supports of structural steel members or steel pipe and fittings. Brace and fasten with flanges bolted to structure.

3.3 SLEEVES

A. Set sleeves in position in advance of concrete work. Provide suitable reinforcing around sleeves.

B. Extend sleeves through potentially wet floors 1 inch above finished floor level. Caulk sleeves full depth and provide floor plate.

C. Where piping passes through floor, ceiling or wall close off space between pipe or duct and construction with non-combustible insulation. Provide tight fitting metal caps on both sides and caulk.

D. Install chrome plated escutcheons where piping passes through finished surfaces.

E. Size pipe sleeves to permit placing pipe and specified insulation material for pipes passing through concrete or masonry walls or concrete slabs.

F. Sleeves for pipes through floor slabs shall be schedule 40 PVC pipe with top of sleeve projecting 2 inches above finished floor. For waterproof sleeves.

G. Sleeves for pipe through walls shall be schedule 40 PVC with ends flush with wall surface.

H. Seal pipes passing through walls or slabs. Use mastic or oakum seal in the annular space in non-fire-rated walls; use Dow-Corning 3-6548 silicone RTV foam firestop sealant or equal in the annular space in fire-rated walls or other envelopes.
I. Seal exposed pipe passing through floor slabs with Dow-corning 3-6548 silicone RTV foam firestop sealant or equal and point with caulking compound. Strike off flush at top of sleeve.

J. Insulated pipe shall be insulated in sleeves, caulked and pointed as above.

K. Sleeves penetrating exterior walls below grade shall be standard weight, black steel pipe with 1/4" thick steel plate secured to the pipe with a continuous fillet weld. The plate shall be located in the middle of the wall and shall be 4" wider all around than the sleeve it encircles. The entire assembly shall be hot dipped galvanized after fabrication. The pipe passing through the sleeve shall be centered within the sleeve and the annulus opening sealed with "Link Seal" casing seals manufactured by Thunderline Corporation, Wayne, Michigan. Series 300 for pipe sizes 1/2" through 10" and series 400 or 500 for larger pipe sizes or equal.

L. Pipe sleeves, pitch pockets, and flashings compatible with the roofing installation shall be provided for roof penetrations.

M. All piping shall be installed with due regard to expansion and contraction. Type of hanger, methods of support, location of supports, etc., shall be governed in part by this consideration.

END OF SECTION
220700 - PLUMBING INSULATION

PART 1   GENERAL

1.1 WORK INCLUDED

A. Insulation of Condensate Drain Piping

B. Insulation of Domestic Hot Water Piping

1.2 RELATED WORK

A. Section 220500 – Common Work Results For Plumbing

B. Section 221116 – Plumbing Piping

1.3 QUALITY ASSURANCE

A. All insulation materials required for piping, and mechanical equipment, etc. shall be furnished and installed under this contract. The execution of the work shall be by approved insulation contractor in strict accordance with the best practice of the trade and the intent of this Specification.

B. It is mandatory that all insulation be applied in a neat and workmanlike manner. Contractor shall be required to remove and replace all insulation not applied in strict accordance with manufacturer's specifications or not presenting a neat finished appearance.

C. All insulation on indoor work shall have composite (insulation, jacket or facing, and adhesive used to adhere jacket or facing to the insulation) fire and smoke hazard Ratings, as tested by procedure ASTM E-84, NFPA 255 and UL 73 not exceeding Flame Spread of 25, Fuel Contributed of 50 and Smoke Developed of 50. Accessories, such as adhesives, mastics, cements, tapes and cloths for fittings shall have component ratings as listed above.

D. Insulation shall be continuous through wall, floor and ceiling openings, hangers and sleeves.

E. Specified mastics, adhesives and coatings shall be applied in strict accordance with manufacturer's instructions, including recommended coverages.

1.4 SUBMITTALS

A. Submit materials and installation instructions in accordance with Section 220500.
PART 2   PRODUCTS

2.1   ACCEPTABLE MANUFACTURERS

A. Products manufactured by Owens-Corning, Knauf, Johns Manville, Certain-Teed, Govain, Benjamin Foster are acceptable provided they meet or exceed these specifications.

2.2   PIPING

A. Piping:

1. Insulation thickness - Fiberglass pipe covering.

<table>
<thead>
<tr>
<th>PIPING TYPE</th>
<th>PIPE SIZE</th>
<th>INSULATION SIZE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Domestic Hot Water Supply &amp; Return</td>
<td>1-1/4&quot; &amp; under</td>
<td>1&quot;</td>
</tr>
<tr>
<td></td>
<td>1-1/2&quot; &amp; up</td>
<td>1-1/2&quot;</td>
</tr>
<tr>
<td>Condensate</td>
<td>all sizes</td>
<td>1/2&quot;</td>
</tr>
</tbody>
</table>

2. All fiberglass pipe insulation shall be nominal 5 pcf density.

3. Insulation jacket shall be factory applied white All Service Jacket (ASJ), with factory supplied self-sealing laps.

4. Condensate piping may be insulated with 1/2" thick expanded rubber insulation at the contractor's option.

5. Fittings, Valves and Flanges:

a. Where manufactured, factory premolded fittings (of the same material and thickness as the pipe insulation) shall be used for all fittings, flanges and valves.

b. Where premolded insulation fittings are not manufactured, all fittings, flanges and valves shall be insulated with mitered segments of nominal 5 lb. density fiberglass pipe covering. Hot Service Finish: embed a 20 x 20 weave white glass reinforcing cloth between two 1/16 inch coats of Benjamin Foster 30-36. The glass cloth and second coat shall overlap adjacent covering by at least two inches. Cold Service Finish: same as above except use Benjamin Foster 30-35.

c. Insulation for removable flanges of pipe strainers shall be fabricated with built-up sections of Fiberglass pipe covering, so arranged as to
facilitate servicing of the strainer. Applications for cold services shall be complete with vapor seals.

6. Insulation on pipes shall be protected by saddles from hangers, guides, and rollers.

PART 3 EXECUTION

3.1 PREPARATION

A. Do not install covering before piping and equipment has been tested and approved.

B. Ensure surface is clean and dry prior to installation. Ensure insulation is dry before and during application.

3.2 INSTALLATION

A. Ensure insulation is continuous through inside walls, supports, etc. Pack around pipes with fire proof self-supporting insulation material, fully sealed.

B. Provide a minimum 12” long, high density insulation insert such as calcium silicate or its equivalent at each support. Insert shall be the same thickness as adjacent piping.

C. Insulate fittings and valves. Do not insulate unions, flanges, strainers, flexible connections and expansion joints. Terminate insulation neatly with plastic material troweled on bevel.

D. Locate insulation cover seams in least visible locations.

E. Hot Piping: Cover fittings and valves with equivalent thickness of insulation material. For exposed fittings and valves apply hydraulic setting cement paste over insulating material before applying canvas jacket.

F. Repair separation of joints or cracking of insulation due to thermal movement or poor workmanship.

END OF SECTION
PART 1 GENERAL

1.1 WORK INCLUDED

A. Sanitary Sewer Piping System
B. Domestic Water Piping System
C. Condensate Piping System
D. Natural Gas Piping System

1.2 RELATED WORK

A. Section 220000 – Common Work Results For Plumbing
B. Section 220523 – Valves For Plumbing
C. Section 220529 – Supports, Anchors and Sleeves For Plumbing
D. Section 220640 – Plumbing Fixtures
E. Section 220719 – Plumbing Piping Insulation
F. Section 221119 – Plumbing Specialties

1.3 REFERENCES

A. ANSI/ASME B16.23 - Cast Copper Alloy Solder Joint Drainage Fittings - DWV.
B. ANSI/ASME B16.29 - Wrought Copper and Wrought Copper Alloy Solder. Joint Drainage Fittings - DWV.
C. ANSI/ASME Sec. 9 - Welding and Brazing Qualifications.
D. ANSI/ASTM B32 - Solder Metal.
E. ASTM B88 - Seamless Copper Water Tube.
F. ASTM B306 - Copper Drainage Tube (DWV).
G. AWS 5.8 - Brazing Filler Metal.
1.4 QUALITY ASSURANCE

A. Valves: Manufacturer's name and pressure rating marked on valve body.

1.5 SUBMITTALS

A. Submit product data in accordance with Section 220500.

B. Include data on pipe materials, pipe fittings, and accessories.

PART 2 PRODUCTS

2.1 SANITARY SEWER PIPING, BURIED WITHIN 5 FEET OF BUILDING

A. Pipe: PVC Schedule 40 DWV Pipe; ASTM D 2665. Fittings: PVC Joints; ASTM D 2665, solvent weld

2.2 SANITARY SEWER PIPING, ABOVE GRADE


2.3 WATER PIPING, BURIED WITHIN 5 FEET OF BUILDING

A. Copper Tubing: ASTM B88, Type K, annealed. Fittings: NONE. Joints: NONE.


2.4 WATER PIPING, ABOVE GRADE


2.5 CONDENSATE PIPING, ABOVE GRADE


2.6 NATURAL GAS PIPING, ABOVE GRADE

2.7 FLANGES, UNIONS, AND COUPLINGS

A. Pipe Size 2 Inches and Under: 150 psig malleable iron unions for threaded ferrous piping; bronze unions for copper pipe, soldered joints.

B. Pipe Size Over 2 Inches: 150 psig forged steel slip-on flanges for ferrous piping; bronze flanges for copper piping; neoprene gaskets for gas service; 1/16 inch thick preformed neoprene bonded to asbestos.

C. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.

PART 3 EXECUTION

3.1 PREPARATION

A. Ream pipe and tube ends. Remove burrs.

B. Remove scale and dirt, on inside and outside, before assembly.

C. Prepare piping connections to equipment with flanges or unions.

3.2 INSTALLATION

A. Provide non-conducting dielectric connections wherever jointing dissimilar metals.

B. Route piping in orderly manner 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.

E. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

F. Provide clearance for installation of insulation and access to valves and fittings.

G. Provide access doors to match wall or ceiling construction where valves and fittings are not exposed.

H. Slope water piping and arrange to drain at low points.

I. Establish elevations of buried piping outside the building to ensure not less than 3 ft of cover.

J. Prepare pipe, fittings, supports, and accessories not prefinished, ready for finish painting where exposed.
K. Establish invert elevations, slopes for drainage to 1/4 inch per foot (2 percent) minimum for sewer piping.

L. Natural gas piping exposed to weather shall be cleaned, primed, and provided with two coats of yellow oil based paint.

3.3 APPLICATION

A. Install unions downstream of valves and at equipment or apparatus connections.

B. Install brass male adapters each side of valves in copper piped system. Sweat solder adapters to pipe.

3.4 DISINFECTION OF DOMESTIC WATER PIPING SYSTEM

A. Prior to starting work, verify system is complete, flushed and clean.

B. Ensure pH of water to be treated is between 7.4 and 7.6 by adding alkali (caustic soda or soda ash) or acid (hydrochloric).

C. Inject disinfectant, free chlorine in liquid, powder, tablet or gas form, throughout system to obtain 50 to 80 mg/L residual.

D. Bleed water from outlets to ensure distribution and test for disinfectant residual at minimum 15 percent of outlets.

E. Maintain disinfectant in system for 24 hours.

F. If final disinfectant residual tests less than 25 mg/L, repeat treatment.

G. Flush disinfectant from system until residual equal to that of incoming water or 1.0 mg/L.

H. Take samples no sooner than 24 hours after flushing, from 10 percent of outlets and from water entry, and analyze in accordance with AWWA C601.

I. Submit statement of test results and procedures to Architect.

3.5 FLUSHING OF DOMESTIC WATER PIPING SYSTEM

A. Prior to start of work, verify system has been disinfected per paragraph 3.04 of this section.

B. All installed plumbing fixtures shall be rinsed (ran) daily for a minimum of 30 seconds each. This shall continue for a minimum period of two (2) weeks.
C. At the conclusion of the flushing cycle, verification samples may be collected by a school representative for testing.

D. If the testing proves that the lead content is in excess of allowable levels, an additional two (2) week flushing period may be required.

E. Records of flushing must be maintained and available for inspection.

3.6 TESTING

A. Test soil and vent systems by plugging lines and filling systems with water to a static head of ten (10) feet of water. Observe water level for two (2) hours. If level is lowered, indicating leakage, repair leaks and test again until no further leakage is detected.

B. Test water piping at 100 psig for a continuous period of four (4) hours. During this time, carefully inspect the system for leaks. If necessary, repair leaks and test again until no further leakage is detected.

C. Test gas piping at 50 psig for a continuous period of four (4) hours. During this time, carefully inspect the system for leaks. If necessary, repair leaks and test again until no further leakage is detected.

END OF SECTION
PART 1   GENERAL

1.1 WORK INCLUDED
A. Cleanouts
B. Backflow Preventers
C. Water Hammer Arrestors
D. Hose Bibbs

1.2 RELATED WORK
A. Section 220500 – Common Work Results For Plumbing
B. Section 220529 – Supports, Anchors and Sleeves For Plumbing
C. Section 224000 – Plumbing Fixtures
D. Section 221116 – Plumbing Piping

1.3 REFERENCES
A. ANSI/ASSE 1012 - Backflow Preventers with Immediate Atmospheric Vent.
B. ANSI/ASSE 1011 - Hose Connection Vacuum Breakers.
C. ANSI/ASSE 1013 - Backflow Preventers, Reduced Pressure Principle.
D. PDI WH-201 Water Hammer Arrestors.

1.4 QUALITY ASSURANCE
A. Manufacturer: For each type of product specified, provide components by same manufacturer throughout.

1.5 SUBMITTALS
A. Submit shop drawings and product data in accordance with Section 220500.
B. Include component sizes, rough-in requirements, service sizes, and finishes.
PART 2  PRODUCTS

2.1  CLEANOUTS

A. Manufacturers: Josam, Mifab, J.R. Smith, Wade, Watts, Zurn or approved equal meeting these specifications are acceptable.

B. Exterior Surfaced Areas: Round coated cast iron body with cast iron non-skid cover and plug; Model 4225 manufactured by J.R. Smith.

C. Exterior Unsurfaced Areas: Line type with coated cast iron body and round gasketed cover; Model 4255 manufactured by J.R. Smith.

D. Interior Finished Floor Areas: Coated cast iron body with round nickel bronze scoriated cover; Model 4020 manufactured by J.R. Smith.

E. Interior Finished Wall Areas: Line type with coated cast iron body and cast iron lead seal plug, and round stainless steel access cover secured with machine screw; Model 4402 manufactured by J.R. Smith.

F. Interior Unfinished Accessible Areas: Calked or threaded type. Provide bolted stack cleanouts on vertical rainwater leaders.

2.2  BACKFLOW PREVENTERS / CHECK VALVES

A. Manufacturers: Febco, Hersey Beeco, Watts, or approved equal meeting these specifications are acceptable.

2.3  WATER HAMMER ARRESTORS

A. Manufacturers: Josam, J.R. Smith, Wade, Watts, Zurn, or approved equal meeting these specifications are acceptable.

B. ANSI A112.26.1; Sized in accordance with PDI WH-201, precharged suitable for operation in temperature range - 100 to 300 degrees F and maximum 250 psig working pressure. Sized on drawings using P.D.I. symbols.

2.4  HOSE BIBBS

A. Manufacturers: Chicago Watts, Wade, Woodford or approved equal meeting these specifications are acceptable.

PART 3  EXECUTION

3.1  INSTALLATION AND APPLICATION
A. Install specialties in accordance with manufacturer's instructions to permit intended performance.

B. Extend cleanouts to finished floor or wall surface. Lubricate threaded cleanout plugs with mixture of graphite and linseed oil. Ensure clearance at cleanout for rodding of drainage system.

C. Encase exterior cleanouts in 18 x 18 x 6 inch concrete pad flush with grade.

D. Install water hammer arrestors complete with access door and isolation valve.

E. Provide backflow preventer or check valves as indicated on plumbing drawings at connection of domestic potable water system to any component which might lead to contamination of the water system.

END OF SECTION
223000 - PLUMBING EQUIPMENT

PART 1  GENERAL

1.1  WORK INCLUDED

A. Water heaters
B. Pumps

1.2  RELATED WORK

A. Section 220000 – Common Work Results For Plumbing
B. Section 220523 – Valves For Plumbing
C. Section 220529 – Supports, Anchors and Sleeves For Plumbing
D. Section 224000 – Plumbing Fixtures
E. Section 220700 – Plumbing Piping Insulation
F. Section 221119 – Plumbing Specialties

1.3  QUALITY ASSURANCE

A. Provide pumps with manufacturer’s name, model number, and rating/capacity identified.

B. Ensure products and installation of specified products are in conformance with recommendations and requirements of the following organizations:
   1. American Gas Association (AGA).
   2. Underwriters Laboratories (UL).

C. Ensure pumps operate at specified system fluid temperatures without vapor binding and cavitation, are non-overloading in parallel or individual operation, operate within 25 percent of midpoint of published maximum efficiency curve.

1.5  REGULATORY REQUIREMENTS

A. Conform to AGA and UL 174 requirements for water heaters.

1.6  SUBMITTALS

A. Submit product data in accordance with Section 220500.
B. Include dimension drawings of water heaters indicating components and connections to other equipment and piping.

C. Include dimensions of tanks, tank lining methods, anchors, attachments, lifting points, tappings, and drains.

D. Indicate pump type, capacity, power requirements, and affected adjacent construction.

E. Submit certified pump curves showing pump performance characteristics with pump and system operating point plotted. Include NPSH curve when applicable.

1.7 OPERATION AND MAINTENANCE DATA

A. Submit operation and maintenance data in accordance with Section 220500.

B. Include operation, maintenance, and inspection data, replacement part numbers and availability.

1.8 WARRANTY

A. Provide two year manufacturer's warranty in accordance with Section 220500.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS - WATER HEATERS

A. Products manufactured by Rheem/Ruud, Bradford White, A.O. Smith, State, P.V.I., or approved equal meeting these specifications are acceptable.

2.2 ACCEPTABLE MANUFACTURERS - IN-LINE CIRCULATOR PUMPS

A. Products manufactured by Armstrong, Bell & Gossett, Grundfos, Paco, Taco, or approved equal meeting these specifications are acceptable.

PART 3 EXECUTION

3.1 WATER HEATER INSTALLATION

A. Install water heaters in accordance with manufacturer's instructions and to AGA and UL requirements.

B. Coordinate with plumbing piping and related fuel piping, gas venting and electrical work to achieve operating system.
3.2 PUMP INSTALLATION

A. Install in accordance with manufacturer's instructions.

END OF SECTION
THIS PAGE INTENTIONALLY LEFT BLANK
224000 - PLUMBING FIXTURES

PART 1  GENERAL

1.1 WORK INCLUDED

A. Water Closets
B. Lavatories

1.2 RELATED WORK

A. Section 220000 – Common Work Results For Plumbing
B. Section 220529 – Supports, Anchors and Sleeves For Plumbing
C. Section 221119 – Plumbing Specialties

1.3 REFERENCES

A. ANSI A112.6.1 - Supports for Off-the-Floor Plumbing Fixtures for Public Use.
B. ANSI A112.18.1 - Finished and Rough Brass Plumbing Fixture Fittings.
C. ANSI A112.19.2 - Vitreous China Plumbing Fixtures.
D. ANSI A112.19.4 - Porcelain Enameled Formed Steel Plumbing Fixtures.
E. ANSI A112.19.5 - Trim for Water-Closet Bowls, Tanks, and Urinals.

1.4 QUALITY ASSURANCE

A. Fixtures: By same manufacturer for each type of product specified throughout.
B. Trim: By same manufacturer for each type of product specified throughout.
C. Determine that intended fixtures fit the available space with adequate service clearance, prior to submittal.

1.5 SUBMITTALS

A. Submit product data in accordance with Section 220500.
B. Include fixtures, sizes, [rough-in dimensions], utility sizes, trim, and finishes.

1.6 OPERATION AND MAINTENANCE DATA
A. Submit operation and maintenance data in accordance with Section 220500.

B. Include fixture trim exploded view and replacement parts lists.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS - FIXTURES

A. Products manufactured by American Standard, Crane, Eljer, Elkay, Just, Kohler, or approved equal meeting these specifications are acceptable.

2.2 ACCEPTABLE MANUFACTURERS - FIXTURE TRIM

A. Products manufactured by American Standard, Bradley, Chicago Faucet, Eljer, Moen, Royal Brass, Symmons, Kohler, Waterless, Sloan, T&S Brass or approved equal meeting these specifications are acceptable.

2.3 ACCEPTABLE MANUFACTURERS - P-TRAP, STOP & SUPPLIES INSULATION

A. Products manufactured by McGuire, Truebro or approved equal meeting these specifications are acceptable.

2.4 ACCEPTABLE MANUFACTURERS - FLUSH VALVES

A. Products manufactured by Sloan, Delany, or approved equal meeting these specifications are acceptable.

2.5 ACCEPTABLE MANUFACTURERS - WATER CLOSET SEATS

A. Products manufactured by Beneke, Church, Olsonite, or approved equal meeting these specifications are acceptable.

2.6 ACCEPTABLE MANUFACTURERS - FIXTURE CARRIERS

A. Products manufactured by Josam, J. R. Smith, Zurn, Wade, Watts or approved equal meeting these specifications are acceptable.

PART 3 EXECUTION

3.1 INSPECTION

A. Review millwork shop drawings and architectural drawings. Confirm location and size of fixtures and openings before rough-in and installation.

B. Verify adjacent construction is ready to receive rough-in work of this Section.
3.2 INSTALLATION

A. Install each fixture with trap, easily removable for servicing and cleaning.

B. Provide chrome plated rigid or flexible supplies to fixtures with loose key and/or screwdriver stops reducers, and escutcheons.

C. Install components level and plumb.

D. Install and secure fixtures in place with wall supports and/or wall carriers and bolts.

3.3 ADJUSTING AND CLEANING

A. Adjust stops or valves for intended water flow rate to fixtures without splashing, noise, or overflow.

B. At completion clean plumbing fixtures and equipment.

END OF SECTION
230500 – COMMON WORK RESULTS FOR HVAC

PART 1 GENERAL

1.1 RELATED WORK

A. General Conditions

B. Special Conditions

C. Supplementary General Conditions

D. Architectural, Structural, Civil, Electrical and Mechanical Drawings & Specifications

1.2 SCOPE OF WORK

A. The work covered by the Mechanical and Plumbing Sections of the Specifications shall include the furnishing of all materials, labor, transportation, tools, permits, fees, inspections, utilities and incidentals necessary for the complete installation of all mechanical and plumbing work required in the Contract Drawings.

B. It is the intent of the Contract Documents to provide an installation complete in every respect. In the event that additional details or special construction is required for work indicated or specified in this Section or work specified in other sections, it shall be the responsibility of the Contractor to provide all material and equipment which is usually furnished with such systems in order to complete the installation, whether mentioned or not.

C. The Contractor shall visit the premises and thoroughly familiarize himself with all the details of the work and working conditions and to verify all dimensions in the field. The Contractor shall advise the Architect of any discrepancy prior to bidding. The submission of bids shall be deemed evidence of the Contractor's site visit, the coordination of all existing conditions, and the inclusion of all considerations for existing conditions.

1.3 PLANS AND SPECIFICATIONS

A. These Specifications are accompanied by drawings of the building and details of the installations indicating the locations of equipment, piping, ductwork, outlets, etc. The drawings and these specifications are complementary to each other, and what is required by one shall be as binding as if required by both.

B. If departures from the drawings are deemed necessary by the Contractor, details of such departures and the reasons therefore shall be submitted to the Architect for review. No departures shall be made without prior written acceptance of the Architect.
C. The interrelation of the specifications, the drawings, and the schedules is generally as follows: The specifications determine the nature and setting of the materials, the drawings establish the quantities, dimensions, and details, and the schedules give the performance characteristics.

D. Should the drawings disagree in themselves or with the specifications, the contractor shall immediately notify the architect and shall perform and/or furnish the better quality or greater quantity of work or materials unless otherwise directed by the architect in writing. In case the specifications should not fully agree with the schedules, the latter shall govern. Figures indicated on drawings govern scale measurements and large scale details govern small scale drawings. In case of disagreement between specifications and drawings, see Division I of these specifications for clarifications.

E. Items specifically mentioned in the specifications but not shown on the drawings and/or items shown on the drawings but not specifically mentioned in the specifications shall be installed by the Contractor under the appropriate section of work as if they were both specified and shown.

1.4 QUALITY ASSURANCE

A. All work shall comply with the applicable rules of the following:
   1. 2018 International Building Code
   2. 2018 International Mechanical Code
   3. 2018 International Plumbing Code
   4. 2018 International Fire Code
   5. 2018 International Energy Conservation Code
   6. National Fire Protection Association Codes
   7. State Fire Marshall
   9. All applicable city, county, state, and federal rules, codes, and ordinances.

B. In any instance where these specifications call for materials for construction of a better quality or larger size than required by the codes, the provisions of these specifications shall take precedence. None of the terms or provisions of this
specification shall be construed as waiving any rules, regulations, or requirements of these authorities. The codes shall govern in case of direct conflict between the codes and the Drawings.

1.5 SUPERVISION

A. A competent foreman or superintendent, initially approved by the Architect, shall be assigned to the project to receive instructions and to act for the Contractor. Once this superintendent has been approved, no change shall be made without approval of the Architect. Architect's authorized representative and/or owner's observer shall have the right to observe the work at any time. The Contractor shall have a representative present when his work is being observed, and he shall give assistance, as may be required, to the Architect's representative. Recommendations made by the observer shall be promptly carried out, and all unsatisfactory material and/or workmanship shall be replaced at once, to the satisfaction of the Architect.

1.6 GUARANTEE

A. The Contractor shall guarantee all materials and workmanship for a period of two (2) years after the final acceptance of work.

1.7 UTILITIES

A. The contract documents reflect the general location, size, and elevations of sewer line, location, size and pressure of water and other lines and manner of routing for all utilities known to be required on this project. It shall be the responsibility of the Contractor to visit the site, meet with the local utility companies in order to coordinate and confirm the exact requirements for each utility to provide a complete and operative system. The bid submitted by the Contractor shall include costs for all such utility company charges and/or fees.

1.8 BUILDING CONSTRUCTION AND LAYOUT OF WORK

A. It shall be the responsibility of the Contractor to consult the architectural and engineering drawings and details so as to thoroughly familiarize himself with the type and quality of construction to be provided on this project.

B. The Drawings are diagrammatic in character and cannot show every connection in detail or every pipe and duct in its exact location. These details are subject to the requirements of ordinances and also structural and architectural conditions. The Contractor shall carefully investigate structural and finish conditions and shall coordinate the separate trades in order to avoid interference between the various phases of work. Work shall be laid out so that it will be concealed in furred chases or above suspended ceilings, etc., in finished portions of the building, unless specifically noted or indicated to be exposed. Work shall be installed to avoid
crippled of structural members; therefore, inserts to accommodate hangers shall be set before concrete is poured, and proper openings through floor, walls, beams, etc., shall be provided as hereinafter specified or as otherwise indicated or required before concrete is poured. All work shall be run parallel or perpendicular to the lines of the building unless otherwise noted.

C. The approximate location of each item is indicated on the drawings. These drawings are not intended to give complete and exact details in regard to location. Exact locations are to be determined by actual measurements at the building and will in all cases be subject to the approval of the Architect, and he reserves the right to make any reasonable changes in the locations indicated without additional cost.

1.9 SHOP DRAWINGS AND BROCHURES

A. After the Contract is awarded, but prior to proceeding with the Work, the Contractor shall obtain, check, certify, and submit complete Shop Drawings and Brochures from Manufacturers, Suppliers, Vendors, etc., for all materials and equipment specified herein. Submit Shop Drawings and Brochures in sufficient time so as not to impede the progress of work. At least two weeks will be required for the processing of Shop Drawings and Brochures in the Engineer's office, exclusive of transmittal time. This time shall be considered by the Contractor when scheduling submittal data.

B. The Engineer's review of Shop Drawings and Brochures shall not relieve the Contractor of the responsibility for dimensions, errors that may be contained therein, or deviations from Contract Document requirements. It shall be clearly understood that the Engineer's noting some errors but overlooking others does not grant the Contractor permission to proceed in error. Regardless of any information contained in the Shop Drawings, the requirements of the Contract Documents shall govern and are not waived or superseded in any way by the submittal data review.

C. Each Shop Drawing shall indicate in the lower right hand corner and each Brochure shall indicate on the front cover the following: the Title of the Sheet or Brochure; name and location of the building; names of the Architect, Engineer, Contractor, Manufacturer, Supplier, Vendor, etc., the date of submittal; and the date of each correction and revision. So far as is practical, each Shop Drawing and/or Brochure shall bear a cross-reference note to the sheet number or numbers of the Contract Drawings and/or Specifications showing the same work. Shop Drawings and Brochures shall be prepared as follows:

I. Shop Drawings: Drawings shall be drawn to a scale that can be easily read and shall contain sufficient plans, elevations, sections, and isometrics to describe clearly the items in question. Drawings shall be prepared by skilled technicians experienced in this type of work. All piping, equipment
layouts, ductwork and similar Shop Drawings shall be drawn to at least 1/4" = 1'0" scale.

2. Brochures: Brochures shall be published by the Manufacturers and shall contain complete and detailed engineering and dimensional information to show that the equipment will fit into the allotted space. Brochures not compiled in the manner described below shall be returned for resubmittal.

3. Brochures submitted shall contain only information which is relevant to the particular equipment or materials to be furnished. Do not submit catalogs that describe several different items other than those items to be used unless all irrelevant information is marked out or relevant information is clearly marked.

D. The submittal format shall follow the Specifications format with a submittal required for each section of Division 23. Each major category of equipment such as fans or pumps or air devices being submitted under a separate cover letter. The first submittal shall be accompanied by a three-ring hard back binder for the A/E to use in retaining copies of the submittals. Copies of each submittal shall be three-hole punched and arranged (or folded if required) for the A/E’s filing convenience. Provide one copy of updated TABLE OF CONTENTS and progressive-tabbed manila index sheets also for the A/E's filing convenience.

E. Submit all Shop Drawings and Brochures for review and approval in accordance with Division 1 – General Requirements

F. Minimum size of submittal data shall be 8-1/2" x 11".

G. Any submittal that is disapproved must be resubmitted within two (2) weeks following notification of such disapproval. If no satisfactory material is submitted within the two-week period, the Architect reserved the right to require the Contractor to furnish items exactly as described in the Contract Documents.

H. No allowances will be made for submittals which are not made in a timely fashion or which are turned down because they are not equal. Should delivery problems arise due to the above, affecting the completion time of the project, the Contractor will furnish and install acceptable alternates until the proper materials arrive and then replace the alternate materials with the approved materials, all at no cost to the Owner. If the Contractor is not able to furnish an acceptable alternate until the proper materials arrive, he will assume all costs for furnishing and installing all alternates as directed by the Architect and/or will pay a suitable penalty for the inconvenience experienced by the Owner. This penalty will be set by the Architect based on the particular circumstances.

1.10 SUBSTITUTIONS
A. The listing of product manufacturers, catalog numbers, etc., in the various sections of the specifications is intended to establish a standard of quality only, and is not intended to preclude open, competitive bidding. The Contractor may at his option submit substitute materials or methods which he feels are equal or superior to those specified. If the Contractor does submit alternate materials or methods, it shall be understood that the Contractor:

1. Has personally investigated the proposed substitute product and determined that it has all the same accessories and is equal or superior in all respects to the item specified.

2. Will provide the same guarantee for the substitution that he would for that specified.

3. Has coordinated the installation of the equipment which he proposes to substitute with all other trades especially in regard to electrical requirements and to operating weights trades and includes the costs for any changes required for the work to be complete in all respects. The Contractor will prepare shop drawings where required by the Architect or where dimensions vary.

4. Waives any and all claims for additional costs related to the substitution.

1.11 SPARE PARTS DATA

A. As soon as practicable after approval of materials and equipment, and, if possible, not later than one months prior to the date of beneficial occupancy, the Contractor shall furnish spare parts data for each different item of equipment listed. The data shall include a complete list of parts and supplies, with current unit prices and sources of supply; a list of parts and supplies that are either normally furnished at no extra cost with the purchase of the equipment or specified hereinafter to be furnished as part of the contract. The foregoing shall not relieve the Contractor of any responsibilities under the guarantee specified.

1.12 RECORD DRAWINGS

A. The Contractor shall keep a set of Drawings of the job, noting daily all changes made in the Drawings in connection with the final installation including exact dimensioned locations of all new and uncovered existing active and inactive utilities outside the building and shall turn over a clean, neatly marked set of sepias reproducible Drawings showing "as-built" work to the A/E for delivery to the Owner. All underground utilities and services and systems shall be accurately located by the Contractor and dimensioned on the "as-built" Drawings.

1.13 OPERATING AND MAINTENANCE MANUAL
A. Prepare and submit to the Architect for delivery to the Owner an indexed manual with complete technical data for every piece of equipment and material installed under this contract.

1. Complete mechanical submittals as approved by Architect.

2. Manufacturer's installation instruction brochures.

3. Manufacturer's local representative and/or Distributor's name, address and phone number.

4. Manufacturer's operating and maintenance brochures.

5. Manufacturer's internal wiring diagrams.

B. This manual shall include all of the listed data bound into a permanent hard-back binder identified on the cover as "Operating and Maintenance Manual" with additional cover display of the names and location of the Building, the Owner, the Architect, the Engineers, the General Contractor, and the Sub-Contractors installing equipment represented in the brochure.

C. Contents of the Manual shall be grouped in sections according to the various sections of the specifications and shall be listed in a Table of Contents.

PART 2   PRODUCTS

2.1 STANDARDS FOR MATERIALS

A. All materials, in general, shall conform to the requirements of all agencies of publications hereinbefore specified under the paragraph QUALITY ASSURANCE and shall be listed, inspected, and approved by the Underwriters Laboratories and shall bear the U.L. label where labeling service is available. The label or listing of the Underwriters Laboratories, Inc. will be accepted as evidence that the materials or equipment conform to the applicable standards of that agency. In lieu of this listing, the Contractor may submit a statement from a nationally recognized testing agency indicating that the items have been tested in accordance with required procedures, and that the materials and equipment comply with all contract requirements.

2.2 STANDARD PRODUCTS

A. Materials and equipment to be provided shall be the standard catalog products of manufacturers regularly engaged in the manufacture of products conforming to these specifications, and shall essentially duplicate materials and equipment that have been in satisfactory use at least two years.
2.3 MANUFACTURERS INSTRUCTIONS

A. The responsibility for the furnishing of the proper equipment and/or material and the responsibility for seeing that it is installed as intended by the manufacturer, rests entirely upon the Contractor. If needed for proper installation, operation, or startup, the Contractor shall request advice and supervisory assistance from the representative of the specific manufacturer. The manufacturers’ published instructions shall be followed for preparing, assembling, installing, erecting, and cleaning manufactured materials or equipment, unless otherwise indicated. The Contractor shall promptly notify the Architect in writing of any conflict between the requirements of the contract documents and the manufacturers’ directions and shall obtain the Architect's instructions before proceeding with the work. Should the Contractor perform any such work that does not comply with the manufacturers’ directions or such instructions from the Architect, he shall bear all costs arising in connection with the deficiencies.

2.4 RUST PREVENTION

A. All metallic materials shall be protected against corrosion. Exposed metallic parts of outdoor apparatus made of ferrous metals but not of corrosion-resistant steel, shall be zinc-coated in accordance with ASTM A123 or A153, except where other equivalent protective treatment is specifically approved in writing.

2.5 STORAGE ON SITE

A. The Contractor shall not receive material or equipment at the job site until ready for installation or until there is a suitable space provided to properly protect equipment from rust, weather, humidity, dust, or physical damage.

2.6 CAPACITIES

A. Capacities shall be not less than those indicated and shall be such that no component or system becomes inoperative or is damaged because of startup or other overload conditions.

2.7 NAMEPLATES

A. Each major component of equipment shall have the manufacturer’s name, address, and catalog number on a plate securely attached to the item of equipment. All data on nameplates shall be legible at the time of final inspection.

2.8 CONDITION OF MATERIAL AND APPURTENANCES

A. All pipe, fittings, appurtenances, and other material required for complete installation of these systems shall be new to conform to manufacturer's recommendations, unless otherwise specified. All equipment injured or damaged
in transit from factory, during delivery to premises, while in storage on premises, while being erected and installed, and while being tested, until time of substantial completion, shall be replaced by the Contractor without extra cost to Owner.

PART 3  EXECUTION

3.1  INSTALLATION OF SYSTEMS

A. Provide and install unions at proper points to permit removal of pipe and various equipment and machinery items without injury to other parts of system. No union will be required in welded lines or lines assembled with solder joint fittings, except at equipment items, machinery items, and other special pieces or apparatus. Companion flanges on lines at various items of equipment, machines and pieces of apparatus, shall serve as unions to permit removal of the particular items. Unions connecting ferrous pipe to copper or brass pipe shall be dielectric type.

3.2  SPACE AND EQUIPMENT ARRANGEMENT

A. All equipment shall be installed in a manner to permit access to parts requiring service without disassembly of other equipment.

B. Any large piece of apparatus which is to be installed in any space in the building, and which is too large to permit access through stairways, doorways, or shafts shall be brought to the job and placed in the space before the enclosing structure is completed. Following placement in the space, such apparatus shall be thoroughly protected against damage.

3.3  PRECEDENCE OF WORK

A. This contract includes many different systems furnished and installed by different trades. Each trade shall coordinate their work with that of all other trades so that it may be installed in the most direct and workmanlike manner without hindering or handicapping any other trades.

3.4  EXCAVATION AND BACKFILL

A. The Contractor shall perform all excavation of every description required in the execution of his work. Excavation shall be through whatever substance encountered, to the depths indicated on the drawings, or as required. Excavated material suitable for backfill shall be piled in an orderly manner a sufficient distance from the trench to prevent overloading sides and causing cave-ins. Excavated materials not suitable for backfill shall be removed or stored as directed. Such grading shall be done as is necessary to protect the excavation from surface water. Trenches shall be maintained in a dry condition by bailing, pumping, or other approved methods. Pipe shall not be laid in wet trenches. Sheet and
shoring shall be provided as required for the protection of the work and the safety of personnel.

B. Trenches shall be of the necessary width and depth to provide for proper laying of pipe and appurtenances, with banks as nearly vertical as possible. Bottoms of trenches shall be excavated to the grade and depth indicated or required, and barrel of pipe shall be laid on firm and undisturbed soil. Bell holes, of a size to permit proper grading, shall be provided as required. Over-depth excavations shall be backfilled to proper level with sand. When rock or other soil not suitable for bedding the pipe is encountered, it shall be removed to a depth of not less than 1' below grade, and backfilled with sand to grade, to provide a suitable bed for pipe. Existing underground piping shall be protected from damage during excavation and backfilling, and if damaged, shall be repaired to the Architect's satisfaction, at the Contractor's expense.

C. Trenches shall not be backfilled until all required tests have been performed. This requirement does not preclude sectional testing and backfilling of the various systems. Trenches shall be carefully backfilled with a minimum 6" sand cover over piping then backfilled with material (free from large earth clods, rocks, and/or foreign materials), laid in 6" layers, compacted to 90 percent of maximum dry density as determined by ASTM D698 (compaction shall be to 95 percent below structures, including sidewalks and roadways).

D. Open trenches abutting foundation or basement excavations, building walls, and grade beams, will not be permitted, but shall be backfilled and completed, for a distance of not less than 10' from the above features, as soon as possible. All damage resulting from flooding due to open trenches shall be paid for by the Contractor.

E. Where excavation requires, existing walks, street, drives, or other existing pavement shall be cut to install new lines and to make new connections to existing lines. The size of the cut shall be held to a minimum, consistent with the work to be accomplished. After the installation of the new materials is completed and the excavation has been backfilled, the paving shall be patched, using materials to match those cut out. The patches shall be thoroughly bound with the original surfaces, and shall be level with them.

3.5 CUTTING AND PATCHING

A. Where it becomes necessary to cut through any wall, floor, or ceiling to permit installation of any work under this section of the specifications or to repair any defects that may appear, up to the expiration of the guarantee period, such cutting shall be done under the observation of the Architect by the Contractor. The Contractor shall not be permitted to cut or modify any structural members without the written direction of the Architect.
B. Patching of all openings cut by the Contractor, or repairing of any damage to the work of other trades occasioned by the cutting operations, or occasioned by the failure of any part of work installed under this contract, shall be performed by the trade whose work is involved, but shall be paid for by the Contractor.

C. Any openings cut through exterior walls or roofs shall be provided with suitable covers, while they are left open, to protect the property or materials involved. Any openings cut through walls below grade shall be properly protected to prevent entrance of water or other damaging elements.

3.6 HOISTING, SCAFFOLDING, AND TRANSPORTATION

A. The Contractor shall provide his own hoisting facilities to set his materials and equipment in place in the building, as indicated on drawings and for subsequent cleaning, testing, and adjusting.

B. The Contractor shall provide necessary transportation to facilitate the delivery of all materials, equipment, tools, and labor to the job, in accordance with intent of these documents.

3.7 CLEANING

A. The Contractor shall, at all times, keep the premises free from accumulations of waste material or rubbish caused by him, his employees, or his work. This debris shall be removed, not only from the building, but also from the project site.

B. At completion of the job, the Contractor shall remove all of his tools, scaffolding, and surplus materials. He shall leave the area "broom clean."

3.8 ELECTRICAL WIRING OF MOTORS AND EQUIPMENT

A. Unless specifically shown, indicated, or specified to the contrary, each item shown or required by the Mechanical Drawings or specified in the Mechanical Specifications shall be accompanied by all motors and starting and controlling equipment necessary for the items' proper operations. These motors shall be integrally attached to and/or installed with their associated equipment item and electrically connected as specified in Division 16 - Electrical. Equipment controlled from motor control centers shall be supplied with motors only. Motor control centers are specified in the Electrical Specifications and shown on the Electrical Drawings.

END OF SECTION
230529 – HANGERS & SUPPORTS FOR HVAC PIPING & EQUIPMENT

PART 1 GENERAL

1.1 WORK INCLUDED

A. Pipe Hangers and Supports
B. Duct Hangers and Supports
C. Sleeves for Mechanical Equipment

1.2 RELATED WORK

A. Section 230500 – Common Work Results for HVAC
B. Section 230529 - Supports, Anchors and Sleeves
C. Section 233113 – Ductwork

1.3 SUBMITTALS

A. Submit shop drawings in accordance with Section 230500.

1.4 REFERENCES

A. Duct Hangers: SMACNA Duct Manuals.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Products shall be as manufactured by Grinnell, Elcen, Fee and Mason, Unistrut or approved equal.

2.2 PIPE HANGERS AND SUPPORTS

A. Hangers: Pipe sizes 1/2 inch to 1-1/2 inch: adjustable wrought steel ring.
B. Steel Beam Clamps: Elcen Figure 33, Type 3 or approved equal.
C. Design hangers to impede disengagement by movement of supported pipe.
D. Provide copper plated hangers and supports for copper piping or two layers Scotch 33 PVC tape or equal.
2.3 HANGER RODS

A. Provide cadmium plated steel hanger rods, threaded both ends, threaded one end, or continuous threaded.

2.4 DUCT HANGERS AND SUPPORTS

A. Hangers: Galvanized steel band iron or rolled angle and 3/8 inch rods.

2.5 SLEEVES

A. Pipes through Walls, Fire Proofing, Footings, Potentially Wet Floor: Form schedule 40 PVC pipe. Use steel pipe for rated walls.

B. Round Ducts: Form with 18 gauge galvanized steel.

C. Rectangular Ducts: Form with 18 gauge galvanized steel.

D. Size large enough to allow for movement due to expansion and to provide for continuous installation.

PART 3 EXECUTION

3.1 PIPE HANGERS AND SUPPORTS

A. All structures and appurtenances employed for the purpose of supporting the pipe and guiding it properly shall be carefully fabricated in such a manner as to preserve the true grade of the pipe without subjecting either the pipe or the supporting and guidance members to any undue strain.

B. Support horizontal piping as follows:

C. Space hangers and furnish rods as follows:

<table>
<thead>
<tr>
<th>Nominal Pipe Size (in.)</th>
<th>Span (ft.) Steel</th>
<th>Span (ft.) Copper</th>
<th>Hanger Rod Diameter (in.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/2</td>
<td>5</td>
<td>5</td>
<td>3/8</td>
</tr>
<tr>
<td>3/4</td>
<td>6</td>
<td>6</td>
<td>3/8</td>
</tr>
<tr>
<td>1</td>
<td>7</td>
<td>6</td>
<td>3/8</td>
</tr>
<tr>
<td>1-1/2</td>
<td>9</td>
<td>8</td>
<td>3/8</td>
</tr>
<tr>
<td>2</td>
<td>10</td>
<td>9</td>
<td>3/8</td>
</tr>
</tbody>
</table>

D. Install hangers to provide minimum 1/2 inch clear space between finished covering and adjacent work.
E. Place a hanger within one foot of each horizontal elbow.

F. Use hangers which are vertically adjustable 1-1/2 inch maximum after piping is erected.

G. Support piping at each change or direction, at ends of branches, at base and top of riser pipes and drops, and wherever necessary to prevent sag, bending or vibration, in addition to above-listed hanger spacing.

H. Pipe hangers on insulated lines shall be sized to fit the outside of the insulation.

I. Where several pipes can be installed in parallel and at the same elevation, provide multiple or trapeze hangers, designed to support loads per ANSI B31.1.

J. Where practical, support riser piping independently of connected horizontal piping.

3.3 LOW VELOCITY DUCT HANGERS AND SUPPORTS

A. Duct hangers and supports to be sized and spaced as per SMACNA requirements.

3.4 SLEEVES

A. Set sleeves in position in advance of concrete work. Provide suitable reinforcing around sleeves.

B. Where piping or ductwork passes through ceiling or wall close off space between pipe or duct and construction with non-combustible insulation. Provide tight fitting metal caps on both sides and caulk.

C. Install chrome plated escutcheons where piping passes through finished surfaces.

D. Provide pipe sleeves for all mechanical piping. Sleeve not required if core drilled.

E. Size pipe sleeves to permit placing pipe and specified insulation material for pipes passing through concrete or masonry walls or concrete slabs.

F. Seal pipes passing through walls.

G. Insulated pipe shall be insulated in sleeves, caulked and pointed as above.

H. Pipe and duct sleeves, pitch pockets, and flashings compatible with the roofing installation shall be provided for roof penetrations.
I. All piping shall be installed with due regard to expansion and contraction. Type of hanger, methods of support, location of supports, etc., shall be governed in part by this consideration.

END OF SECTION
230593 - TESTING, ADJUSTING AND BALANCING FOR HVAC

PART 1 GENERAL

1.1 WORK INCLUDED

A. Testing, adjusting and balancing of the following systems:
   1. Air Distribution Systems
   2. Exhaust Systems
   3. HVAC Systems
   4. Plumbing Systems

1.2 RELATED WORK

A. Section 230500 – Common Work Results for HVAC
B. Section 233423 – HVAC Power Ventilators
C. Section 233713 – Diffusers, Registers & Grilles
D. Section 236200 – Packaged Heating/Cooling Units
E. Section 236315 – Ductless Air Conditioning Units

1.3 REFERENCED STANDARDS

A. Associated Air Balance Council, AABC National Standards.
B. Applicable SMACNA Standards.

1.4 QUALITY ASSURANCE
A. All work for the testing and balancing of the HVAC air distribution systems shall be
done by an independent Testing and Balancing firm that specializes in and whose
business is limited to the testing and balancing of heating, ventilating and air
conditioning systems.

B. If requested, the test shall be conducted in the presence of the Architect and/or the
Owner.

C. The environmental systems including all equipment, apparatus and distribution
systems shall be tested, adjusted and balanced in accordance with the latest
edition of the AABC Procedural Standards for Testing, Adjusting and Balancing of
Air Distribution and Hydronic Systems.

D. Instruments used in all HVAC systems and equipment tests shall be as
recommended by the AABC, ASHRAE, or as approved by the Architect. Test
instruments used shall be initially and periodically checked thereafter to verify their
 calibration accuracy.

E. All test equipment shall be furnished by the Contractor and shall remain in his
property. Any adapters such as "Pete's Plugs", pitot tube traverse connections,
etc. shall be left in place and marked for future use.

1.5 SUBMITTALS

A. Submit test reports in accordance with Section 230500.

B. Specific procedures used in all tests shall be included in the test report. Contractor
shall identify all equipment by the identification code as shown on the drawings.

C. Data shall be on printed forms published by either AABC or the Contractor.

D. The test report shall include as a minimum the following information and data:

1. Motors:
   Equipment number
   Manufacturer
   Model or serial number
   Frame size
   Rated horsepower
   Rate rpm
   Corrected full load amperage
   Measured amperage and voltage
   Calculated bhp
   Measured rpm
   Sheave size, type and manufacturer
2. Fans:
   Equipment number
   Manufacturer
   Model or serial number
   Rated cfm
   Rated rpm
   Rated pressures
   Measured cfm
   Measured rpm
   Measured pressures
   Pulley size, type and manufacturer
   Belt size and quantity

3. HVAC Units
   Equipment number
   Manufacturer and type
   Total cfm (design and actual)
   Outdoor air cfm (design and actual)
   Return air cfm (design and actual)
   Total static pressure (design and actual)
   Measured discharge static pressure
   Measured suction static pressure
   Pressure drop across components, if possible

4. Diffuser, Registers and Grilles:
   System identification
   Grille number
   Grille or diffuser manufacturer
   Manufacturer's model number
   ADC flow factor
   Instrument to be used with ADC flow factor
   Grille size
   Design velocity
   Design cfm
   Final measured velocity
   Final measured cfm

E. All reports shall be certified by the Testing and Balancing Contractor that the methods used and the results achieved are as specified. In addition, each individual reporting form submitted must bear the signature and the Technician.

1.6 GUARANTEE

A. The test and balance firm shall include an extended warranty of 90 days, after the submittal of the test and balance report, during which time the Architect, at his discretion, may request a recheck or resetting of any outlet, supply air fan, exhaust
fan, or any other item listed in the test report. The firm shall provide technicians to assist the Architect making any tests he may require during this period of time.

PART 2 PRODUCTS

Not applicable for this section.

PART 3 EXECUTION

3.1 INSPECTION

A. The Testing and Balancing Contractor shall act as an authorized inspection firm responsible to the Architect. He shall review the HVAC design drawings and shop drawings prior to fabrication and installation of the HVAC systems to insure that all of the necessary balancing equipment required to balance these systems is shown.

3.2 PREPARATION

A. Coordinate Schedules with the Test and Balancing Engineer and provide sufficient time before final completion of work so that testing and balancing can be accomplished. Provide all labor and tools to make corrections to the system when required to balance the system without undue delay to the Test and Balancing Contractor. Put all equipment into full operation and continue it in operation during each working day of testing and balancing. No test and balancing work shall start until all of the air handling equipment has new filters installed. The Test and Balancing Engineer shall be kept informed during the construction of the project of major changes made to the HVAC system. Provide the Test and Balancing Contractor with one (1) set of shop drawings on all equipment which he will be required to work on when balancing the HVAC system.

B. Shop drawings shall be submitted to the Test and Balancing Contractor. The Test and Balancing Contractor will, during the construction of the HVAC system, make job site inspections to familiarize himself with the project and shall report to the Architect items installed incorrectly or not installed in accordance with the contract drawings and specifications.

C. Work shall not begin until all systems which are to be tested have been completed and are in full working order. Put all systems and equipment into full operation and continue the operation of all equipment during each working day of the testing and balancing work.

3.3 AIR DISTRIBUTION SYSTEMS TESTING AND BALANCING

A. Utilizing the latest issue of design documents, compare the installed equipment to the design and check for completeness of the installation.
B. The system and air outlet air quantities shall be balanced to the values indicated on the drawings.

C. The grille manufacturer’s outlet flow factors as determined by the ADC test code and recommended procedure for testing air outlets shall be used.

D. Pre-balance equipment check:
   1. Check fan housing, ducts, duct elbows, coils, louvers, etc., to insure they are clean and free of foreign material.
   2. Check filters to insure that they are clean and in place.
   3. Examine drivers for proper belt tension and alignment.
   4. Check fan and motor lubrication.
   5. Coordinate with Electrical Contractor to verify correct motor overload protectors.
   6. Check fans for proper rotation.

E. Pre-balance System Check:
   1. Verify installation of all required balancing dampers. Set all systems dampers in their open position.
   2. Check for air leaks at the fan and the system ductwork. Coordinate with the Contractor for repair of leaks.
   3. Position all building doors and windows (if a part of system design) in their normal position.
   4. Check air temperature to insure required air temperature delivery.

F. Air Handling Equipment Balance:
   1. Check motor amperage and voltage to insure motor is not being overloaded.
   2. Measure and set minimum outdoor air quantity where applicable.
   3. Determine the volume of air being delivered by the fan. Adjust the fan speed, if belt-driven, or the dampers in the system, if direct-driven, to increase or decrease the flow required. If the speed is increased, or the
flow changes due to a damper adjustment, insure that the motor is not overloaded.

4. Check fan and motor speed, no-load amperage, operating amperage and voltage. Calculate brake horsepower.

5. Take fan static pressure readings.

6. Variation of air flow for all modes of operation from the design values shall be within +10 percent of design values.

3.4 OTHER EQUIPMENT TESTS

A. All equipment installed shall be tested, adjusted, and reported upon unless stated otherwise. The equipment discussed herein is not necessarily all of the equipment requiring testing.

B. Fans:

1. Record nameplate data.

2. Check belt alignment and belt tension.

3. Measure current, voltage, and speed (rpm).

END OF SECTION
232300 - REFRIGERANT PIPING

PART 1   GENERAL

1.1 WORK INCLUDED
   A. Refrigerant Piping Systems

1.2 RELATED WORK
   A. Section 230500 – Common Work Results for HVAC
   B. Section 236315 – Ductless Air Conditioning Units

1.3 REFERENCES
   A. ANSI/ASTM B280 - Copper Air Conditioning and Refrigeration Tube (ACR).

PART 2   PRODUCTS

2.1 REFRIGERANT PIPING
   A. Type ACR Copper tubing, hard temper with wrought copper fittings with long radius elbow.

2.2 JOINTS
   A. Brazed, phos-copper alloy or bronzed, silver alloy.

PART 3   EXECUTION

3.1 INSTALLATION
   A. Grade piping as necessary to facilitate oil return when required.

   B. Joints shall be made up in the presence of dry nitrogen only and shall be tested before any coverings are applied. If it is observed that refrigerant lines are being or have been brazed without proper circulation of nitrogen through lines, all refrigerant lines installed up to that point in time shall be removed and replaced at no additional cost to Owner.

   D. Evacuation and leak testing of refrigeration piping systems. Positive pressure test will not suffice for procedure outlined below.

       1. Draw vacuum on each entire system with two stage vacuum pump. Draw vacuum to 300 microns using micron vacuum gauge capable of reading from
atmosphere to 10 microns. Do not use cooling compressor to evacuate system nor operate it while system is under high vacuum.

2. Break vacuum with nitrogen and re-establish vacuum test. Vacuum shall hold for 30 minutes at 300 microns without vacuum pump running.

3. Conduct tests at 70 deg F ambient temperature minimum.

4. Do not run systems until above tests have been made and systems started up as specified. Inform Owner’s Representative of status of systems at time of final inspection and schedule start-up and testing if prevented by outdoor conditions before this time.

5. After testing, fully charge system with refrigerant and conduct test with Halide Leak Detector.

6. Recover all refrigerant in accordance with applicable codes. Do not allow any refrigerant to escape to atmosphere.

E. Provide 1/2" thick expanded rubber insulation to suction return line. For ductless split systems, insulate the suction and liquid lines as required by the manufacturer. Paint exterior insulation with two coats of weather- resistant pigmented plasticized vinyl lacquer. Apply per manufacturer’s specifications.

3.2 TESTING

A. Test piping systems prior to the application of insulation.

B. For piping installed in concealed spaces or buried, test piping before system is concealed or backfilled.

C. After testing, and whenever conditions permit, operate systems at normal operating pressure and temperature for not less than five consecutive days. The piping systems must remain free from leaks during this period.

END OF SECTION
233113 - DUCTWORK

PART 1  GENERAL

1.1  WORK INCLUDED

A.  Ductwork and Plenums

B.  Fasteners

C.  Sealants

1.2  RELATED WORK

A.  Section 230500 – Common Work Results for HVAC

B.  Section 230529 – Hangers & Supports for HVAC

C.  Section 230593 – Testing, Adjusting & Balancing For HVAC

D.  Section 232114 – Duct Lining

E.  Section 233300 – Air Duct Accessories

F.  Section 233423 – HVAC Power Ventilators

G.  Section 233713 – Diffusers, Registers & Grilles

1.3  REFERENCE STANDARDS

A.  Fabricate in accordance with the most recent edition of SMACNA HVAC Duct Construction Standards.


1.4  DEFINITIONS

A.  Duct Sizes: Dimensions shown on the Drawings are sheet metal sizes.

B.  Low Pressure or Velocity: All return, transfer, and exhaust ductwork and all supply ductwork from all constant volume air handlers to air devices.
PART 2    PRODUCTS

2.1    ACCEPTABLE MANUFACTURERS

A. Products manufactured by the following manufacturers meeting these specifications are acceptable.

B. Flexible ducts manufactured by Thermaflex, Wire Mold, Certain Tweed and ATCO are acceptable.

C. Round and oval ductwork manufactured by United Sheet Metal, Semco, General Metals, Spiro-Fab and Metal Manufacturing are acceptable.

2.2    MATERIALS

A. Galvanized Ductwork: Galvanized steel lock forming quality having zinc coating of 1.25 ounces per square foot for each side per ASTM A525 G90. All ductwork to be galvanized unless otherwise noted.

B. Fasteners: Use rivets and bolts throughout; sheet metal screws accepted on low pressure ducts.

C. Sealant: Water resistant, fire resistive, compatible with mating materials. All mastics shall be listed and labeled in accordance with U.L. 181.

D. Flexible Ducts: UL 181 Class 1 airduct consisting of inner vapor barrier supported by a helically wound steel wire; wrapped with 1-1/2" thick flexible fibrous glass insulation, enclosed by a reinforced foil outer jacket. Ductwork shall be a factory fabricated assembly with hanger tab support system equal to CertainTeed Certaflex 25.

2.3    FABRICATION

A. The contractor shall visit the premises and thoroughly familiarize himself with all the details of the work and working conditions and to verify all dimensions in the field prior to fabricating ductwork. The contractor shall advise the Architect of any discrepancy prior to fabrication.

B. Lap metal ducts in direction of air flow. Hammer down edges and slips to leave smooth duct interior.

C. Construct tees, bends, and elbows with radius of not less than 1-1/2 times width of duct on center line. Where not possible and where rectangular elbows used, provide single thickness type turning vanes.
D. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible.

E. Rigidly construct metal ducts with joints mechanically tight, substantially airtight, braced and stiffened so as not to breathe, rattle, vibrate, or sag. Seal all duct joints and connections with "hard cast" tape sealant or equal as ducts are being assembled.

F. Fabricate continuously welded medium pressure round duct fittings one gauge heavier than gauges indicated for duct size. Joints shall be 4 inch cemented slip joint, brazed, or electric welded. Prime coat welded joints. Fabricate elbows of five piece construction. Provide standard 45 degree takeoffs unless otherwise indicated where conical 90 degrees tee takeoff connections may be used.

2.4 DUCT GAUGES AND REINFORCEMENT

A. Provide minimum duct wall thickness and reinforcement as required by the latest edition of the SMACNA HVAC Duct Construction Standards.

PART 3 EXECUTION

3.1 INSTALLATION

A. Provide openings in ductwork where required to accommodate thermometers and controllers. Provide pitot tube openings where required for testing of systems, complete with metal can with spring device or screw to ensure against air leakage. Where openings are provided in insulated ductwork, install insulation material inside a metal ring.

B. Clean duct system with forced air at high velocity through duct to remove accumulated dust. To obtain sufficient air, clean half the system at a time. Protect equipment which may be harmed by excessive dirt with filters, or bypass during cleaning.

C. Seal all transverse joints with Hard Cast or equivalent.

D. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.

E. At each point where ducts pass through partitions, seal joints around duct with non-combustible material. Provide sheet metal closure around opening when exposed.

F. Paint all exposed ductwork as directed by architect.

END OF SECTION
THIS PAGE INTENTIONALLY LEFT BLANK
233114 - DUCT LINING

PART 1   GENERAL

1.1 WORK INCLUDED

A. Duct Lining

1.2 RELATED WORK

A. Section 230500 – Common Work Results for HVAC

B. Section 233113 – Ductwork

1.3 QUALITY ASSURANCE

A. International Mechanical Code and Local Codes

1.4 REFERENCE STANDARDS

A. SMACNA Duct Liner Application Standard

1.5 SHOP DRAWINGS

A. Submit product data and installation instructions in accordance with Section 230500.

PART 2   PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Products manufactured by Johns-Manville, Knauf, Owens-Corning or CertainTeed meeting these specifications are acceptable.

2.2 MATERIALS

A. All low pressure rectangular supply ductwork between the terminal unit and air devices and all constant volume rectangular supply and return ductwork shall be provided with Type 1 flexible duct liner, 1" thick, 1-1/2 lbs. per cubic foot density “K” value at 75 degrees F mean temperature of 0.26 BTU/in/sq. ft./degrees F/hr., suitable for temperature range of 40 degrees F to 250 degrees F and maximum velocity of 4000 fpm.

B. Weld pins or approved equal mechanical fasteners capable of withstanding 50 lb. tensile load test.
C. Adhesives meeting FM, UL and NFPA requirements for fire and smoke ratings, maximum 25 flame spread and maximum 50 smoke developed. Adhesives shall conform to Adhesive and Sealant Council Standards for Adhesives for Duct Liner ASC-A-7001C-1972.

PART 3 EXECUTION

3.1 INSTALLATION

A. All duct designated to receive liner shall be completely covered with liner. Transverse joints shall be neatly butted and there shall be no interruptions or gaps. The black coated surface of the duct liner shall face the air stream. Provide 26 gauge galvanized steel "Z" strip at leading edge of duct liner.

B. Duct liner shall be adhered to sheet metal with mechanical fasteners and 100% coverage of adhesive. Transverse edges of liner to be coated with adhesive. Duct liner shall be cut to assure overlapped and compressed longitudinal corner joints.

C. For velocities up to 2,000 feet per minute, fasteners shall start within 3" of the upstream transverse edges of the Duct Liner and 3" from the longitudinal joints and shall be spaced at a maximum of 12’ o.c. around the perimeter of the duct, except that they may be a maximum of 12" from corner break. Elsewhere they shall be a maximum of 18” o.c. except that they shall be placed no more than 6” from a longitudinal joint of the liner nor 12” from a corner break.

END OF SECTION
PART 1   GENERAL

1.1   WORK INCLUDED

   A.   Duct Thermal Insulation

   B.   Adhesives, Tie Wires, Tapes

1.2   RELATED WORK

   A.   Section 230500 – Common Work Results for HVAC

   B.   Section 233113 – Ductwork

1.3   QUALITY ASSURANCE

   A.   All insulation materials required for ductwork shall be furnished and installed under the contract. The execution of the work shall be by approved insulation contractor in strict accordance with the best practice of the trade and the intent of the specification.

   B.   It is mandatory that all insulation be applied in a neat and workmanlike manner. Contractor shall be required to remove and replace all insulation not applied in strict accordance with the manufacturer's specifications or not presenting a neat finished appearance.

   C.   The Ductwork insulation shall meet NFPA Standards 902 and 906 for fire resistance.

1.4   SUBMITTALS

   A.   Submit product data and installation instructions in accordance with Section 230500.

1.5   REFERENCE STANDARDS

   A.   NFPA 90A and 90B.

   B.   ASTM Standard E84-75.

1.6   JOB CONDITIONS

   A.   Deliver material to job site in original non-broken factory packaging, labeled with manufacturer's density and thickness.
PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Materials as manufactured by Certain-Teed, Johns-Manville, Knaul, Owens-Corning, Foster Products, Childers or approved equal meeting these specifications are acceptable.

2.2 TYPE AND PERFORMANCE

A. Adhesives and Insulation Materials: Composite fire and smoke hazard ratings maximum 25 for Flame Spread and 50 for Smoke Developed. Adhesives to be waterproof.

B. All Rectangular and Round Supply Ducts: Rigid or Flexible fibrous glass insulation, 1 1/2 inch thick "K" value at 75 degrees F maximum 0.26 btu/hr.sq.ft./Deg. F/hr. with factory applied reinforced aluminum foil vapor barrier for temperatures for +40 Deg. F to +250 Deg. F services.

PART 3 EXECUTION

3.1 PREPARATION

A. Do not install covering before ductwork has been tested and approved.

B. Ensure surface is clean and dry prior to installation. Ensure insulation is dry before and during application.

3.2 INSTALLATION

A. Ensure installation is continuous through inside walls. Pack around ducts with fireproof self-supporting insulation material, properly sealed.

B. Finish insulation neatly at hangers, supports and other protrusions.

C. Locate insulation or cover seams in least visible locations.

D. Concealed Ducts: Adhere flexible insulation to ductwork with adhesive applied in 6 inch wide strips on 16 inch centers. Provide 16 gage annealed tie wire tied, spiral wound or half hitched at 16 inch centers for securing duct insulation until adhesive sets. Butt insulation and seal joints and breaks in ducts conveying air at less than room temperature with 2 inch of foil adhered over joint.
E. Repair separation of joints or cracking of insulation due to thermal movement or poor workmanship.

END OF SECTION
THIS PAGE INTENTIONALLY LEFT BLANK
233300 – AIR DUCT ACCESSORIES

PART 1   GENERAL

1.1 WORK INCLUDED

A. Access Doors
B. Balancing Dampers
C. Backdraft Dampers
D. Flexible Connections
E. Turning Vanes

1.2 RELATED WORK

A. Section 230500 – Common Work Results for HVAC
B. Section 230593 – Testing, Adjusting & Balancing For HVAC
C. Section 233115 – Duct Insulation
D. Section 233113 – Ductwork
E. Section 232114 – Duct Lining
F. Section 233423 – HVAC Power Ventilators
G. Section 233713 – Diffusers, Registers & Grilles

1.3 QUALITY ASSURANCE

A. Accessories shall meet the requirements of NFPA 90A, Air Conditioning and Ventilating Systems as applicable.
B. Fabricate in accordance with ASHRAE handbooks and SMACNA duct manuals.

1.4 SUBMITTALS

A. Submit product data in accordance with Section 230500.

PART 2   PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS
A. Products manufactured by Air Balance, Greenheck, DuroDyne, Penn, Krueger, Safe Air, Dowco or Ruskin meeting these specifications are acceptable.

2.2 ACCESS DOORS

A. Fabricate rigid and close-fitting doors of galvanized steel with sealing gaskets and quick fastening locking devices. For internally lined or insulated ductwork, install minimum one inch thick insulation with sheet metal cover.

B. Provide two hinges and two sash locks for sizes up to 18 inch square, two hinges and two compression latches with outside and inside handles for sizes up to 24 inch x 48 inch. Provide an additional hinge for larger sizes.

2.4 DAMPERS

A. Fabricate balancing dampers of galvanized steel, minimum 16 gauge and provide with locking quadrants.

B. Fabricate multi-blade damper of opposed blade pattern with maximum size 16 sq. ft. Assemble center and edge crimped blade in prime coated or galvanized channel frame with suitable hardware and locking quadrant.

C. Fabricate multi-blade, counter balanced backdraft dampers with blades a maximum 8 inch width having felt or flexible vinyl sealing edges, linked together in rattle-free manner and width adjustment device to permit setting for varying differential static pressure.

2.5 FLEXIBLE CONNECTION

A. Fabricate of neoprene coated flameproof fabric approximately 4 inch wide tightly crimped into metal edging strip and attach to ducting and equipment by screws or bolts at 6 inch intervals.

2.6 TURNING VANES

A. Fabricate turning vanes and rails of 24 gauge galvanized steel and assemble rattle free.

B. Turning vanes shall be single thickness prefabricated or assembled per manufacturer's instructions for optimum shape.

C. Secure to duct with sheet metal screws, rivets or weld. Final assembly shall be rattle free.

2.7 APPLICATION
A. Provide access doors for inspection and cleaning at filters, fans, and as indicated on the drawings. Review locations prior to fabrication.

B. Provide balancing dampers at points on supply, return, and exhaust systems where branches are taken from larger ducts as required for air balancing and where indicated on the drawings.

C. Provide flexible connections immediately adjacent to equipment, in ducts associated with fans, equipment subject to forced vibration and as shown on the drawings.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install items in accordance with manufacturer’s printed instructions and SMACNA Standards.

B. For connections to fans, install 1/2 inch thick neoprene pad over fabric and hold in place with additional metal strips.

END OF SECTION
233423 – HVAC POWER VENTILATORS

PART 1  GENERAL

1.1 WORK INCLUDED

A. Curb Mounted Roof Exhaust Fans

1.2 RELATED WORK

A. Section 230500 – Common Work Results for HVAC
B. Section 230593 – Testing, Adjusting & Balancing For HVAC
C. Section 233113 – Ductwork
D. Section 233300 – Air Duct Accessories
E. Division 26 – Electrical Requirements

1.3 QUALITY ASSURANCE

A. AMCA rated for both sound and air flow performance
B. AMCA rating seals

1.4 SUBMITTALS

A. Submit product data including dimensional data, material specifications, capacity data, sound data and installation procedures in accordance with Section 230500.

PART 2  PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Products manufactured by Greenheck, Cook, Penn, Jenn Fan or Twin City meeting these specifications are acceptable.

2.2 CURB MOUNTED ROOF EXHAUST FAN

A. Provide belt or direct driven centrifugal roof exhausters as scheduled. Performance shall meet or exceed that scheduled.

B. Ventilator housing shall be of heavy gauge spun aluminum construction or formed galvanized steel and shall be weatherproof, incorporating an integral weather shield.
C. Ventilators shall be furnished with birdscreen.

D. Fan wheels shall be backward inclined, non overloading centrifugal type, statically and dynamically balanced. RPM and motor horsepower shall be as specified and shall not exceed the maximum listing in the manufacturer's catalog for the unit specified.

E. Housing shall be provided with wiring channel and is to be of the direct discharge design.

F. Motor and fan assembly shall be on vibration isolating mounts.

F. Motors shall be permanently lubricated, sealed ball bearing type self-cooled with clean, cool, outside air and shall be located in a compartment separate from the exhaust air stream so that no lint, heat, grease, fumes, or dust in the exhaust air can come in contact with the motor.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install roof exhauster on roof curb provided by fan manufacturer. Carefully coordinate exact curb dimensions.

B. Connect to ductwork as specified in Section 233113.

C. Balance in accordance with Section 230593.

END OF SECTION
233713 – DIFFUSERS, REGISTERS & GRILLES

PART 1   GENERAL

1.1   WORK INCLUDED

A. Supply, Return, Transfer and Exhaust Air Devices and Accessories.

1.2   RELATED WORK

A. Section 230500 – Common Work Results for HVAC

B. Section 230593 – Testing, Adjusting & Balancing For HVAC

C. Section 233113 – Ductwork

D. Section 233300 – Air Duct Accessories

1.3   QUALITY ASSURANCE

A. Make air flow tests and sound level measurement in accordance with applicable ADC equipment test codes and ASHRAE standards.

B. Manufacturer shall certify cataloged performance and ensure correct application of air outlet types.

1.4   SUBMITTALS

A. Submit in accordance with Section 230500.

B. Submit product data and shop drawings covering each item together with schedule of outlets, listing cfm, neck velocity, NC level and Ak factor and air flow measurement procedures.

1.5   JOB CONDITIONS

A. Review requirements (including architectural drawings) of outlets as to size, finish, and type of mounting prior to submitting shop drawings and schedules of outlets.

B. Check location of outlets and make necessary adjustments in position to conform with architectural features, symmetry, and lighting arrangement.
PART 2  PRODUCTS

2.1  ACCEPTABLE MANUFACTURERS

A. Products manufactured by Krueger, Tuttle & Baily, Titus, J&J, Price or Nailor, meeting these specifications are acceptable.

2.2  GENERAL REQUIREMENTS

A. Provide air devices equal in all respects to those scheduled on the drawings.
B. Rate units in accordance with ADC standards.
C. Base air outlet application on space noise level of NC 35 maximum in all areas unless indicated otherwise on drawings.
D. Provide supply outlets with sponge rubber seal around edge.
E. All devices shall be factory finished.
F. When required provide air devices factory installed in metal panels painted to match air device finish. Panel shall be suitable for insertion into lay-in-tile ceilings.

PART 3  EXECUTION

3.1  INSTALLATION

A. Install items in accordance with manufacturer’s printed instructions.
B. Paint ductwork visible behind air outlets matt black.
C. Seal square to round adaptors or lined plenum boxes air tight to diffusers or grilles.
D. When required cut metal panels for insertion in ceiling at grid location where tiles may be less than nominal size. Center diffuser or grille within modified panel.

END OF SECTION
PART 1   GENERAL

1.1   WORK INCLUDED

   A.  Packaged heating/cooling unit
   B.  Controls
   C.  Commissioning of HVAC

1.2   RELATED WORK

   A.  Section 230500 - Basic Mechanical Requirements
   B.  Section 230529 – Hangers & Supports for HVAC Piping & Equipment
   C.  Section 233113 - Ductwork
   D.  Section 230593 - Testing, Adjusting & Balancing

1.3   QUALITY ASSURANCE

   A.  Meet the requirements of UL and applicable codes.
   B.  Test and rate cooling systems to the appropriate ARI Standard.

1.4   REFERENCE STANDARDS

   A.  ARI Standard 210/240 or 360 and 270.
   B.  National Electrical Code.
   C.  American Gas Association Certification.

1.5   SUBMITTALS

   A.  Submit shop drawings and product data in accordance with Section 15010.
   B.  Submit manufacturer's installation instructions.
   C.  Submit manufacturer's descriptive literature including dimensions, capacity data, fan performance data, motor data and filter data.
D. Submit schedule of actual unit performance data versus design unit performance data.

1.6 WARRANTY

A. Provide 5 year unconditional parts warranty on compressor.

PART 2  PRODUCTS

2.1 ACCEPTABLE MANUFACTURER'S

A. Units manufactured by Carrier or Trane meeting or exceeding these specifications are acceptable.

2.2 TYPE AND PERFORMANCE

A. Units shall be self-contained, factory assembled and prewired with single point electrical connection. Unit shall consist of cabinet and frame, supply fan, heat exchanger and burner, economizer cycle dampers and controls when required, compressors, evaporator coil, condenser coil and fan(s) and all required and necessary safety and operating controls.

B. Units shall be suitable for outdoor use.

C. Unit shall meet or exceed the capacity scheduled.

2.3 CABINET AND FRAME

A. Unit shall be fabricated of heavy gauge, galvanized steel with weather-resistant baked enamel finish.

B. Insulate the cabinet interior with 1/2 inch thick minimum coated fiberglass insulation. Protect exposed edges from erosion.

C. Cabinet panels shall be easily removable for serving.

D. Unit shall have a factory installed, sloped condensate drain pan with drain connection.

2.4 FANS AND MOTORS

A. Fans shall be forward curved centrifugal type. Fan and motor shall be internally isolated from the unit frame. Fans shall be belt or direct driven as scheduled. Belt drive units shall have an adjustable pitch motor pulley.
B. Outdoor fans shall be of the propeller type, direct drive, statically and dynamically balanced. Fan motor shall have permanently lubricated bearings and have built-in thermal overload protection. Fan motor shall be totally enclosed.

2.5 COILS

A. Evaporator and condenser coils shall be of non-ferrous construction with aluminum plate fins mechanically bonded to enhanced copper tubes with all joints brazed. Coils shall be factory leak tested and pressure tested. Condenser coil shall be provided with hail guard assembly to prevent damage from hail and debris.

2.6 COMPRESSORS

A. Compressor(s) shall be fully hermetic or semi-hermetic with unloading and have spring vibration isolators and crankcase heaters. Compressors shall be capable of operation down to 25 degrees F outdoor air temperature.

2.7 COOLING SYSTEM SAFETY CONTROLS

A. Compressors shall be provided with the following minimum protections:

1. Overcurrent Protection.
2. Over-Temperature Protection.
3. Short Cycle (minimum 5 minutes before restart).
4. Loss of Refrigerant (low pressure).
5. Indoor Coil Freeze Protection Thermostat.
6. High-Pressure Switch.

2.8 GAS HEAT EXCHANGERS

A. Heating section shall have a heat exchanger constructed of corrosion resistant steel components.

B. Gas burner shall be induced draft combustion type and shall be constructed of corrosion resistant steel.

C. Heating controls shall consist of the following as a minimum:

1. Redundant gas main valve.
2. Electronic spark ignition system.
3. High temperature limit switches for excessive bonnet temperature.
4. Flame rollout switch.
5. Flame proving controls.

2.9 REFRIGERANT COMPONENTS
2.10 FILTER SECTION

A. Filter section shall consist of two inch thick disposable pleated media filters, Aerostar Green Pleat MERV-13 or equivalent.

2.11 CONTROLS

A. Unit shall be provided with a protected low-voltage control circuit.

B. Unit shall be controlled by a Honeywell programmable thermostat as scheduled with locking cover. Install thermostat and wire to unit as per manufacturer's instructions.

2.12 OUTDOOR DAMPER

A. Unit shall be provided with a motorized outdoor air damper and rainhood. Rainhood shall be provided with birdscreen covering outdoor air opening.

2.13 ELECTRICAL

A. Unit shall be provided with a single point electrical connection.

B. Unit shall be provided with a unit-mounted, non-fused disconnect switch.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install units in strict accordance with manufacturer's installation instructions.

B. Unit shall be installed on a factory roof curb. Roof curb shall allow the installation and securing of ductwork prior to maintaining unit on curb.

C. Provide flexible connection at all duct connections. Provide sheet metal weather guard over flex connections on side discharge units.

END OF SECTION
236315 - DUCTLESS AIR CONDITIONING UNITS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Ductless Split System Air Conditioning Units

1.2 RELATED WORK

A. Section 230593 - Testing, Adjusting and Balancing
B. Section 230500 – Common Work Results for HVAC
C. Section 232300 - Refrigerant Piping

1.3 REFERENCE STANDARDS

A. Unit shall be U.L. Listed.
B. Unit shall be certified in accordance with ARI Standard 210/240.

1.4 SUBMITTALS

A. Submit product data in accordance with Section 230500.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Products manufactured by Carrier, Daikin, Fujitsu, Mitsubishi, Samsung, and Sanyo are acceptable provided they meet or exceed these specifications.

B. The condensing unit and matching fan coil unit shall be products of the same manufacturer.

2.2 PERFORMANCE

A. Unit performance shall meet or exceed performance scheduled on the drawings.
B. Verify with manufacturer that refrigerant piping sizes connecting indoor unit to outdoor unit are adequate to insure performance scheduled on the drawings.
2.3 GENERAL

A. Unit shall be factory assembled and tested. Outdoor unit shall contain hermetic rotary compressor(s), plate fin condenser coil, fan, motors and controls. System shall operate using refrigerant R-410A.

2.4 INDOOR UNIT

A. Indoor, direct expansion, wall mounted fan coil. Unit shall be complete with cooling/heating coil, fan, fan motor, piping connectors, electrical controls, microprocessor control system, and integral temperature sensing. Unit shall be furnished with integral wall mounting bracket and mounting hardware.

B. Coil shall be copper tube with aluminum fins and galvanized steel tube sheets. Fins shall be bonded to the tubes by mechanical expansion. A drip pan under the coil shall have a drain connection for hose attachment to remove condensate. Condensate pan shall have internal trap.

C. Unit shall have cleanable filters.

D. Controls shall consist of a microprocessor-based control system which shall control space temperature, determine optimum fan speed, and run self diagnostics. Unit shall have remote thermostat control either wired or wireless type.

2.5 OUTDOOR UNIT

A. Casing shall be constructed of minimum 18 gauge galvanized steel. Exterior surfaces shall be finished with weather-resistant baked enamel finish. Casing shall have removable panels to allow for easy service of all major components.

B. Compressor shall be direct drive hermetic rotary type with centrifugal oil pump provided for lubrication of moving parts. Provide crankcase heater, internal spring isolation and sound muffling device.

C. Condenser coil shall be 3/8" copper tubes mechanically bonded to aluminum plate fins. Coil shall be factory pressure and leak tested. Condenser fan(s) shall be direct drive propeller type, statically and dynamically balanced. Fan motor shall be permanently lubricated totally enclosed type.

D. Provide all necessary refrigeration system components including but not limited to expansion valve, filter drier and service valves and gauge ports.

E. Safety and operating controls shall include but not be limited to compressor and fan motor overloads, high and low pressure cut-off devices, defrost control, low ambient operation (allows operation to 20 degrees), anti-recycling control and all necessary fusing. Provide 24-volt control system including control power transformer, fuses, relays and all other required devices.
PART 3 - EXECUTION

3.1 INSTALLATION

A. Install unit as per manufacturer's instructions.

B. Insure that exact location of condensing unit has adequate clearance for air flow and servicing as per manufacturer's specifications.

END OF SECTION
DIVISION 26 - ELECTRICAL

260500 - ELECTRICAL

1.1 GENERAL

A. Drawings, Section I - Legal Documents and Division 1 Specification Sections, apply to this Section.

B. This Section uses the term "Architect." Change this term to match that used to identify the design professional as defined in the General and Supplementary Conditions.

1.2 SCOPE

A. Includes all labor, material and equipment required to furnish and install a complete electrical system as shown on the drawings and as specified herein.

B. Work includes but is not necessarily limited to the following:

1. Electrical secondary feeders and distribution equipment and grounding.
2. Wiring for light and power to all outlets, devices, controls and equipment.
3. Lighting fixtures as specified, complete with lamps and necessary hardware.
4. Lighting controls, complete with necessary incidentals, wiring and programming for a complete and operating system.
5. Final electrical connections of equipment specified or furnished under other divisions of this specification.
6. Special systems (fire alarm, etc.) as specified by other sections of this specification or as indicated on the drawings.
7. Cutting and patching as necessary to install electrical work.

C. Omission of express reference to any material or labor necessary for or incidental to a complete installation shall not be construed as releasing Contractor from furnishing such material and labor. The electrical system as installed shall be complete and functional with all electrical items in operable condition.

D. Carefully examine the building site and compare the drawings with existing conditions. Further, verify utility requirements with the proper utility companies involved. By the act of submitting a bid, the contractor shall be deemed to have made such examination and to have accepted such conditions, and to have made allowance therefore in preparing this bid.

E. Construction Power Electrical Service:
1. Make all necessary arrangements, apply for all permits, and provide all temporary electrical service and lighting required for construction purposes during the entire period of construction.
2. Coordinate with all trades and provide temporary lighting and power adequate for construction.
3. Comply with all applicable OSHA and NFPA-70, National Electrical Code requirements for temporary wiring at construction sites.
4. Existing building electrical system may be used as the power supply for the construction power electrical system. Verify point of connection with Architect/Engineer.

F. Permanent Utility Services:

1. Existing to remain.

1.3 DRAWINGS

A. The architectural drawings take precedence over the electrical drawings in the representation of the general construction work and the drawings of the various trades take precedence in the representation of the work of those trades.

B. For the purpose of clearness and legibility, the electrical drawings are essentially diagrammatic. The size and location of equipment is shown to scale whenever possible, but the contractor shall make use of all the data in the contract documents to properly locate all electrical equipment.

1. Refer to Architectural Reflected Ceiling Plan for exact location of ceiling mounted lighting fixtures, heat and smoke detectors, loud speakers and similar equipment which are mounted on ceiling.
2. When Architectural Interior or Millwork Elevations show electrical outlets, the locations on such elevations shall define the exact location of the outlet.
3. Maintain Code clearances about electric equipment.
4. Although the drawings are diagrammatic and the exact location and routing of raceways is not indicated, it is intended that the point-to-point connections of the raceways as shown on the circuited plans be adhered to.
5. When raceways are indicated to be installed above the floor (by being drawn with solid lines), they shall not be changed to be run under floor inside the building. When specifically indicated (by dashed lines) raceways shall run under floor inside the building.
6. In the event that Contractor proposes to deviate from layouts as indicated, submit for prior approval before making any changes. Shop drawings showing the proposed changes may be required. All such changes shall be approved and be recorded in the record drawings.
1.4 CODES AND STANDARDS

A. All electrical equipment, materials and method furnished and installed by this contractor shall comply with the 2017 edition of NFPA-70 National Electrical Code as adopted by the legally constituted authorities having jurisdiction; including all local ordinances, safety orders of the State Division of Industrial Safety, and state and local fire marshals. All code references in the Contract Documents (Drawings, Specifications, Addenda, Change Orders, etc.) are to the current adopted edition of the Code.

B. Materials shall be listed by a nationally recognized testing laboratory which is accepted by the authority having jurisdiction, such as Underwriter's Laboratories, Inc. (UL), where such a listing exists for that style or general arrangement of equipment. Equipment shall be installed and connected in compliance with all the listing instructions.

C. It is recognized that Codes specify minimum standards, and whenever the Contract Documents call for materials, workmanship, arrangement or construction of quality or standard higher than Code, the Contract Documents shall take precedence. In the event that the contract documents call for a quality or standard lower than Code, then Code requirements shall govern.

1.5 PERMITS AND INSPECTIONS

A. Refer to Division 1 for Permits.

B. All work shall be subject to the inspection of any authorized agency and the Owner or Owner's Agent. No work shall be covered or concealed in any way prior to inspection and approval by the proper authorities. Should uninspected work be covered, the contractor shall, at no cost to Owner, uncover all such work and, after it has been inspected and approved, repair all damage done in a manner satisfactory to the Architect.

1.6 APPROVAL OF MATERIALS

A. For convenience in designation, certain materials are specified by manufacturer’s name and catalog number. Alternative equipment which is of equal capacity, style, size and quality as the equipment specified may be used subject to the approval of the Architect. The burden of proof as to the comparative suitability of the alternate equipment shall be upon the Contractor. Provide all information, demonstrations, and samples necessary or related hereto as required by the Architect. The Architect shall be the sole judge in such matters and his decision shall be final.
B. Requests for approval of alternate material or method shall be submitted to the Architect at least seven (7) days prior to bid date and in addition shall conform with all provisions of the General Provisions of these Specifications.

C. Where the use of alternate materials results in a change of arrangement, location or size from that indicated on the drawings, the Contractor shall submit for approval shop drawings showing the proposed changes.

D. Verify availability of all equipment and materials proposed for use in execution of Contract prior to submitting same for approval. Discontinuance of production of any equipment or materials shall not relieve the Contractor from furnishing and installing approved alternate equipment and/or materials of equal quality and style without additional cost to Owner.

1.7 SUBMITTALS

A. Before starting work, submit shop drawings and/or product literature for at least the materials listed below:

Switchboards -- shop drawings  
Panelboards -- shop drawings  
Motor Controls -- product literature  
Safety Switches and Disconnects -- product literature  
Switches, Receptacles and Device Cover Plates -- product literature  
Floor Boxes and Covers -- product literature  
Wall Box Dimmers -- product literature  
Lighting Fixtures -- shop drawings  
Nameplates and Engraved Cover Plates -- schedule describing all types  
Special Systems (i.e. fire alarm, etc.) -- shop drawings  
Control Systems -- shop drawings

B. Submittals shall be in accordance with Division 1 requirements. If paper submittals are provided, they shall be in four (4) copies, one (1) of which will be returned to the contractor. The contractor shall make reproductions of the returned copy in quantities as required for his own use and in addition shall give one (1) copy to the equipment supplier, keep one (1) copy at his office and include four (4) copies in the Maintenance and Operating Instructions.

C. Do not include operating, maintenance or repair manuals in the product submittals unless specifically requested.

D. All electrical submittals shall be made at one time. Incomplete or partial submittals will not be accepted.

E. Re-submittals shall not include material which was previously reviewed and approved.
F. Shop drawings larger than 11" x 17" paper size shall be prepared using the same size drawing sheet as the bid/construction documents. Such shop drawings shall be included as part of the Record Drawings.

1.8 MAINTENANCE AND OPERATING INSTRUCTIONS

A. Prepare four (4) complete sets of Maintenance and Operating Instructions which cover electrical systems and equipment furnished and installed for this project.

B. Include all published literature which is provided by the equipment manufacturer. As a minimum, the following shall be provided:

1. Instruction sheets or manuals
2. Repair manuals
3. Spare parts lists
4. Wiring Diagrams
5. Manufacturer's warrantee information
6. Other written material or drawings furnished with or packed with the products or available on-line from the equipment manufacturer.
7. Manufacturer and Catalog Number of all ballasts and lamps.

C. Do not include copies of the electrical product submittals in the O & M material. Only submit material described in 1.8 B. 1 thru 8 above.

D. Assemble each set of Maintenance and Operating Instructions into 3-ring binder.

E. Provide table of contents and tab separators to organize the manual by specification section and product type.

F. Provide a copy of the product submittals in a separate binder labeled: "Electrical Products Submittals."

1.9 RECORD DRAWINGS

A. Provide and keep up-to-date one (1) separate complete and legible "as-built" set of drawing prints, corrected daily and showing every change from the original drawings and specifications, exact "as-built" location, size and kind of fixture, runs of wire and conduit, location of pull and junction boxes, and other equipment as actually installed. In addition, items changed or deleted by addendum or change orders shall be indicated. This drawing shall be kept on-site and used only as a record set. This set shall not be used for construction purposes.
B. In each section of the record drawings and specifications the manufacturer's name, product name, and catalog number for each product used shall be indicated. When the bid documents indicate more than one name or catalog number for a product, the products not used shall be deleted from the record drawings so that only the exact products used are the only types described on the record drawings.

C. Addenda, Change Order and Clarification drawings issued for construction during the course of the work shall be drawn on to the record drawings at the correct location and on the correct drawings.

D. Changes as shown on corrected drawing prints shall be professionally drawn in accordance with Division 1 requirements. Such drawings shall be accurate and will provide a record for future maintenance and service.

1.10 MASTER KEYING

A. For equipment such as panelboards and equipment cabinets which are supplied with integral locks, all such locks shall be keyed alike. Furnish three (3) sets of keys for each lock.

B. For equipment such as outdoor switchboards and safety switches provide provisions for padlocking for all such equipment with direct access by the public. Provide Master Model 3 padlocks for all such equipment. In addition on safety switches and similar equipment provide one padlock for unit cover and one padlock to lock switch handle on. All padlocks keyed alike, unless specifically indicated otherwise.

C. All keys shall be identified as to the locks which they operate.

1.11 IDENTIFICATION

A. For switchboards and panels, provide nameplates for each section or panel stating the section name and voltage. Each circuit breaker and fused switch in distribution panels or switchboards shall have a nameplate indicating the load served.

B. Individual safety switches, disconnect switches, starters, contactors, time-switches, etc. shall have nameplates describing the load served.

C. Switches for lights installed remote from the switch location shall have engraved cover plates provided.

D. Control switches for mechanical and other equipment shall be identified by engraved cover plates or nameplates attached to the switch.

1. Describe the load controlled.
2. Describe the power source feeding the equipment.
3. Engraved cover plates shall be factory machine engraved and shall have black enamel filled lettering.
4. Nameplates shall be engraved bakelite type.
5. Applies to all switches except light switches.

E. Nameplates as specified above shall be constructed of laminated bakelite.
   1. Use white-black-white color laminated bakelite.
   2. Lettering shall be 3/16” high (or larger when called for on drawings) cut through white layer of bakelite to reveal black layer.
   3. All nameplates shall be screwed or riveted to the equipment. Adhesive attachment is not acceptable.

F. Home run junction boxes and pull boxes located above accessible ceilings and exposed in unfinished spaces shall have panel name and circuit numbers written on the box cover. Use waterproof marking pen, 1” high lettering.

G. Pull and junction boxes for special systems (i.e. fire alarm, etc.) shall be identified. Use waterproof marker on cover for boxes above accessible ceilings and exposed in unfinished spaces, write identification on inside of box when in exposed location.

H. Pull, outlet and junction boxes for special systems shall be color coded by painting the inside and outside of box (and cover when in unfinished space or in equipment room) prior to installation. Boxes painted after installation are not acceptable. Also write type of system on cover.
   1. Fire Alarm: Red

I. Switchboards, Panelboards, industrial control panels and Motor Control Centers shall be field marked to warn qualified persons of potential electric arc flash hazards in accordance with NFPA-70, Article 110.16. Warning label shall comply with ANSI Z535.4-2011 requirements.

1.12 COOPERATION WITH OTHERS

A. Work shall proceed so that it will harmonize with that of other trades. All work shall coordinate with other trades and contractor is responsible for correct placing of work in proper location to avoid conflict.

1.13 PRELIMINARY OPERATION

A. Owner may require operation of any portion of systems or equipment prior to final completion and acceptance of work. Such preliminary operation shall not be construed as an acceptance of any work.
B. Contractor shall become familiar with the requirements and schedule for construction phasing and shall comply as required to have Electrical systems operational at the appropriate time. It may be necessary for electrical work to be completed ahead of other trades or ahead of the scheduled completion of a given area of the building in order to make the work functional in a preceding phase of work.

1.14 CHANGES AND ADDITIONAL WORK

A. Changes shall not be made from the work as indicated except on written order of Architect, stating change to be made for the work.

1.15 PROTECTION

A. Materials, equipment, etc., including those furnished by others that are to be installed by this contractor shall be received and properly protected from damage.

1.16 WARRANTY

A. Refer to Division 1 for basic warranty requirements.

B. Ballasts, LED Drivers and lighting controls shall be warranted for at least two (2) years, including material and labor to replace defective equipment.

C. When manufacturer's warranty exceeds the warranty as described in Division 1 the full manufacturer's warranty shall apply to this work.

PART 2 PRODUCTS

2.1 GENERAL

A. Except as specifically noted, materials shall be new, full weight or size, standard in every way, the best quality of their respective kinds, and satisfactory to the Architect.

B. Equipment and Materials shall be suitable for use intended (i.e. weatherproof enclosures for exterior or wet locations, proper voltage ratings for fuses and safety switches, etc.).

C. All metallic conduit shall be hot dipped galvanized, sherardized or electro-galvanized.

2.2 RACEWAYS

A. Rigid Metallic Conduit:
1. Full weight, minimum size is 3/4 inch trade size.
2. Fittings installed underground, in wet locations or exposed outdoors shall be threaded type -- no set screw or compression types.
3. Fittings installed indoors where otherwise impracticable to install threaded type fittings shall be permitted to be steel compression type. Other indoor locations shall use threaded type fittings.
4. Rigid Metallic Conduit installed underground or concealed in slabs on grade shall be protected from corrosion by Scotch No. 50 tape, half overlap wrapped. Such tape wrapping shall cover the entire conduit system below grade or in concrete slabs on grade.
5. Rigid Metallic Conduit shall be permitted to be used as raceway for all wiring systems at any location concealed or exposed (exposed wiring only when specifically permitted). Hazardous (classified) locations shall be required to use Rigid Metallic Conduit with threaded fittings.

B. Intermediate Metal Conduit (IMC):

1. Minimum size is 3/4 inch trade size.
2. Fittings installed underground, in wet locations or exposed outdoors shall be threaded type -- no set screw or compression types.
3. Fittings installed indoors where otherwise impracticable to install threaded type fittings shall be permitted to be steel compression type. Other indoor locations shall use threaded type fittings.
4. IMC installed underground or in concrete slabs on grade shall be protected from corrosion as specified above for Rigid Metallic Conduit.
5. IMC shall be permitted to be used for raceways for all wiring systems at any location concealed or exposed (exposed wiring only when specifically permitted) except IMC shall not be used in hazardous locations or when drawings indicate use of a different type of raceway for the specific run.

C. Electrical Metallic Tubing (EMT):

1. Minimum size is 1/2 inch trade size.
2. EMT may be used concealed in attic, furred spaces and stud walls.
3. EMT may be used concealed in masonry and brick above grade. EMT may be embedded in poured concrete above grade.
4. EMT may be used exposed, but only when exposed raceway is permitted, EMT shall not be used for exposed raceways subject to physical damage.
   a. Do not use exposed EMT above roofs.
   b. Do not use exposed EMT in any location subject to severe physical damage such as loading docks or locations exposed to vehicular traffic.
c. In such locations exposed raceways shall be rigid steel or IMC raceways with threaded fittings.

D. EMT Fittings and Connectors:

1. Appleton, Crouse-Hinds or Thomas & Betts.
2. In concealed work use steel set screw or compression type fittings. Do not use die cast or pot metal type.
3. In exposed work use only steel compression type fittings for sizes 2 inch and smaller (steel set screw fittings are acceptable only for exposed runs of 2 1/2 inch and larger EMT).
4. Use insulated throat connectors except when insulated bushings are used.

E. Rigid Non-Metallic Conduit (PVC):

1. Heavy wall schedule 40 or of type as noted on drawings. Minimum size is 3/4" trade size.
2. Fittings used with PVC shall be cement-on style, rated for same operating temperature as the conduit.
3. PVC may be used for underground conduit runs both outside and under floor inside building. PVC shall not be used anywhere above grade or exposed. Use Rigid Metallic Conduit for penetrations through concrete slabs from PVC below. For pulls over 25' long, bends and elbows in PVC system shall be rigid steel, with appropriate coupling to PVC or they shall be concrete encased PVC.
4. Provide concrete encasement for PVC only when indicated. Concrete encasement shall cover conduits minimum of 3" on all sides. Provide plastic conduit supports as necessary for duct alignment in concrete encased duct banks.

F. Flexible Metallic Conduit (Greenfield):

1. Greenfield connectors shall be screw clamp type -- no twist-in connectors allowed. Do not use 90 degree flex connectors without prior approval.
2. Use only steel flex conduit, not aluminum. Minimum size shall be 1/2" except 3/8" may be used for light fixture whips.
3. Greenfield shall be used in lengths not to exceed 3'-0". Use only indoors in dry locations.
4. Fixture whips up to 6'-0" long may be used to connect lay-in type lighting fixtures. (In general, light fixture manufacturer's standard flex connectors are not acceptable.)

G. Liquid-Tight Flexible Non-Metallic Conduit (Liquid-Tight Flex):
1. Connectors shall be weatherproof compression type.
2. Minimum size 1/2" trade size.
3. Liquid-tight flex shall be used in lengths not to exceed 3'-0".
4. Do not use Liquid-Tight Flexible Metallic Conduit in locations outdoors where exposed to sunlight.

H. Special Raceways: As indicated.

2.3 OUTLET BOXES AND JUNCTION BOXES

A. Galvanized code gauge steel construction for concealed work.

B. Size in accordance with Articles 312 and 314 of NFPA-70 National Electrical Code.

C. Provide plaster rings or tile covers of proper gang as required.

D. Minimum size for any outlet is 4" sq. x 1-1/2" deep or larger when required with appropriate plaster ring.

E. Use cast aluminum type boxes and matching cover plates for surface outlets, switches, etc. in exposed work and for surface or flush weather-proof locations. Use Pass & Seymour WPB series in 1-gang, 2-gang and 3-gang configurations or equivalent by other manufacturers. (Above 8'-0" A.F.F. stamped steel boxes may be used in interior locations when exposed except when surface metal raceways are used.)

F. Floor boxes shall be Legrand Evolution Series with grey finished metallic covers. Unless otherwise indicated provide dual service boxes flush in floor with (2) duplex power receptacle devices and provision for telephone-data outlet devices. Actual telephone-data devices provided by Division 27. Coordinate exact mounting plate required for telephone-data devices. When used for feed to systems furniture provide systems furniture activation cover and liquid tight flexible conduit whips to connect to furniture. Covers and flanges shall match floor finishes at each location. Provide carpet flanges in carpeted locations. Minimum size conduit supplying telephone-data compartment is 1". Provide larger conduit when indicated.

2.4 CONDUCTORS

A. Unless indicated otherwise, all conductors shall be insulated, 98% minimum conductivity copper.

1. Minimum size for lighting and power circuits is No. 12 AWG, provide larger size when indicated or required.
2. Fixture whips and internal wiring in light fixtures shall be No. 18 AWG minimum, unless larger size indicated.
3. Minimum size for fire alarm circuits is No. 14 AWG, solid copper conductor.
4. Minimum size for line voltage controls is No. 14 AWG, stranded or solid copper conductor when overcurrent protection on control circuit does not exceed 15 amperes.
5. Minimum size for low voltage controls is No. 18 AWG, copper. Low voltage control wiring shall be type and ratings as recommended by the control system manufacturer.
6. Provide Aluminum Alloy type conductors for specific, indicated feeders and service lateral conductors only.

B. Conductors construction:
1. No. 10 AWG and smaller solid conductor.
2. No. 8 AWG and larger for general wiring stranded conductor.
3. No. 8 - 2 AWG exposed grounding conductors solid conductor.

C. Conductor insulation:
1. No. 12 - 8 AWG in wet or dry locations: "THHN or THWN" or "THWN-2".
2. No. 6 AWG and larger in wet or dry locations: "THHN or THWN", "THWN-2", "XHHW" or "XHHW-2".
4. Fire alarm conductors installed underground: "XHHW" or "XHHW-2". Alternatively, West Penn AquaSeal type cable can be used.
5. Special conductor insulation as noted.

D. Color code all conductors. Use colored insulation (not colored tape) for sizes No. 6 AWG and smaller. Use colored tape at all terminations, junction and pull boxes, etc., for sizes No. 4 AWG and larger.

1. 208Y/120V three phase system -- Neutral White, Phase A Black, Phase B Red, Phase C Blue, Ground Green.
2. 480Y/277V three phase system – Neutral Gray, Phase A Brown, Phase B Orange, Phase C Yellow, Ground Green.
3. Isolated ground wires Green with yellow tracer.

E. Copper conductor, #12 AWG minimum, THHN insulated in types AC and MC cables are approved for 15A and 20A branch circuits installed above grade in frame wall and above ceiling spaces. Provide AC and MC cables with proper color coded conductors for each circuit application.

2.5 WIRING DEVICES
A. Catalog numbers listed below are for Pass & Seymour wiring devices. Equal products as manufactured by Arrow Hart, Hubbell and Leviton are acceptable.

B. Color of all devices shall be brown unless otherwise indicated.

C. Toggle Switches:
   1. Single pole, double pole, 3-way, 4-way Hard Use Specification Grade 20A 120/277V # CSB20AC1, CSB20AC2, CSB20AC3, CSB20AC4 respectively.
   2. Toggle switch type equipment disconnect switches shall be heavy duty industrial grade type of ampere rating, voltage and number of poles indicated.

D. Manual Motor Starter Switches:
   1. Square D class 2510, with overload protection, 1-Pole or 2-pole as required. With overload heaters selected per manufacturer's recommendation for actual motor nameplate amperes. Use for all locations unless switch without overload protection is specifically indicated.
   2. When non-overload protected manual motor starter switches are indicated use Square D class 2510 switches of the proper style for the application.

E. Duplex Receptacles:
   1. Tamper Resistant 20A, 125V #TR5362.
   2. Duplex receptacle devices shall have Auto-ground clip on one device mounting screw.
   3. On 15A circuits use 15A rated versions of devices indicated above.

G. Ground Fault Circuit Interrupter Receptacles:
   1. Indoor Tamper Resistant 20A, 125V #2095TR.
   2. Outdoor or Weather Proof locations 20A, 125V #2095TRWR. These are also tamper resistant.
   3. On 15A circuits use 15A rated versions of devices indicated above.

H. Special Receptacles: Ampere rating, voltage, number of poles and NEMA type as indicated. All such devices shall be specification grade. 20A and smaller devices shall be same color as listed above for switches and duplex receptacle type devices. 30A and larger single receptacles shall be permitted to be brown or black color if devices are not available in color to match the lower rated devices.
I. Time Switches:
   1. As indicated. Refer to drawing notes.

J. Photo Controls: Tork #2101/2104 or equal Paragon or Intermatic. Verify voltage with circuit to which unit is wired. Provide weatherproof junction box for mounting.

K. Furnish all devices of similar type as products of a single manufacturer.

2.6 COVER PLATES

A. For flush outlets in interior, non-weatherproof locations use Pass & Seymour standard size satin finish stainless steel #302. All plates shall be of same type and style. Do not use oversize cover plates to cover up oversized wall openings.

B. For surface outlets in interior, non-weatherproof locations with exposed raceways and cast aluminum type boxes use stainless steel type flush device plates as above, sized to fit the cast box face.

C. For weatherproof toggle switches use Pass & Seymour type CA1-GL, or approved equal.

D. For weatherproof 15A or 20A, 125V duplex receptacles located in damp locations as defined in Article 406.8 (A) of NFPA-70 use Pass & Seymour type 4512 (for GFCI type duplex receptacle), or approved equal.

E. For weatherproof 15A or 20A, 125V duplex receptacles located in wet locations as defined in Article 406.8 (B) of NFPA-70 use Pass & Seymour type WIUC10-G, or approved equal.

F. When lockable type outdoor receptacles are indicated (only in damp locations per Article 406.8 (A) of NFPA-70) use P&S #4600 flush-in-wall enclosure with #4600-26P mounting plate (for GFCI type duplex receptacle) with key locking cover, or approved equal.

2.7 POWER DISTRIBUTION AND CONTROL EQUIPMENT

A. General:
   1. For the following classes of equipment, the catalog numbers listed are for products as manufactured by Eaton Corporation. Equal products as manufactured by GE Industrial Solutions, Schneider Electric and Siemens are approved. Power distribution and control equipment shall be products of the same manufacturer.
2. Terminal lugs for circuits rated 15A and larger shall be rated for use with 75° C rated conductors. Terminal lugs on equipment shall be sized for the conductors sizes as indicated. If necessary provide larger circuit breaker frame sizes in order to accommodate the required lugs.

B. Branch Circuit and Distribution Panelboards:

1. Type: Eaton PRL1a (250V or less), PRL2a or PRL3 (277/480V), or PRL4B/PRL4F (Distribution Panelboards) as scheduled.

2. Arrangement and Ratings: Circuit breakers and spaces shall be arranged and numbered exactly as shown on panel schedules. Where spaces are indicated, they shall be fully prepared to accept an overcurrent device of the maximum rating for the frame size used in the panelboard. Circuit breakers shall be quick-make, quick-break, trip free thermal magnetic type unless otherwise indicated. Minimum interrupting capacity 10,000 AIC unless indicated higher. Two and three pole breakers shall be common trip, do not use single pole breakers with handle ties for this function. Use bolt-on style circuit breakers. Schneider Electric I-line panels with plug-in breakers are also acceptable. Circuits shall be numbered adjacent to each breaker with an engraved plastic number strip running vertical between the breakers or other approved permanent circuit number tags – paper or tape labels which can be peeled off breaker are not acceptable. Provide a "Caution--Series Rated System" nameplate on interior of panel dead front when series tested short circuit rating of the panelboard is used.

3. Bus Bars: All phase, neutral and ground busses shall be 98% conductivity copper or tin plated aluminum. Provide an equipment ground bus, bolted or welded to the panel cabinet in all panelboards. When so indicated, provide an insulated, isolated ground bus. When so indicated, provide double capacity neutral bus (200% neutral).

4. Cabinets and Fronts: Cabinets shall be made from unpainted galvanized code gauge steel. Cabinets shall be of sufficient size to provide a minimum gutter space on all sides not less than as required by Underwriter's Laboratories Standard (UL) 67 and in no case less than 4". Minimum size of cabinets is 20" wide x 5-3/4" deep. End walls shall be blank. Fronts shall be fabricated from code gauge sheet steel. All exterior and interior steel surfaces of the front shall be properly cleaned and finished with gray ANSI-61 paint over a rust inhibiting phosphatized coating. Fronts for flush panels shall overlap the cabinet by at least 3/4" all around. Surface fronts shall have the same height and width as the cabinet. Provide a door over the overcurrent devices on all panelboards except for fusible switch panelboards. Doors shall have concealed hinges. Doors shall have a lock (all locks keyed alike). Panelboard fronts shall be hinged trim type with hinges to box on one side of the trim. (Door over dead front circuit breaker compartment; entire front opens by removing screws.)
5. Panels 60 circuits and larger shall be provided with oversized boxes, at least 26" wide x 6" deep to provide sufficient room for wiring leaving top and bottom of box.

6. Directories: Provide a metal directory frame welded to inside of panel front door with 1/16" thick plastic cover or plastic pocket type directory card holder. Provide typewritten list of all circuits. Circuits shall be described using the final room name or number and any other pertinent data to accurately and succinctly describe the destination of all circuits. For fusible switch and circuit breaker distribution panelboards using breakers larger than 1 inch wide per pole, provide a laminated bakelite nameplate for each circuit.

C. Safety Switches and Disconnects:

1. Non-fused single pole toggle switch for 115 volt, single phase motors 3/4 horsepower and smaller shall be Square "D" Class 2510 motor starting switch.
2. 60A and smaller 240V class disconnect switches shall be General Duty type.
3. Provide "Heavy-Duty" type safety switches for all locations except as indicated above.
4. Enclosures shall be suitable for location where used, i.e., use NEMA 3R enclosures at locations exposed to weather.
5. Disconnects for motors and A/C equipment shall be horsepower rated.
6. Disconnects shall be capable of being padlocked in the open or closed position.

D. Dry Type Transformers:

1. Type: Eaton Energy Efficient Dry Type.
2. General Arrangement and Ratings: Dry type, totally enclosed except for ventilation openings. Unless noted otherwise, single phase transformers shall have 480V primary and 120/240V secondary; three phase transformers shall have 480V Delta primary and 208Y/120V secondary. Provide minimum of four 2-1/2% primary taps on units rated 25kVA and larger. Insulation system shall be 220 degrees C UL component recognized. Unless noted otherwise, provide 150 degree C temperature rise, DOE 2016 compliant energy efficient type. If 115 degrees C or 80 degrees C temperature rise is specified, transformers so rated shall be capable of carrying continuous overloads of 15% and 30% respectively without loss of life.
3. When indicated, provide transformers specially designed for non-linear loads. Provide K factor rated transformers of the indicated K factor.
4. Transformer coils shall utilize aluminum or copper windings, unless otherwise indicated.

2.8 FUSES
A. Provide Limitron, Low-Peak, Fusetron and Hi-Cap types as manufactured by Bussmann Division of Eaton Corporation. Fuses shall be of the voltage class, ampere rating and type as noted on the drawings. Fuse clips shall match the fuse type and class.

B. When class RK-1 fuses are specified provide a permanent nameplate on each switch enclosure which states: "CAUTION -- REPLACE FUSES ONLY WITH CURRENT LIMITING TYPE OF SAME RATING."

C. Littelfuse and Mersen are approved equal to Bussmann.

2.9 LIGHTING FIXTURES

A. Lighting fixture schedule: The manufacturer, type, style, size, color, general arrangement, mounting, etc., of all lighting fixtures shall be as indicated on the lighting fixture schedule and as described elsewhere in the drawings.

B. General: All lighting fixtures shall be furnished complete with all brackets, lenses, lamps, etc., for a complete and finished installation.

1. Coordinate fixture mounting configuration to make fixtures compatible with ceilings used on this project at each location. The contractor shall be responsible for making fixtures compatible and fixtures which do not fit ceiling system must be corrected at Contractor’s expense.

2. Voltage for LED drivers shall correspond to voltage of circuit wired on -- in general, most LED fixtures are 277V. Multi-voltage drivers may be used when suitable for the purpose.

2.10 LAMPS:

A. See light fixture schedule for specific lamp types. Unless otherwise noted, catalog numbers listed in light fixture schedule are GE or Sylvania types.

B. LED lamps as indicated on light fixture schedule.

PART 3 EXECUTION

3.1 GENERAL

A. Work to be accomplished under this specification shall be performed by experienced, competent personnel.

B. Except where otherwise specifically permitted by these specifications or drawings, raceways and wiring of every system shall be installed concealed.
C. Except where otherwise specifically permitted by these specifications or drawings, all wiring of every system shall be installed in approved raceways. The “PRODUCTS” part of this specification describes the approved locations for each type of raceway system and the requirements set forth in that section shall be adhered to for all raceway systems including systems for power, lighting, telephone, sound, fire alarm, television, data, and any other special system. The use of types NM, SE and UF cable type wiring methods are not approved. Types AC and MC cables are approved for 20A and smaller branch circuits installed above grade concealed in walls or in above ceiling locations. MC cables may also be installed exposed in open ceiling locations, but shall be adequately supported and installed and routed parallel or perpendicular to the building structure and supported tight to the structure or ceiling deck above.

D. Any installation of underground conduit stub-ups to switchboards, transformers and similar equipment will not be accepted until such time that reviewed shop drawings are on site to compare rough-ins with conduit space in the equipment.

E. Chases and Openings:

1. Any chases and openings other than those described on drawings that are found necessary to accommodate electrical work shall be provided at proper time to prevent unnecessary cutting. Provide approved access panels or doors if necessary.
2. Fire stop all chases and openings as required by Fire Stopping section.

F. Penetrations through Roof:

1. Penetration through finished roof caused by work of this division shall be properly flashed or otherwise waterproofed as required by the roofer and Architect.
2. No penetration shall occur closer than 12” from any other penetration.
3. No electrical work shall run above roof except for vertical penetration for roof mounted HVAC equipment.
4. When roof mounted HVAC units are provided with integral disconnecting means supplied by the HVAC unit manufacturer, the electrical supply wiring to the unit shall be routed through the unit curb without roof penetration. Thermostat, control and interlock wiring shall also be routed in the same manner.

3.2 EXCAVATION

A. Do all excavating required to install the work. Except under concrete floors laid on the ground, the underground conduit shall be buried to a depth of not less than 24” below the finished grade.
B. The depth of conduits run under concrete floors and slabs on grade (concrete minimum 4" thickness) may be reduced to 8" below the slab. Do not allow conduits to be embedded in the concrete floor, except at floor boxes and where conduits turn out of floor.

C. Backfill, puddle and tamp all excavations and remove all surplus materials from the site. All backfill and compaction shall be in accordance with the Architect’s instructions. Provide plastic marker tape 12” below grade over all underground conduit runs outside of building.

3.3 INSTALLATION OF RACEWAYS

A. Unless otherwise noted, all wiring of every description shall be run in conduit. Conduit, except as otherwise specifically noted, shall be run concealed. Exposed conduit shall be run parallel with supporting wall, beam or ceiling and with each other, with right angle turns consisting of cast metal fittings (LB condulets shall not be used for conduit larger than 1-1/4" in diameter) or symmetrical bends, and with supports spaced per NEC requirements. All runs of conduit shall be installed in such manner as to avoid trapped condensation. No junctions or splices in wire shall be made in condulets.

B. Minimum size conduit is 1/2". Where five or more No. 12 AWG wires are in one conduit minimum size shall be 3/4". Where No. 10 AWG or larger wire is used minimum size shall be 3/4". Larger sizes as noted. Minimum size underground conduit is 3/4”.

C. Conduit shall be installed as a complete system, continuous from outlet to outlet, cabinet, box for fitting and be so mechanically and electrically connected that adequate electrical continuity from one conduit to another is secured.

D. Conduit to be installed in concrete work shall be carefully laid and rigidly supported in the forms, as directed, and in such manner as to provide proper clearances and so that all boxes and outlets will be in exact locations after concrete has set and forms are removed. Conduit run in concrete walls or floors shall be embedded deep enough so that no portions of the conduit or fittings will show through the concrete and so there will be no cracking of the concrete finished surfaces. Obtain approval of the Structural Engineer prior to installing conduits in concrete work. Use only rigid steel conduit embedded in concrete.

E. Conduit shall not run through any structural member of the building, except as specifically directed by the Architect. This shall not prohibit conduit run through open web trusses or through factory made openings in structural members.
F. On exposed runs of conduit where junctions, bends or offsets are required, provide condulets whether such condulets are indicated on drawings or not. Bends will not be permitted around corners or beams, or equipment. Condulet covers shall be accessible. Condulet fittings shall not be used on conduit larger than 1-1/4" trade size. Use junction boxes on larger conduit. Use two hole straps on all exposed runs of conduit.

G. Separate conduit shall be used for each home run indicated on drawings. Do not combine conduit runs. Run exactly as shown on the plan. Do not run branch circuits under floor unless so indicated (by dashed lines) on the plans.

H. Conduits shall be securely supported to the building structure. Support or fasten conduits within 18" of all outlet, junction or pull boxes. Support or fasten conduit runs at intervals not to exceed NEC requirements. Exposed conduits 1" size or smaller and located below 8' AFF shall be supported at least every 5'. Single runs of conduit may be supported with 12 gauge galvanized tie wire. For multiple runs, use conduit trapezes made of suitable Unistrut or Kindorf channel with threaded rod (not less than 1/4" outside diameter) and suitable conduit straps. For multiple exposed conduit runs, use Unistrut or Kindorf channel with suitable conduit straps. Channels embedded in concrete shall not be deeper than 7/8". Nails, perforated strap and plumber's tape are not acceptable means of support.

I. Anchors which fasten devices, raceways, etc. to brick or masonry shall be metal expansion type with screws or bolts. Plastic or shot-in anchors are not acceptable.

J. Anchors which fasten devices, raceways, etc. to hollow, dry, or plaster walls shall be a type which expands after it has penetrated the material such as toggle, molly, etc. Wood screws into 2x4 or larger wood framing is acceptable.

L. Conduit shall not run closer than 6" to any hot water pipe, steam pipe, heater flue or vent.

M. Projections through roofing shall be made watertight by proper flashing and/or pitch pockets satisfactory to Roofing Contractor, Architect and roof bonding company. Verify method prior to rough-in and comply as required. Contractor shall supply all required roof jacks.

N. Conduit connections to tops of enclosures located outdoors or other location subject to water shall be made with Myers hubs or weatherproof hubs that are supplied with the equipment. Gasketed locknuts as only weatherproof fitting are not approved for conduits entering the tops of enclosures.
O. The use of pliers for tightening of conduit connections or making up runs of conduit is prohibited. All conduit joints and connections shall be wrench tight.

P. Upon completing the installation of any run of conduit, test the runs and see that they are free from all obstructions and have a smooth interior. Plug each end with conduit pennies and bushings and leave plugged until ready to pull wire. Wood or fiber plugs or concrete nails are not acceptable.

Q. The ends of conduit shall be cut square and carefully reamed out to full size with a tapered burring reamer and shouldered in the fitting.

R. No running threads will be permitted, special union fittings shall be used in lieu thereof. The open ends of conduit shall be kept closed with approved conduit seals during the construction of the building. Rigid conduit couplings shall be of the threaded type.

S. Except as otherwise indicated on drawings, bends in conduits 1” and larger shall be made with standard conduit ells. Wire or cable bends in junction boxes or pull boxes shall be made on long radius of not less than five (5) times diameter of the cable. Nesting of conduits shall be made when more than one conduit is used in parallel without the use of standard ells.

T. Where ungrounded conductors of No. 4 or larger enter a raceway in a gutter, pull box, junction box, or auxiliary gutter, the conductors shall be protected by a substantial bushing or liner sleeve providing a smoothly rounded insulating surface, unless the conductors are separated from the raceway fitting by a substantial insulating material securely fastened in place.

U. A nylon pull string shall be installed in all raceways which do not have conductors pulled by this contractor.

V. Flexible "Greenfield" shall be used only where necessary, approved, or directed for connections to equipment which is removable (as for belt replacement and adjustment), or is mounted on isolation units for nontransmittal of vibration or sounds of operation. Regulation fittings shall be used for all connections to terminal, junction and switch boxes. Use liquid-tight flex where exposed to weather. Maximum length shall be 3'-0". Run conduit to within 3'-0" of outlet before using flex.

3.4 INSTALLATION OF OUTLETS, WIRING DEVICES AND JUNCTION BOXES

A. Lighting outlets, convenience outlets and wall switches shall be installed as shown on the drawings, with switch control as indicated. All outlets and switches shall be accurately located and shall be installed plumb with building walls. The final position of such outlets must be verified with the...
Architect. Wall switches shall typically be within 4" of the door frame on the lock side according to the Architectural plans.

B. Outlets in unplastered masonry walls shall be 4" square (or larger when required) boxes with deep plaster rings or box extensions already attached to the box when the outlet box is installed in the masonry. Help the Mason set each box (and every box) in place, so that the face of the ring or extension is vertical and approximately 1/16" in from the finished surface. The Mason and Electrician shall be mutually responsible for the proper execution of the work.

C. Light outlet boxes shall be sized to comply with Code, but not less than 4" square.

D. Ceiling outlet boxes shall be equipped with plaster rings and extension rings as required.

E. Convenience outlets, switch, telephone, television and intercom outlets, shall be 4" square (or larger when required) pressed steel boxes with plaster rings.

F. Flush outlet boxes shall be installed with the box edge flush to not more than 1/16" recessed into the wall. Provide box extensions as necessary for proper installation.

G. Outlet boxes in concrete shall be of a type which will allow the placing of conduit without displacing of reinforcement bars.

H. Boxes shall be set so that when covers are in place they will be flush with finished building surface, and so that fixtures will stand at right angles. Where exposed to weather, use conduit cast body type or cast aluminum type.

I. All boxes shall be securely supported to the building structure. In metal stud work, provide bracing between studs for all boxes. Attachment to a single vertical metal stud without additional bracing is not acceptable.

J. Safety switches and disconnects for HVAC and similar equipment shall be supported independently from unit. Provide Unistrut or Kindorf brackets from structure as required. Do not attach switches to equipment or duct work.

K. Approved bar hangers, fitted with fixture studs, shall be used to support outlet boxes in stud partitions and furred or drywall ceilings.

L. The Owner shall reserve the right, without additional cost, to relocate any outlet up to 6'-0" from the location shown on the drawings provided that such instruction is given to the contractor prior to rough-in.
M. Mounting Heights:

1. Light Switches +3'-10" unless otherwise directed
2. Control Switches for HVAC +3'-10" unless otherwise directed
3. Receptacles +1'-6" unless otherwise directed
4. Telephone, Data, etc. +1'-6" unless otherwise directed
5. Wall bracket lights As directed
6. Fire Alarm Manual Station +3'-10" unless otherwise directed
7. Fire Alarm Strobe Light +6'-8" to bottom of strobe
8. Heights given are from box center to finish floor. Consult Architect for any heights not listed above.

N. All receptacle devices shall be installed vertical unless otherwise directed. Install with grounding pole at top. When receptacle devices are horizontally mounted, grounding pole shall be at left side.

O. All control apparatus, outlet boxes, junction and pull boxes, and other similar equipment shall be installed and maintained in accessible positions and locations. Refer to the complete set of drawings covering the mechanical and architectural plans for locations of HVAC equipment (dampers, motors, etc.) and access panels. At areas adjacent to these openings, provide accessible locations for junction and pull boxes.

P. Provide a junction box accessible and close to all recessed can and similar type lighting fixtures. This box shall be furnished as part of the lighting fixture. Wiring from lamp socket to junction box shall be approved for temperature involved. This box shall be sized to allow a minimum of eight No. 12 AWG conductors in the box. When more than eight No. 12 AWG conductors are in box provide oversize boxes.

Q. Receptacle outlet supplying wall mounted electric drinking fountains shall be concealed within the drinking fountain so that unit cord and plug is not visible after installation.

R. Surface mounted boxes installed below 8'-0" A.F.F. shall be cast aluminum type or when larger than three gang shall be standard sheet metal type with screw on cover and no knockouts.

S. Every box shall have a cover, either blank or the appropriate system outlet cover. Telephone, data and similar outlets which are not activated with an outlet shall have a blank stainless steel cover installed.

T. Outlets for telephone, data, television, computer and similar systems shall have a raceway stubbed from the outlet box to accessible ceiling space unless specifically indicated otherwise. When no accessible ceilings exist the raceway shall run to the nearest telephone (or applicable other system) terminal board or terminating point on the same floor level as the outlet.
Floor outlets may stub into ceiling space of floor below unless specifically indicated otherwise. Minimum size raceway is 1-inch. Use larger raceways when specifically indicated. When a specific raceway layout is shown on drawings it shall take precedence over the general requirements stated in this paragraph. When no specific raceway layout is shown on drawings then the general requirements stated herein shall apply. Coordinate with ‘T’ series drawings and associated Division 17 specification sections.

U. Switch and receptacle devices shall be wired using the back wiring terminals on the device which are tightened by a screw. Do not thru-wire receptacles. Instead, provide wire nut splice in box to tap circuit to feed the receptacle device. All screw terminals on wiring devices shall be made tight.

V. Three-way and four-way switches shall be installed such that when all switches on the same switch leg are operated with the toggle handle down the load will be off.

W. 15A and 20A, 125V receptacle devices shall be GFCI type or GFCI protected when installed in locations per NFPA-70, National Electrical Code Section 210.8 (B). Do not use feed-thru type devices unless indicated. GFCI protection shall be provided for higher rated receptacle devices as described in NEC 210.8 (B).

X. 15A and 20A, 125V receptacle devices in Pre-School, Child Care Spaces, Auditorium, Gymnasium, and all outside shall be Tamper Resistant type.

3.5 INSTALLATION OF CONDUCTORS

A. All circuits and feeder wires shall be continuous from switch to terminal or most distant outlet. No splices shall be made except in pull, junction or outlet boxes, or in switchboards or panels.

B. Thoroughly clean out all conduits and wireways and see that all parts are perfectly dry before pulling any wires. Do not install any permanent wiring until all drywall taping is done and dirt removed. Any run of conduit which does not allow conductors to be fished in readily will be condemned and the run must be replaced by other conduit satisfactory to the Architect.

C. Splices and taps for conductors No. 10 AWG and smaller shall be made with approved solderless mechanical connectors, size of the connector to be selected in accordance with the listing of the connector. All splices and taps which are not self-insulating shall be covered with thermoplastic insulating tape (Scotch No. 33) layered to a thickness equal to or greater than the conductor insulation.

D. At all outlet and switch boxes, leave not less than 6" free conductor outside of the box for connection of devices and fixtures.
E. Provide pull boxes wherever indicated or as necessary to facilitate the pulling in of wires or cables. Run shall not exceed 200’ for straight pulls without any bends. Reduce pull box spacing to 150’ if one 90 degree bend or equivalent in the run; 100’ if two 90 degree bends or equivalent in the run; and 90’ if more than two 90 degree bends or equivalent in the run. Pull boxes shall be sized in accordance with Article 314 of the National Electrical Code.

F. Vertical runs shall be supported in accordance with Section 300-19 of NFPA-70 National Electrical Code. Use wedge-in conduit cable supports or cleats in J-box as required.

G. Underground splices in pull boxes or direct buried shall be insulated with listed splicing and insulating materials for submersible, water proof splices.

H. Minimum size conductors for power and lighting circuits is #12AWG, copper. Provide larger conductors when indicated.

I. Do not combine neutrals to make multi-wire branch circuits unless circuits are specifically indicated that way and multi-pole overcurrent devices with simultaneous switching of all line-voltage conductors are provided.

3.6 TAGGING

A. All branch circuits shall be left tagged in panelboards, gutters, etc., for the purpose of distinguishing the various circuits. Phase, neutral, equipment grounding and isolated grounding conductors shall be tagged with circuit numbers. In addition, where more than one circuit occurs in junction boxes, provide tags indicating circuit numbers. All feeders and main lines shall be tagged in all junction boxes, gutters, switchboards, etc. Use Ideal or Brady wire marker numbers for circuit numbers, etc. Do not use metal numbering tags.

B. In panel gutters, junction and pull boxes containing multiple neutrals, neutral conductors shall be tagged with circuit numbers to ensure that multi-wire branch circuits are not inadvertently made by sharing neutrals between two or three phase legs.

3.7 INSTALLATION OF PANELS, SWITCHBOARDS, ETC.

A. Panels and equipment enclosures shall be securely supported to wall to which they are mounted in accordance with the equipment manufacturer’s installation instructions.

B. In general, branch circuit panels shall be installed with top at 6’-3” above finished floor. For wall mounted panels over 5’-6” high consult Architect for mounting height.
C. When more than one branch circuit panel is installed in the same location or room, the panels shall be mounted with tops at all same height.

D. Provide at least one 1-1/4 inch conduit nipple between all adjacent panel back boxes that are flush mounted at a common location. This conduit shall be empty for future use.

E. Where branch circuit panels are installed flush with the walls, empty conduits shall be extended from the panel to an accessible space above or as indicated on the plans. Furnish a minimum of one 3/4" conduit for every three single pole circuit breakers or spaces or fraction thereof, but never less than three conduits. Provide one additional 1-1/4" conduit stub on all 200A and larger panels.

F. When conduits leave top of weatherproof switchboards or panelboards, conduit connections to the equipment shall be made with Myers hubs or weatherproof hub type fittings by the switchboard or panelboard manufacturer. Generally, conduits shall not leave the tops of switchboards and panelboards installed outside unless specifically indicated; or with special permission.

G. Panelboards and switchboards shall be installed with all operating handles not over 6"-7" above finished floor.

H. Pads for switchboards, transformers, etc., shall have steel rebar reinforcing rods (#4) installed 12" on center. Concrete pads on grade over earth shall have conduit openings boxed out such that entering conduits are not encased by the concrete. The boxed out openings shall be able to accommodate future conduits additions. Concrete pads shall be sized approximately 2" larger than the switchboard plan dimension on all sides and shall be finished in accordance with the Concrete Section. Pad corners and edges shall be chamfered or rounded.

I. Switchboards shall be bolted to the pads with approved seismic restraints and where mounted against a wall shall also be attached to the wall near the top of the enclosure.

J. Install enclosed dry type transformers a minimum of 3" away from walls along sides with ventilation openings. Use flexible conduit to connect transformers if conduits connect to transformer above the floor. When conduits enter bottom of transformer from under floor flexible conduit connection is not required. Provide concrete housekeeping pad (4" high) for floor mounted transformers when indicated.

K. Conductors in panelboard and switchboard interiors shall be neatly trained but shall not be bundled or tied together.
3.8 MOUNTING AND INSTALLATION OF LIGHT FIXTURES

A. Lighting fixtures shall be adequately supported to building structure in accordance with applicable building codes.

B. For lay-in grid type ceilings, provide a minimum of two (2) No. 12 gauge galvanized seismic wires from fixture to structure. Seismic wires shall be slack enough to permit the fixture to set level in the ceiling grid. Points of attachment of seismic wires to structure shall be located on opposite corners of the fixture so that the fixture will not drop more than 6” if the surrounding ceiling should fail to support the fixture. Provide at least three (3) full twists of seismic wires at attachment points.

Exception to this requirement: When ceiling system is designed and installed per manufacturer’s instructions and is rated to carry the weight of the installed light fixtures the seismic wires may be omitted. Ceiling system may require additional support wires installed within 3” of corners of the light fixture. Coordinate installation with ceiling installer.

C. Provide approved seismic clips or screws to attach fixtures to the ceiling grid on all fixtures installed in grid ceilings. Such clips shall be constructed to be able to support the entire weight of the fixture in any direction.

D. When for any reason light fixtures have an asymmetrical lighting pattern or appearance, all similar fixtures shall be installed with the with the asymmetry or pattern aligned or oriented in the same direction to provide a uniform appearance, unless other specific instruction is given regarding the placement or orientation of the light fixtures.

E. In hard (non-accessible) ceilings, the fixture wiring and maintenance (such as LED Driver replacement) shall be accessible through the light fixture trim opening. Do not use flex conduit whips with remote inaccessible junction boxes to supply such fixtures. Instead, the branch circuit wiring shall be run to the permanent outlet box mounted to the fixture, accessible through the fixture trim opening.

F. Any fixture with field replaceable lamps (screw shell or b-pin) installed and operated (other than testing) more than 3 months ahead of substantial completion (or preliminary use by the Owner) shall have new lamps installed at the time of substantial completion.

3.9 OVERCURRENT PROTECTION

A. All equipment shall have proper overcurrent protection.
B. The fuse sizes indicated on the drawings for motors and equipment are based on equipment sizes as specified. Substitutions of equipment as well as change in manufacturer may make overcurrent devices of a different rating necessary.

C. The contractor shall verify the actual nameplate ampere rating of all equipment and shall select fuses and overload heaters based on the following criteria.

1. For motors:
   a. When fuses are the only overcurrent protective device for the motor they shall be rated not over 125% of the motor full load running current. If possible, select fuses rated between 105% and 115% of the motor full load running current.
   b. When manual or magnetic starters are provided for motors, size overload heaters based on motor nameplate amperes according to the starter manufacturer’s instructions. Fuses used in conjunction with motor starter shall be sized as indicated.

2. For heating units and appliances: Fuses shall be rated at least 125% but not over 150% of the unit full load running current, but in no case shall exceed the "Maximum Fuse Size" listed on the unit nameplate.

3. For packaged A/C units: The fuse size shall not exceed the "Maximum Fuse Size" listed on the unit nameplate.

D. When circuit breakers (in switchboards, panels or individually mounted) are shown as the only overcurrent device for appliances or equipment, verify the circuit breaker rating with the actual nameplate “Maximum Overcurrent Protection” or “MOCP” rating on the equipment. Provide actual circuit breaker ratings to comply with the equipment nameplate rating.

3.10 GROUNDING

A. All electrical apparatus, either stationary or portable, shall be adequately grounded, either by direct connection from frame of the apparatus or an approved ground wire connected securely to conduit, or by an approved grounded flexible cord through an approved cap and receptacle.

B. All raceways and junction boxes shall be installed in a manner such that all joints are electrically conductive to function as an equipment grounding conductor.

C. Concentric knockouts are not considered an adequate grounding means. Provide grounding bushings on all conduits connected to concentric knockouts for all system voltages.
D. For branch circuits and feeders, provide a green insulated equipment grounding conductor sized in accordance with Table 250.122 of NFPA-70, National Electrical Code, or as indicated whichever is larger. Such conductor shall be installed in the raceway along with the circuit conductors whether or not shown on the drawings.

E. Service main bonding and grounding shall be in accordance with the Service Grounding detail on the drawings. Always use the UFER ground if available.

F. Neutrals throughout the system shall not be grounded except at service entrance equipment and at the first overcurrent devices served by the secondaries of dry type transformers.

3.11 EQUIPMENT CONNECTIONS

A. All outlets, devices, equipment, etc., shall be connected to circuits and made operational as required.

B. The Electrical Section shall connect electrically all heating, cooling, ventilating and plumbing equipment. For HVAC equipment as specified in the Mechanical Section, the Electrical Section shall run all conduits to electrically operated thermostats and controls (line voltage and 24 volt) and do all line voltage control wiring. 24 volt control wiring will be provided by the Mechanical Section. The Electrical Section shall provide magnetic starters unless otherwise indicated. A disconnecting means shall be provided at all equipment by the Electrical Section unless equipment is furnished with integral disconnecting means which meets the requirements of NFPA-70.

C. The Electrical and Mechanical sub-contractors shall coordinate their work along with the Architect to attain proper installation.

3.12 TESTS AND COMMISSIONING

A. Contractor shall test the work in sections. All defects shall be made good immediately at Contractor's expense, including all repairs to walls, ceilings, floors, or other portions of building damaged in making repairs. Furnish all instruments necessary for testing and pay observers necessary. Owner's representative will check observations only.

B. Contractor shall perform megger test on all feeders. Minimum resistance shall be 500,000 ohms to ground using 500V megger. All branch circuits shall be free from grounds and shorts. Contractor shall perform, as directed, megger test on any branch circuit or feeder as required by Engineer. All megger tests shall be made with representative from Engineer's office present.
C. Test and verify A-B-C phase rotation on main service entrance and at all motors.

D. Electrical equipment with adjustments or settings shall be adjusted as recommended by the equipment manufacturer, engineer or Owner as required or directed, for proper operation.

E. Controls systems such as lighting controls and time switches shall be adjusted to Owner’s schedule, or as directed. The Contract shall include the initial adjustment or settings as well as two follow-up sessions to change or modify settings upon the request of the Owner which may occur any time during the warranty period. At the time such settings are made, the Contractor shall instruct the Owner on the methods of making the adjustments.

3.13 PAINTING

A. Exposed electrical conduits, boxes, equipment, enclosures, etc. shall be finish painted to match adjacent building finishes, except in equipment rooms or unfinished space, work may be left unpainted.

B. Do not paint panelboard fronts unless specifically directed.

END OF SECTION
DIVISION 27 – COMMUNICATIONS

270500 – BASIC COMMUNICATIONS SYSTEMS REQUIREMENTS

1. GENERAL

A. SECTION INCLUDES

(1) Basic Communications Systems Requirements specifically applicable to Division 27 sections, in addition to Division 1 - General Requirements.

B. RELATED WORK:

(1) Related work described elsewhere Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section. The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

C. SCOPE OF WORK

(1) This Specification and the accompanying drawings govern the work involved in furnishing, installing, testing and placing into satisfactory operation the Communications Systems as shown on the drawings and specified herein.

(2) Each Contractor shall provide all new materials as indicated in the schedules on the drawings, and/or in these specifications, and all items required to make their portion of the Communications Systems a finished and working system.

(3) Description of Systems include but are not limited to the following:

a. Complete Structured Cabling System including, but not limited to:

i. Voice and data backbone cabling and terminations.
ii. Voice and data horizontal cabling and terminations.
iii. Information outlets (IO’s) including faceplates, jacks and labeling.
iv. Equipment racks, cabinets, cable management and equipment.
v. Telecommunication Room equipment including patch panels, optical distribution cabinets, and termination blocks.
vi. Cabling pathways.
vii. Grounding and Bonding
viii. Testing


d. Complete Classroom Sound Reinforcement Systems

e. Low Voltage Communications Wiring (less than +120VAC) as specified and required for proper system control and communications.

f. All associated backboxes, conduit, miscellaneous cabling, and power supplies required for proper system installation & support systems.

g. Firestopping of penetrations as described in Division 7 Section 270503.

D. QUALITY ASSURANCE

(1) Codes

a. National Fire Protection Association (NFPA)

b. NFPA 70, National Electrical Code® (NEC®)

c. NFPA 70E, Standard for Electrical Safety Requirements for Employee Workplaces,

d. NFPA 72, National Fire Alarm Code®

e. NFPA 75, Standard for the Protection of Electronic Computer/Data Processing Equipment

f. NFPA 76, Recommended Practice for the Fire Protection of Telecommunications Facilities

g. NFPA 90A, Standard for the Installation of Air Conditioning and Ventilating Systems


i. NFPA 255, Standard Method of Test of Surface Burning Characteristics of Building Materials

j. NFPA 262, Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces

k. NFPA 780, Standard for the Installation of Lightning Protection Systems

l. NFPA 5000™, Building Construction and Safety Code

(2) Reference Standards

a. Telecommunications Structured Cabling System Standards:

b. All work and equipment shall conform to the most current
ratified version of the following published standards unless otherwise indicated that draft standards are to be followed:

i. ANSI/NECA/BICSI 568 - Standard for Installing Commercial Building Telecommunications Cabling
ii. ANSI/TIA-568-C.0 - Generic Telecommunications Cabling for Customer Premises

1.) C.1- Commercial Building Telecommunications Standard
2.) C.2-Balanced Twisted-Pair Telecommunications Cabling and Components Standard
3.) C.3 - Optical Fiber Cabling Components Standard
4.) C.4 - Broadband Coaxial Cabling and Components Standard

iii. ANSI/TIA-569-C - Telecommunications Pathways and Spaces
iv. ANSI/TIA-606-B- Administration Standard for Commercial Telecommunications Infrastructure
v. ANSI/TIA-607-B - Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications
vi. ANSI/TIA-758-B - Customer-Owned Outside Plant Telecommunications Standard
viii. ANSI/TIA-942-A - Telecommunications Infrastructure Standard for Data Centers
ix. ANSI/TIA-1152 - Requirements for Field Test Instruments and Measurements for Balanced Twisted-Pair Cabling
x. ANSI/TIA-1179 Healthcare Facility Telecommunications Standard
xi. ANSI/TIA/EIA-598-C - Optical Fiber Cable Color Coding
xii. NFPA 70 (NEC) - National Electrical Code (Current Edition)
xiii. UL 444 - Standard for Safety for Communications Cable
(3) BICSI- Telecommunication Distribution Methods, Customer Owned Outside Plant

E. Refer to individual sections for additional Quality Assurance requirements.

F. Qualifications:

a. Only products of reputable manufacturers as determined by the Architect/Engineer will be acceptable.

b. The installing Contractor shall be certified by the manufacturer of the structured cabling system to offer CommScope/Uniprise 25 component warranty; Corning NPI 25 year warranty. Shop drawings will not be approved until proof of certification is submitted. Refer to the end of this specification section for certification documentation requirements.

c. Each Contractor and their subcontractors shall employ only workers who are skilled in their respective trades and fully trained. All workers involved in the termination of cabling shall be individually certified by the manufacturer.

d. The Contractor shall be experienced in all aspects of this work and shall be required to demonstrate direct experience on recent systems of similar type and size.

e. The Contractor shall own and maintain tools and equipment necessary for successful installation and testing of optical and copper structured cabling systems and have personnel adequately trained in the use of such tools and equipment.

f. The Contractor must have a RCDD (Registered Communications Distribution Designer) on-staff serving as a project manager. Project shop drawings and test reports shall be stamped by the RCDD.

G. COMPLIANCE WITH CODES, LAWS, ORDINANCES:

(1) This Contractor shall conform to all requirements of the City of Tucson, Laws, Ordinances and other regulations having jurisdiction over this installation.

(2) This Contractor shall also conform to all published standards of the Vail Unified School District as related to this installation.

(3) In the event there are no local codes having jurisdiction over this
job, the current issue of the National Electrical Code shall be followed.

(4) If there is a discrepancy between the codes and regulations having jurisdiction over this installation, and these specifications, the codes and regulations shall determine the method or equipment used.

(5) If the Contractor notes, at the time of bidding, any parts of the drawings and specifications which are not in accordance with the applicable codes or regulations, he shall inform the Architect/Engineer in writing, requesting a clarification. If there is insufficient time to follow this procedure, he shall submit with the proposal, a separate price required to make the system shown on the drawings comply with the codes and regulations.

(6) All changes to the system made after the letting of the contract, in order to comply with the applicable codes or the requirements of the Inspector, shall be made by the Contractor without cost to the Owner.

H. EXAMINATION OF DRAWINGS:

(1) The drawings for the Communications Systems work are diagrammatic, intended to convey the scope of the work and to indicate the general arrangements and locations of equipment etc., and the approximate sizes of equipment.

(2) Contractor shall determine the exact locations of equipment and the exact routing of cabling so as to best fit the layout of the job. Scaling of the drawings will not be sufficient or accurate for determining this layout. Where a specific route is required, such route will be indicated on the drawings.

(3) Where job conditions require reasonable changes in indicated arrangements and locations, such changes shall be made by the Contractor at no additional cost to the Owner.

(4) If an item is either shown on the drawings, called for in the specifications or required for proper operation of the system, it shall be considered sufficient for including same in this contract.

(5) The determination of quantities of material and equipment required shall be made by the Contractor from the drawings. Schedules on the drawings and in the specifications are completed as an aid to the Contractor but where discrepancies arise, the greater number shall govern.

(6) Where words "provide", "install", or "furnish" are used on the drawings or in the specifications, it shall be taken to mean, to furnish, install and terminate completely ready for operation, the items mentioned.
I. Electronic Media/Files:

(1) Construction drawings for this project have been prepared utilizing AutoCAD/AutoCAD Revit.

(2) If the information requested includes floor plans prepared by others, the Contractor will be responsible for obtaining approval from the appropriate Design Professional for use of that part of the document.

(3) The electronic contract documents can be used for preparation of shop drawings and as-built drawings only. The information may not be used in whole or in part for any other project.

(4) The drawings prepared for bidding purposes may not be used directly for ductwork layout drawings or coordination drawings.

(5) The use of these CAD documents by the Contractor does not relieve them from their responsibility for coordination of work with other trades and verification of space available for the installation.

(6) The information is provided to expedite the project and assist the Contractor with no guarantee by Dplace as to the accuracy or correctness of the information provided. Dplace accepts no responsibility or liability for the Contractor’s use of these documents.

J. FIELD MEASUREMENTS:

(1) Before ordering any materials, this Contractor shall verify all pertinent dimensions at the job site and be responsible for their accuracy.

(2) Field conditions that will result in telecommunications drops that exceed the length limitations identified in the contract documents shall be brought to the attention of the Architect/Engineer prior to installation. The cost of reworking cabling that is too long, that was not brought to the written attention of the Architect/Engineer will be borne entirely by the Contractor.

(3) This Contractor shall provide the Architect/Engineer with written documentation of any cabling drops that will not be able to use the cable tray (where cable tray is available) due to the resulting cabling lengths. This documentation shall be submitted prior to installation and installation shall not commence until approved by
the Architect/Engineer.

2. PRODUCTS

   A. REFER TO INDIVIDUAL SECTIONS

   B. General Product Requirements” Provide products that comply with the Contract Documents, that are undamaged and, unless otherwise indicated, new at the time of installation.

   C. Materials and equipment shall be the standard products of the manufacturer regularly engaged in the manufacture of the products and shall be the manufacturer’s latest standard design that has been in satisfactory use for at least 2 years prior to bid opening, and as approved by submittal.

3. EXECUTION

   A. FIELD QUALITY CONTROL

      (1) General:

         a. Refer to specific Division 27 sections for further requirements.

         b. The Contractor shall conduct all tests required and applicable to the work both during and after construction of the work.

         c. The necessary instruments and materials required to conduct or make the tests shall be supplied by the Contractor who shall also supply competent personnel for making the tests who has been schooled in the proper testing techniques.

         d. In the event the results obtained in the tests are not satisfactory, This Contractor shall make such adjustments, replacements and changes as are necessary and shall then repeat the test or tests which disclose faulty or defective work or equipment, and shall make such additional tests as the Architect/Engineer or code enforcing agency deems necessary.

         e. All telecommunications tests that fail, including those due to excessive cabling lengths, shall be remedied by the Contractor without cost to the project.

      (2) Protection of Cable From Foreign Materials:

         a. It is the Contractor’s responsibility to provide adequate physical protection to prevent foreign material application or contact with any cable type. Foreign material is defined as
any material that would negatively impact the validity of the manufacturer’s performance warranty. This includes, but is not limited, to overspray of paint (accidental or otherwise), drywall compound, or any other surface chemical, liquid or compound that could come in contact with the cable, cable jacket or cable termination components.

b. Application of foreign materials of any kind on any cable, cable jacket or cable termination component will not be accepted. It shall be the Contractor’s responsibility to replace any component containing overspray, in its entirety, at no additional cost to the project. Cleaning of the cables with harsh chemicals is not allowed. This requirement is regardless of the PASS/FAIL test results of the cable containing overspray. Should the manufacturer and warrantor of the structured cabling system desire to physically inspect the installed condition and certify the validity of the structured cabling system (via a signed and dated statement by an authorized representative of the structured cabling manufacturer), the Owner may, at their sole discretion, agree to accept said warranty in lieu of having the affected cables replaced. In the case of plenum cabling, in addition to the statement from the manufacturer, the Contractor shall also present to the Owner a letter from the local Authority Having Jurisdiction stating that they consider the plenum rating of the cable to be intact and acceptable.

c. Comply with manufacturer’s instruction for installation of products, Anchor each product securely in place, accurately located and aligned with other Work. Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.

B. INSTRUCTING THE OWNER’S REPRESENTATIVE

(1) Adequately instruct the Owner’s designated representative or representatives in the maintenance, care, and operation of the complete systems installed under this contract.

(2) Provide verbal and written instructions to the Owner’s representative or representatives by FACTORY PERSONNEL in the care, maintenance, and operation of the equipment and systems.

(3) The Owner has the option to make a video recording of all instructions. Coordinate schedule of instructions to facilitate this
recording.

(4) The Architect/Engineer shall be notified of the time and place for the verbal instructions to be given to the Owner's representative so that their representative can be present if desirable.

(5) Refer to the individual specification sections for minimum hours of instruction time for each system.

(6) Operating Instructions:

a. The Contractor is responsible for all instructions to the Owner and/or Owner's operating staff on the Communications Systems.

b. If the Contractor does not have Engineers and/or Technicians on staff who can adequately provide the required instructions on system operation, performance, troubleshooting, care and maintenance, they shall include in the bid an adequate amount to reimburse the Owner for the Architect/Engineer to perform these services.

C. SYSTEM COMMISSIONING

(1) The Communications Systems included in the construction documents are to be complete and operating systems. The Architect/Engineer will make periodic job site observations during the construction period. The system start-up, testing, configuration, and satisfactory system performance is the responsibility of the Contractor. This shall include all calibration and adjustments of electrical equipment controls, equipment settings, software configuration, troubleshooting and verification of software, and final adjustments that may be required.

(2) All operating conditions and control sequences shall be simulated and tested during the start-up period.

(3) The Contractor, subcontractors, and equipment suppliers are expected to have skilled technicians to insure that the system performs as designed. If the Architect/Engineer is requested to visit the job site for the purpose of trouble shooting, assisting in the satisfactory start-up, obtaining satisfactory equipment operation, resolving installation and/or workmanship problems, equipment substitution issues or unsatisfactory system performance, including call backs during the warranty period through no fault of the design; the Contractor shall reimburse the Owner on a time and material basis for services rendered at the
Architect/Engineer’s standard hourly rates in effect at the time the services are requested. The Contractor shall be responsible for making payment to the Owner for services required that are product, installation or workmanship related. Payment is due within 30 days after services are rendered.

D. ADJUST AND CLEAN

(1) Contractor shall thoroughly clean all equipment and systems prior to the Owner’s final acceptance of the project.

(2) Contractor shall clean all foreign paint, grease, oil, dirt, labels, stickers, and other foreign material from equipment.

(3) Contractor shall remove all rubbish, debris, etc., accumulated during the Contractor’s operations from the premises

END OF SECTION
270526 – GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS

1. GENERAL

A. SECTION INCLUDES
   (1) Bonding Conductors
   (2) Bonding Connectors
   (3) Grounding Busbar (TMGB and TGB)
   (4) Rack-mount Telecommunications Grounding Busbar

B. RELATED WORK
   (1) Section 260513 – Wire and Cable
   (2) Section 260526 – Grounding and Bonding
   (3) Section 260533 – Conduit
   (4) Section 260536 – Cable Trays
   (5) Section 264100 – Lightning Protection Systems
   (6) Section 270500 – Basic Communications Systems Requirements
   (7) Section 270532 – Firestopping
   (8) Section 270553 – Identification and Administration
   (9) Section 271116 – Communications Cabinets, Racks, Frames and Enclosures

C. QUALITY ASSURANCE
   (1) Refer to Section 270500 for relevant standards
   (2) Material and work specified herein shall comply with the applicable requirements of the current revision of the following:
      a. ANSI/TIA-568 Commercial Building Telecommunications Cabling Standard
      b. ANSI/TIA-569 Telecommunications Pathways and Spaces
      c. ANSI/TIA-606 Administration Standard for the Telecommunications Infrastructure
      d. BICSI – Telecommunications Distribution Methods Manual
      e. J-STD-607-A Joint Standard for Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications
      f. NFPA 70 – National Electric Code
   (3) Communications bonding system component, device, equipment, and material manufacturer(s) shall have a minimum of five (5) years documented experience in the manufacture of communications bonding products.
   (4) The entire installation shall comply with all applicable electrical...
codes, safety codes, and standards. All applicable components, devices, equipment, and material shall be listed by Underwriters' Laboratories, Inc.

D. REFERENCES

(1) ANSI/IEEE 1100 – Recommended Practice for Power and Grounding Sensitive Electronic Equipment in Industrial and Commercial Power Systems

(2) ANSI/TIA/EIA 568-C – Commercial Building Telecommunications Cabling Standard

(3) ANSI/TIA/EIA 569-A – Commercial Building Standard for Telecommunications Pathways and Spaces

(4) ANSI/TIA/EIA 606 – Administration Standard for the Telecommunications Infrastructure of Commercial Buildings

(5) ANSI/TIA/EIA 758 – Customer Owned Outside Plant

(6) ANSI-J-STD-607-A–Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications


(8) IEEE 837 – IEEE Standard for Qualifying Permanent Connections Used in Substation Grounding

(9) NFPA 70 – National Electrical Code

(10) NFPA 780 – Standard for the Installation of Lightning Protection Systems

(11) UL 96 – Lightning Protection Components

(12) UL 96A – Installation Requirements for Lightning Protection Systems

(13) UL 467 – Grounding and Bonding Equipment

E. SUBMITTALS

(1) Submit product data and shop drawings under provisions of Section 270500 and Division 1.

(2) Provide manufacturer’s technical product specification sheet for each individual component type. Submitted data shall show the
following:

(3) Compliance with each requirement of these documents. The submittal shall acknowledge each requirement of this section, item-by-item, including construction, materials, ratings, and all other parameters identified in Part 2 - Products.

(4) Manufacturer's installation instructions indicating application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of product.

F. DELIVERY, STORAGE, AND HANDLING

(1) Deliver products to the site under the provisions of Section 270500.

(2) Store and protect products under the provisions of Section 270500.

(3) Contractor shall exercise care to prevent corrosion of any products prior to installation. Corroded products shall not be acceptable for use on this project.

G. SYSTEM DESCRIPTION

(1) This section describes the requirements for the furnishing, installation, adjusting, and testing of a complete turnkey communications bonding system, including connection to the electrical ground grid.

(2) Performance Statement: This specification section and the accompanying drawings are performance based, describing the minimum material quality, required features, operational requirements, and performance of the system. These documents do not convey every wire that must be installed, every equipment connection that must be made, or every feature and function that must be configured. Based on the equipment constraints described and the performance required of the system as presented in these documents, the Contractor is solely responsible for determining all components, devices, equipment, wiring, connections, and terminations required for a complete and operational system that provides the required performance.

(3) This document describes the major components of the system. All additional hardware, subassemblies, supporting equipment, and other miscellaneous equipment required for complete, proper system installation and operation shall be provided by the Contractor.
(4) Basic System Requirements:

a. A complete communications bonding infrastructure is required for this project. Refer to the drawings and the requirements of ANSI-J-STD-607-A and NFPA 70 for complete information.

b. The bonding system shall include, but not be limited to, the following major components:

   i. Bonding Conductor for Telecommunications (BCT)
   ii. Telecommunications Main Grounding Busbar (TMGB)
   iii. Telecommunications Bonding Backbone (TBB)
   iv. Telecommunications Grounding Busbar(s) (TGB)
   v. Rack mount Telecommunications Grounding Busbar(s)
   vi. Bonding Conductor(s) (BC)
   vii. Bonding Connectors
   viii. Bonding system labeling and administration as defined in Section 270553

2. PRODUCTS
   A. MANUFACTURERS
      (1) Panduit: www.panduit.com
      (2) Chatsworths Products Inc.: www.chatsworth.com

   B. GROUND BARS
      (1) Telecommunications Main Grounding Busbar (TMGB): TMGB shall be Panduit GB2B0612TPI-1 busbar kit.
      (2) Telecommunications Grounding Busbar: (TGB) shall be Panduit GB2B0304TPI-1 busbar kit.
      (3) Rack Grounding Strip: (RGB) shall be Panduit RGS134-1 with paint piercing grounding washers installed.

   C. GROUND WIRE: Unless otherwise noted, all conductors green insulated stranded copper
      (1) Telecommunications Bonding Backbone:(TBB) 2/0
      (2) Common Bonding Network:(CBN) #6 AWG
      (3) Equipment Jumper Kits: #6 AWG 24" length with 90 degree bent lug to straight lug

   D. CONNECTORS AND ACCESSORIES
(1) Grounding Clamp: U-bolt bronze for attachment to rods, pipes (non-water) and tubes

(2) Ground Lugs:
   a. TMGB: Code conductor, two-hole, long barrel irreversible compression with window lug
   b. TGB: Code conductor, one-hole, long barrel irreversible compression with window lug

(3) Paint Piercing Grounding Washers: 3/8" stud size .875 O.D. with antioxidant

(4) HTAP: Single or multitap to meet conductor size with clear cover

(5) Electro Discharge (ESD) Port: Panduit RGESD-1 with wrist strap

(6) Exothermic Connections:

(7) Substitutions: See Section 016000 - Product Requirements.

3. EXECUTION

A. INSTALLATION

(1) General Bonding Requirements:

   a. The communications bonding system shall be a complete system. Contractor shall furnish and install all necessary miscellaneous components, devices, equipment, material, and hardware, including, but not limited to, lock washers, paint-piercing washers, hex nuts, compression lugs, insulators, mounting screws, lugs, etc., to provide a complete system.

   b. A licensed electrician shall perform all bonding to electrical systems.

   c. Bonding conductors shall be green or marked with a distinctive green color.

   d. Interior water piping is not acceptable for use as a communications bonding system bonding conductor.

   e. Metallic cable shields are not acceptable for use as communications bonding system bonding conductors

(2) Comply with the manufacturer’s instructions and recommendations for installation of all products.

(3) Provide or coordinate installation of TBB from the main electrical service entrance ground bus.

   a. Do Not route TBB on Cable Ladderway
b. TBB must be insulated if exposed more than 24” within the CER.

(4) Ensure TMGB is connectorized within 24” of TBB entrance has vertical access to Cable Ladderway and is no more than 18” above finished floor

(5) Provide bonding to meet requirements described in Quality Assurance.

(6) Provide (1) RGB at of each rack

(7) Provide (1) TGB at each Voice Board

(8) Provide & install ground buses as shown on plans.

(9) Provide & install CBN from TMGB to each RGB & TGB in home run fashion. Do not daisy chain grounds.

(10) Provide & install CBN from TMGB to all ladderway. Provide CBN grounding across all joints in ladderway.

(11) Provide (2) spare Equipment Jumper Kits for each rack installed

(12) Provide ESD port for each rack installed

B. FIELD QUALITY CONTROL

(1) Owner will provide field inspection in accordance with Section 01 40 00.

C. TESTING

(1) Test installed system under provisions of Section 271710.

(2) Measure and document resistance to ground at TMGB, each TGB, each RTGB, and each electrical distribution panel bonded to the TMGB or a TGB.

(3) Measurements shall be made not less than two full days after the last trace of precipitation, and without the soil being moistened by any means other than natural drainage or seepage, and without chemical treatment or other artificial means of reducing natural ground resistance. Perform tests by the fall-of- potential method according to IEEE 81.

(4) Measured resistance to ground at TMGB, each TGB, and each RTGB must not exceed 1 ohm. Under no circumstances shall any point in the communications bonding system have a lower resistance to ground than that of nearby electrical distribution system components that it is bonded to.

(5) Measure and document voltage between screen of installed and terminated ScTP, FTP, and/or SSTP horizontal cables and electrical ground of electrical outlet(s) serving the information outlet
location area.

a. The voltage between the screen and the ground wire shall not exceed 1.0 V rms, and 1.0 V dc for any installed and terminated ScTP, FTP, and/or SSTP horizontal cables.

(6) Include measurement documentation in test data submitted at completion of project.

END OF SECTION
270529 – HANGERS AND SUPPORTS FOR COMMUNICATIONS SYSTEMS

1. GENERAL

A. SECTION INCLUDES
   (1) Hangers equipment supports.
   (2) Anchors and fasteners.
   (3) Backboards

B. REFERENCES
   (1) Section 270500 - Basic Communications Requirements

C. SUBMITTALS
   (1) See Section 013300 - Administrative Requirements, for submittal procedures.

D. QUALITY ASSURANCE
   (1) Products: Listed and classified by Underwriters Laboratories, Inc. as suitable for the purpose specified and indicated.
   (2) Non-continuous cable supports and cable support assemblies shall be listed by Underwriters Laboratories for both Canadian and US standards (cULus).
   (3) Non-continuous cable supports shall have the manufacturers name and part number stamped on the part for identification.
   (4) Manufacturer: Company specializing in manufacturing products specified in this section with a minimum of five years documented experience in the industry, and certified ISO 9000.

E. Coordination
   (1) Coordinate installation of hangers supports and cables with other trades.

2. PRODUCTS

A. MANUFACTURERS
   (1) Erico Caddy Cablecat: www.ericocom.
   (2) Substitutions: See Section 016000 - Product Requirements.

B. MATERIALS
   (1) Non-continuous Cable Support Systems
      a. Non-continuous cable supports
      b. Non-continuous cable supports shall provide a bearing
surface of sufficient width to comply with required bend radii of high-performance cables; cULus Listed

c. Non-continuous cable supports shall have flared edges to prevent damage while installing cables

d. Non-continuous cable supports sized 1-5/16" and larger shall have a cable retainer strap to provide containment of cables within the hanger. The cable retainer strap shall be removable and reusable and be suitable for use in air handling spaces

e. Non-continuous cable supports shall have an electro-galvanized or G60 finish and shall be rated for indoor use in non-corrosive environments

f. Stainless Steel non-continuous cable supports are intended for indoor and outdoor use in non-corrosive environments or where only mildly corrosive conditions apply

(2) Multi-tiered non-continuous cable support assemblies

a. Multi-tiered non-continuous cable support assemblies shall be used where separate cabling compartments are required. Assemblies may be factory assembled or assembled from pre-packaged kits. Assemblies shall consist of a steel angled hanger bracket holding up to six non-continuous cable supports, rated for indoor use in non-corrosive environments; UL Listed.

b. If required, the multi-tier support bracket may be assembled to manufacturer recommended specialty fasteners including beam clamps, flange clips, C and Z purlin clips.

(3) Non-continuous cable support assemblies from tee bar

a. Tee bar support bracket with one non-continuous cable support, factory or jobsite assembled; rated for indoor use in non-corrosive environments; UL Listed.

(4) Non-continuous cable support assemblies from drop wire/ceiling

a. Fastener to wire/rod with one non-continuous cable support, factory or jobsite assembled; rated for indoor use in non-corrosive environments; cULus Listed.

(5) Installation accessories for non-continuous cable supports

a. Cable Pulley

i. Non-continuous cable supports may be used as an installation tool when a removable pulley assembly is included. The pulley shall be made of plastic and be
without sharp edges. The pin and bail assembly must be able to be secured to the J-Hook during cable installation. The pulley must remain secured while cables are being pulled.

ii. The pin and roller assembly must be removed after cables are installed.

b. Cable Protector
   i. The protective steel tube shall fit over threaded rod and be at least 4” in length.
   ii. The tube shall prevent damage to cables placed in or pulled through CAT-CMTM U-hooks. The tube shall not inhibit the pulling of cables.

(6) Backboards
   a. 3/4 " AC fire treated plywood

3. EXECUTION
   A. INSTALLATION
      (1) Install hangers and supports as required to adequately and securely support cable system components, in a neat and workmanlike manner, as specified in NECA 1 and minimally 4’ O.C.
      a. Installation and configuration shall conform to the requirements of the current revision levels of TIA Standards 568 and 569, NFPA 70 (National Electrical Code), applicable local codes, and to the manufacturer’s installation instructions.
      b. Do not exceed load ratings specified by manufacturer.
      c. Adjustable non-continuous support sling shall have a static load limit of 100 lbs.
      d. Follow manufacturer’s recommendations for allowable fill capacity for each size non-continuous cable support.
      e. Do not fasten supports to pipes, ducts, mechanical equipment, or conduit.
      f. Do not drill or cut structural members.

END OF SECTION
270532 – FIRESTOPPING FOR TELECOMMUNICATIONS SYSTEMS

1. GENERAL

A. SECTION INCLUDES

(1) Firestopping of Through Penetrations in Fire Rated Assemblies.
(2) Smoke Seals.
(3) Construction enclosing compartmentalized areas.

B. SCOPE

(1) This SECTION describes the requirements for furnishing and installing firestopping for fire-rated construction. This includes all openings in fire-rated floors, walls and other rated elements of construction, both blank (empty) and those accommodating items such as cables, conduits, pipes, ducts, etc.
(2) Fireblocking for Concrete Floor or Wall Sleeved Cables.
(3) Fireblocking for Gypsum Wall Sleeved Cables.
(4) Fireblocking for Concrete Block Wall Sleeved Cables.

C. RELATED SECTIONS

(1) Division 3 – Section 033000 – Cast-In-Place Concrete
(2) Division 4 – Section 042200 – Concrete Unit Masonry
(3) Division 9 – Section 092000 – Plaster and Gypsum Board
(4) Division 7 – Section 078413 – Penetration Firestopping
(5) Division 26 – Section 260000 – Electrical
(6) Division 27 – Section 270000 – Communications

D. REFERENCES

(1) ASTM E 84, "Surface Burning Characteristics of Building Materials”.
(2) ASTM E 119, “Fire Tests of Building Construction and Materials”.
(3) ASTM E 814, “Fire Tests of Through Penetration Firestops”.
(5) ANSI/UL723, “Surface Burning Characteristics of Building Materials”.
(6) ANSI/UL1479, “Fire Tests of Through Penetration Firestops”.
(7) Underwriters Laboratories Inc. (UL) – Fire Resistance Directory
E. PERFORMANCE REQUIREMENTS

(1) Fire rated pathway devices shall be the preferred product and shall be installed in all locations where frequent cable moves, adds-ons and changes will occur.

(2) Where non-mechanical products are utilized, provide products that upon curing do not re-emulsify, dissolve, leach, breakdown or otherwise deteriorate over time from exposure to atmospheric moisture, sweating pipes, ponding water or other forms of moisture characteristic during or after construction.

(3) Where it is not practical to use a mechanical device, openings within floors and walls designed to accommodate telecommunications and data cabling shall be provided with re-enterable products that do not cure or dry.

(4) Openings for cable trays shall be sealed using re-enterable firestopping pillows.

F. SUBMITTALS

(1) Submit under provisions of Section 013300.

(2) Product Data: Provide manufacturer’s standard catalog data for specified products demonstrating compliance with referenced standards and listing numbers of systems in which each product is to be used.

(3) Shop Drawings: Submit schedule of opening locations and sizes, penetrating items, and required listed design numbers to seal openings to maintain fire resistance ratings.

(4) Certificates: Product certificates signed by firestop system manufacturer certifying material compliance with applicable code and specified performance characteristics.

(5) Installation Instructions: Submit manufacturer’s printed installation instructions.

G. QUALITY ASSURANCE
(1) Products/Systems: Provide firestopping systems that comply with the following requirements:

a. Firestopping tests are performed by a qualified, testing and inspection agency. A qualified testing and inspection agency is UL, or another agency performing testing and follow-up inspection services for firestop system acceptable to authorities having jurisdiction.

b. Firestopping products bear the classification marking of qualified testing and inspection agency.

c. Installer Qualifications: Experience in performing work of this section who is qualified by the firestopping manufacturer as having been provided the necessary training to install firestop products in accordance with specified requirements.

H. COORDINATION

(1) Coordinate layout and installation of Firestopping System with other trades.

(2) Revise locations and elevations from those indicated as required to suit field conditions and as approved by the Architect.

(3) Storage and Handling: Avoid breakage, denting and scoring finishes. Damaged products will not be installed. Store devices and accessories in original cartons and in clean dry space; protect from weather and construction traffic. Wet materials will be unpacked and dried before storage.

I. PROJECT CONDITIONS

(1) Do not install firestopping products when ambient or substrate temperatures are outside limitations recommended by manufacturer.

(2) Do not install firestopping products when substrates are wet due to rain, frost, condensation, or other causes.

(3) Maintain minimum temperature before, during, and for a minimum 3 days after installation of materials.

(4) Do not use materials that contain flammable solvents.
(5) Coordinate construction of openings and penetrating items to ensure that through-penetration firestop systems are installed according to specified requirements.

(6) Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate through-penetration firestop systems.

(7) Schedule installation of firestopping after completion of penetrating item installation but prior to covering or concealing of openings.

2. PRODUCTS

A. MANUFACTURERS

(1) Acceptable Manufacturer: Specified Technologies Inc., 200 Evans Way, Somerville, NJ 08876. Tel: (800) 992-1180, Fax: (908) 526-9623, Email: specseal@stifirestop.com, Website: www.stifirestop.com.

(2) Substitutions: Pre-Approval.

(3) Single Source: Obtain firestop systems for each type of penetration and construction condition indicated only from a single manufacturer.

B. MATERIALS

(1) General: Use only firestopping products that have been tested for specific fire resistance rated construction conditions conforming to construction assembly type, penetrating item type, annular space requirements, and fire rating involved for each separate instance.

(2) Firestop Sealants: STI SpecSeal® Brand single component latex formulations that upon cure do not re-emulsify during exposure to moisture, the following products are acceptable:

   a. Specified Technologies Inc. (STI) SpecSeal® Series SSS Sealant
   b. Specified Technologies Inc. (STI) SpecSeal® Series LCI Sealant

(3) Firestop Putty: STI SpecSeal® Brand intumescent, non-hardening, water resistant putties containing no solvents, inorganic fibers or silicone compounds, the following products are acceptable:
(4) Specified Technologies Inc. (STI) SpecSeal® Series SSP Putty

(5) Firestop Pillows: STI SpecSeal® Brand re-enterable, non-curing, mineral fiber core encapsulated on six sides with intumescent coating contained in a flame retardant poly bag, the following products are acceptable:

(6) Specified Technologies Inc. (STI) SpecSeal® Series SSB Pillows

(7) Fire Rated Cable Pathways: STI EZ-PATH™ Brand device modules comprised of steel raceway with intumescent foam pads allowing 0 to 100 percent cable fill, the following products are acceptable:

(8) Specified Technologies Inc. (STI) EZ-PATH™ Fire Rated Pathway

3. EXECUTION

A. EXAMINATION

(1) Before beginning installation, verify that substrate conditions previously installed under other sections are acceptable for installation of firestopping in accordance with manufacturer's installation instructions and technical information.

(2) Surfaces shall be free of dirt, grease, oil, scale, laitance, rust, release agents, water repellants, and any other substances that may inhibit optimum adhesion.

(3) Provide masking and temporary covering to protect adjacent surfaces.

(4) Do not proceed until unsatisfactory conditions have been corrected.

B. INSTALLATION

(1) General: Install through-penetration firestop systems in accordance with Performance Criteria and in accordance with the conditions of testing and classification as specified in the published design.

(2) Manufacturer's Instructions: Comply with manufacturer's instructions for installation of firestopping products.

C. FIELD QUALITY CONTROL
(1) Inspections: Owner shall engage qualified independent inspection agency to inspect through-penetration firestop systems.

(2) Keep areas of work accessible until inspection by authorities having jurisdiction.

(3) Where deficiencies are found, repair firestopping products so they comply with requirements.

D. ADJUSTING AND CLEANING

(1) Remove equipment, materials, and debris, leaving area in undamaged, clean condition.

(2) Clean all surfaces adjacent to sealed openings to be free of excess firestopping materials and soiling as work progresses.

E. SCHEDULES:

<table>
<thead>
<tr>
<th>Penetrant Type</th>
<th>Concrete Floor</th>
<th>Concrete Wall</th>
<th>Gypsum Board Wall</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blank Opening</td>
<td>C-AJ-0100, C-AJ-0101</td>
<td>C-AJ-0100, C-AJ-101</td>
<td></td>
</tr>
</tbody>
</table>

END OF SECTION
270533 – CONDUITS AND BACKBOXES FOR COMMUNICATIONS SYSTEMS

1. PART 1 - GENERAL
   (1) SECTION INCLUDES
       a. Wall and ceiling outlet boxes.
       b. Floor boxes.
       c. Pull and junction boxes.
   (2) RELATED SECTIONS
       a. Section 270500 - Basic Communications Requirements
       b. Section 270532 - Firestopping.
   (3) SUBMITTALS
       a. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
       b. Project Record Documents: Record actual locations and mounting heights of outlet, pull, and junction boxes on project record documents.
   (4) QUALITY ASSURANCE
       a. Conform to requirements of NFPA 70.
       b. Products: Provide products listed and classified by Underwriters Laboratories, Inc., as suitable for the purpose specified and indicated.
       c. All building penetrations shall be reviewed and approved by the owner

B. PRODUCTS
   (1) MANUFACTURERS
       a. Hubble; www.hubble.com
       b. Wiremold; www.wiremold.com
       c. Carlon; www.carlon.com
       d. Substitutions: See Section 016000 - Product Requirements.
   (2) CONDUIT REQUIREMENTS
       a. Conduit Size: Comply with NFPA 70.
       b. Minimum Size: 1 inch unless otherwise specified.
       c. Conduit Sweeps
          i. All conduit shall use sweeps as follows
          ii. Non-thread couplings shall not be used on metallic conduits.
iii. Metallic sweeps shall have a factory applied 40 mil PVC coating or be doubled (half overlap) wrapped with a 10 mil PVC plastic tape specifically manufactured for corrosion protection of metallic conduits installed below grade.

iv. Sweeps shall have a minimum radius of 12 times the nominal diameter of the conduit.

d. Underground Installations:
e. More than Five Feet from Foundation Wall: Use thickwall non-metallic conduit.
f. Within Five Feet from Foundation Wall: Use rigid steel conduit.

(3) Outdoor Locations Above Grade:
a. Use rigid steel conduit or electrical metallic tubing.

(4) Dry Locations:
a. Concealed: Use electrical metallic tubing.
b. Exposed: Use electrical metallic tubing.

(5) Building Penetrations:
a. Provide core only.

(6) METAL CONDUIT
a. RIGID STEEL CONDUIT:
i. All conduits 2” and greater galvanized rigid steel.


c. Fittings and Conduit Bodies: NEMA FB 1; threaded, water and concrete-tight.

d. FLEXIBLE METAL CONDUIT
i. Description: Interlocked steel construction.
ii. Fittings: NEMA FB 1.

e. LIQUIDTIGHT FLEXIBLE METAL CONDUIT
i. Description: Interlocked steel construction with PVC jacket.
ii. Fittings: NEMA FB 1.

f. ELECTRICAL METALLIC TUBING (EMT)
i. Suitable for all sizes up to and including 1-1/2”

ii. Description: ANSI C80.3, UL797; galvanized tubing, coated on the inside with a smooth, hard finish of lacquer, varnish or enamel.

iii. Fittings and Conduit Bodies: NEMA FB 1; Throated steel compression gland type.
g. NONMETALLIC CONDUIT
i. Unless otherwise specified, all conduit to be installed underground or installed in concrete structures shall be 4-inch diameter, rigid Polyvinyl Chloride (PVC) Non-Metallic Conduit.

ii. Description: UL 651, NEMA TC 2; Schedule 40 PVC, heavy wall, sunlight resistant, manufactured from high impact material and shall be rated for use at 90 degrees centigrade.

iii. Fittings and Conduit Bodies: UL 514, NEMA TC 3, Bell ends.

iv. Solvent Cement: ASTM D 2564 a medium or heavy-bodied cement capable of making watertight joints.

v. Primer: As recommended by cement manufacturer for the conduit.

h. INTEGRAL MULTI-CELL DUCT
i. Description: Schedule 40 PVC modular and,

ii. Slip fit lengths.

iii. Pre-lubricated innerducts with internal spacers and which expand and contract at the same rate as the outerduct.

iv. Anti-reversing gaskets.

v. Integral innerduct o-ring.

vi. Inward tapered holes.

vii. Alignment indicator.

viii. Marked 'INSTALL PRINT SIDE UP' with marked innerducts & holes for installation coordination.

ix. Flexible bends cut through resistant.

x. Manufacturers:


xii. Fittings: Match to manufacturers system.

i. FLEXIBLE NON-METALLIC CONDUIT (INNERDUCT)

i. Requires per-approval for use in direct buried situations.

ii. Description: Polyvinyl Chloride (PVC), or Polyethylene (PE) plastic.

iii. Use Plenum innerduct in the appropriate environment.

iv. Fittings: Connection between the flexible conduit and conduits of other materials shall be made with a watertight transition coupling manufactured for the specific type of material.

v. Smooth walled exterior and a ribbed interior with 1250 pound test mule tape installed. No corrugated innerduct will be accepted.

vi. Substitutions: See Section 01 60 00 - Product Requirements.

j. OUTLET BOXES

i. Sheet Metal Outlet Boxes: NEMA OS 1, galvanized steel.
1.) New work: minimum 4”x 4” deep box with single mud ring
2.) Surface box: weather proof deep Bell box.

ii. Cast Boxes: NEMA FB 1, Type FD, aluminum. Provide gasketed cover by box manufacturer. Provide threaded hubs.

k. FLOOR BOXES
i. Floor Boxes: NEMA OS 1, fully adjustable, 1-1/2 inches deep.
ii. Material: Cast metal.
iii. Shape: Rectangular.
iv. Service Fittings: As specified in Section 26 2726.
v. Approved Manufacturer
   1.) Hubble HBLCFB401
   2.) Wiremold RFB4

l. PULL AND JUNCTION BOXES
i. Sheet Metal Boxes: NEMA OS 1, galvanized steel.
ii. Hinged Enclosures: As specified in Section 26 2716.

C. EXECUTION

(1) EXAMINATION
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.
d. Verify locations of floor boxes and outlets in offices and work areas prior to rough-in.

(2) HANDLING & STORAGE
a. All conduit shall be transported in modules or bundled in a straight and level position. The straps securing the conduit to any transport vehicle shall be a minimum of 4 inches in width and shall not deform or damage the conduit in any manner. Conduits shall be unloaded in accordance with the manufacturer's recommendations and shall not be dropped to the ground.
b. All conduit shall be transported in modules or bundled in a straight and level position. The straps securing the conduit to any transport vehicle shall be a minimum of 4 inches in width and shall
not deform or damage the conduit in any manner. Conduits shall be unloaded in accordance with the manufacturer's recommendations and shall not be dropped to the ground.

(3) INSTALLATION

a. All underground conduits shall have a minimum 36" cover.

b. Install a minimum of four 1 inch smooth wall exterior ribbed interior innerducts in all 4 inch conduits.

c. Install conduit securely, in a neat and workmanlike manner, as specified in NECA 1.

d. All conduits subject to mechanical injury or exposed in wet locations shall be Rigid Galvanized Steel.

e. Flexible conduit shall not be utilized for making bends in conduit system.

f. Field bent conduit shall not have flat spots or crimps.

g. Connection between flexible conduits and conduits of other materials shall be made with a watertight transition coupling manufactured for the specific type of material

h. Connection to a RGS bend, shall use a threaded PVC female adapter.

i. Arrange supports to prevent misalignment during wiring installation.

j. Group related conduits; support using conduit rack. Construct rack using steel channel; provide space on each for 25 percent additional conduits.

k. Fasten conduit supports to building structure and surfaces under provisions of Section 260529.

l. Do not support conduit with wire or perforated pipe straps. Remove wire used for temporary supports.

m. Do not attach conduit to ceiling support wires.

n. Route exposed conduit parallel and perpendicular to walls.

o. Route conduit installed above accessible ceilings parallel and perpendicular to walls.

p. Cut conduit square using saw or pipecutter; de-burr cut ends.

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 to fasten conduit to sheet metal boxes in damp
and wet locations.

s. Install no more than equivalent of two 90 degree sweeps 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 size.

t. All 90-degree turns in raceway must be provided with the appropriate junction to ensure non-violation of bend radius

u. Any conduit from a workstation that does not go home-run to the telecommunications room but rather is specified as a stub out above a push-up tile ceiling shall include a gentle sweep toward the proposed telecommunications closet, a connector, and bushing.

v. Install non-metallic flexible conduit, (innerduct) per fill as shown on plans

w. Provide suitable pull string in each empty conduit except sleeves and nipples.

x. Use suitable caps to protect installed conduit against entrance of dirt and moisture.

y. Ground and bond conduit under provisions of Section 260526.

z. Install boxes securely, in a neat and workmanlike manner, as specified in NECA 1.

aa. Set wall mounted boxes at elevations to accommodate mounting heights indicated.

i. Install boxes to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 07 84 00.

ii. Coordinate mounting heights and locations of outlets mounted above counters, benches, and backsplashes.

iii. Align adjacent wall mounted outlet boxes for switches, thermostats, Information Outlets, and similar devices.

bb. Do not install flush mounting box back-to-back in walls; provide minimum 12 inches separation. Provide minimum 24 inches separation in acoustic rated walls.

i. Secure flush mounting box to interior wall and partition studs. Accurately position to allow for surface finish thickness.

ii. Support boxes independently of conduit.

iii. Use gang box where more than one device is mounted together. Do not use sectional box.
iv. Use gang box with plaster ring for single device outlets.

v. Set floor boxes level.

vi. Provide firestopping under provisions of Section 07 8400 to sustain ratings when passing conduits and raceways through fire-rated elements.

vii. Paint all conduits and raceways to match.

(4) ADJUSTING

a. Adjust floor boxes flush with finish flooring material.

b. Adjust flush-mounting outlets to make front flush with finished wall material.

c. Install knockout closures in unused box openings.

d. Seal all penetrations per local, state and federal codes.

(5) CLEANING

a. Remove all debris from pullboxes, conduit systems.

b. Ensure no water or other foreign materials have entered the system; remove completely

c. Clean interior of boxes to remove dust, debris, and other material.

d. Clean exposed surfaces and restore finish.

END OF SECTION
THIS PAGE INTENTIONALLY LEFT BLANK
1. GENERAL
   A. SECTION INCLUDES
      (1) Cable trays and accessories.
   B. REFERENCES
      (1) ANSI/NFPA 70 – National Electrical Code (NEC)
      (2) ANSI/TIA-569 - Telecommunications Pathways & Spaces
      (3) ASTM A 510 - Specification for General Requirements for Wire Rods and Coarse Round Wire, Carbon Steel
      (5) ASTM B 633 – Specification for Electrodeposited Coatings of Zinc on Iron and Steel
      (6) ASTM A 123 – Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
      (7) ASTM A 653 - Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Structural (Physical) Quality
      (8) IEC 61537 (2001) – Cable Tray Systems and Cable Ladder Systems for Cable Management
      (9) NEMA VE 1-2002/CSA C22.2 No. 126.1-02 – Metal Cable Tray Systems
   C. SUBMITTALS
      (1) See Section 013300 - Administrative Requirements, for submittal procedures.
      (2) Product Data: Provide data for fittings and accessories.
      (3) Manufacturer’s Instructions: Indicate application conditions and limitations of use stipulated by product testing agency specified under Quality Assurance. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
      (4) Project Record Documents: Record actual routing of cable tray and locations of supports.
   D. QUALITY ASSURANCE
      (1) Comply with NFPA 70, National Electrical Code, Article 392: Cable
Trays; provide UL Classification and labels.

(2) Comply with IEC 61537, Cable Tray Systems and Cable Ladder Systems for Cable Management.

(3) Comply with NEMA VE 1/CSA C22.2 No. 126.1, Metal Cable Tray Systems, for materials, sizes, and configurations; provide Certificate and labels.

E. COORDINATION

(1) Coordinate layout and installation of cable tray with other trades.

(2) Revise locations and elevations from those indicated as required to suit field conditions and as approved by the Architect.

(3) Storage and Handling: Avoid breakage, denting and scoring finishes. Damaged products will not be installed. Store cable trays and accessories in original cartons and in clean dry space; protect from weather and construction traffic. Wet materials will be unpacked and dried before storage.

2. PRODUCTS

A. MANUFACTURERS

(1) Square D; www.squared.com.

(2) GS Metals; Flextray: www.flextray.com

(3) WBT; www.wbtray.com

(4) Substitutions: See Section 01 60 00 - Product Requirements.

B. LADDER-TYPE CABLE TRAY

(1) Description: NEMA VE 1, Class 20C ladder type tray.

(2) Material: Formed sheet steel, hot-dip galvanized after fabrication in accordance with ASTM A 123/A 123M, painted with gray epoxy.

(3) Straight Section Rung Spacing: 6 inches on center.

(4) Provide manufacturer’s standard clamps, hangers, brackets, splice plates, reducer plates, blind ends, barrier strips, connectors, and grounding straps

a. Covers: Flanged, solid, flush cover.

C. STEEL MESH - TYPE CABLE TRAY

(1) Cable tray will consist of continuous, rigid, welded steel wire mesh cable management system, to allow continuous ventilation of cables and maximum dissipation of heat, with UL Classified splices where tray (including UL Classified painted tray) acts as Equipment
Grounding Conductor (EGC). Wire mesh cable tray will have continuous Safe-T-Edge T-welded top side wire to protect cable insulation and installers.

(2) Provide splices, supports, and other fittings necessary for a complete, continuously grounded system.
   a. Mesh: 2 x 4 inches (50 x 100 mm).
   b. Straight Section Lengths: 118 inches (3,000 mm).
   c. Wire Diameter: Patented design includes varying wire sizes to meet application
   d. Load requirements; to optimize tray Strength; and to allow tray to remain lightweight.
   e. Safe-T-Edge: Patented Safe-T-Edge technology on side wire to protect cable
   f. Insulation and installers’ hands.
   g. Fittings: Wire mesh cable tray fittings are field-fabricated from straight tray
   h. Sections, in accordance with manufacturer’s instructions and

(3) CF Series Cable Tray Size:
   a. Depth: Cable tray depth will be 4 inches
   b. Width: Cable tray width will be 6, 12, 18, or 24 inches as required
   c. Length: Cable tray section length will be 118 inches (3000mm) unless otherwise shown on drawings.
   d. Fill Ratio: Cable tray may be filled to total fill capacity per NEC. Minimum 20% spare capacity recommended to accommodate future cabling changes or additions.
   e. Load Span Criteria:
      i. Cable tray will be capable of carrying a uniformly distributed load of 50 pounds per foot on an 8-ft. support span, according to load tests of standard shown in Item A above

(4) Cable Tray Supports & Accessories
   a. Fittings/Supports: Wire mesh cable tray fittings are field-fabricated from straight tray sections, in accordance with manufacturer’s instructions. Supports will include the FAS (Fast Assembly System) where possible so that screws,
bolts, and additional tools are not required for cable tray mounting; installation time is reduced; and tray path can adapt to installation obstacles without the need for additional parts. Place supports so that support span does not exceed that shown on the drawings.

i. FAS System support methods to mount from ceiling and wall structures with 1/4", 3/8" or 1/2" threaded rod, if applicable

ii. Splices, including those approved for electrical continuity (bonding), as recommended by cable tray manufacturer. Select one of the following splicing methods, if applicable:

iii. UL Classified EDRN Fast Splice: No hardware required

iv. UL Classified SWK Splice Washer Kit: Swaged set for splicing, turns, bends, tees

v. UL Classified ED Universal Splice Bar: Cut & bend to fit any configuration

vi. Pre-click Splice: Bolted connection optional

vii. UL Classified EDT Splice Plate: Bolted connection

viii. UL Classified CE 25 & CE 30 Square Splice Washers: Use with EZ BN ¼" Nut & Bolt

ix. UL Classified CE 40 Square Splice Washer: Use with EZ BN ¼" to splice trays on bends, adjustable tees

x. FASLock Splice: For sweeps and bends with tray 12" (300mm) and wider.

xi. UL Classified EZ T 90 kit: For tees and 90s

xii. UL Classified RADT90 kit: For 5-1/2” radius Tees and 90s

3. EXECUTION

A. EXAMINATION

(1) Verify that field measurements are as indicated.

(2) Match all new materials to existing

B. INSTALLATION

(1) Install metallic cable tray in accordance with NEMA VE 1.

(2) Support trays in accordance with Section 270529. Provide supports at each connection point, at the end of each run, and at
other points to maintain spacing between supports of 6 ft maximum.

(3) Use expansion connectors where required.

(4) Provide firestopping under provisions of Section 078400 to sustain ratings when passing cable tray through fire-rated elements.

(5) Ground and bond cable tray under provisions of Section 270526.
   a. Provide continuity between tray components.

END OF SECTION
270553 – IDENTIFICATION FOR COMMUNICATION SYSTEMS

1. GENERAL

A. SUMMARY

(1) Administration of the telecommunications infrastructure includes documentation of cables, termination hardware, patching and cross-connection facilities, conduits, other cable pathways, Telecommunications Rooms, and other telecommunications spaces. All facilities shall apply and maintain a system for documenting and administering the telecommunications infrastructure.

(2) The owner maintains a campus wide labeling scheme for voice and data outlets and patch panels.

(3) Industry Labeling Standards and Conventions shall be used unless otherwise stated in the bid documents or by the Owner’s Representative.

(4) Telecommunications Infrastructure Records must be maintained in a computer spreadsheet, or in a computer database. Paper records are encouraged, but are optional. A cable record is prepared for each backbone cable. The record will show the cable name, and must describe the origin point and destination point of the cable. The cable record will record what services and/or connections are assigned to each cable pair or strand. An equipment record is prepared for services distributed from a certain piece of equipment, such as a router, or a system such as the telephone system PBX.

(5) Installer shall maintain accurate, up-to-date Installation or Construction Drawings. At a minimum, the Installation Drawings shall show pathway locations and routing, configuration of telecommunications spaces including backboard and equipment rack configurations, and wiring details including identifier assignments.

(6) Installer shall provide a complete and accurate set of as-built drawings. The as-built drawings shall record the identifiers for major infrastructure components including; the pathways, spaces, and wiring portions of the infrastructure which may each may have separate drawings if warranted by the complexity of the installation, or the scale of the drawings.
B. RELATED DRAWINGS

a. T-Series drawings follow the specifications in this Section.

b. Electrical drawings specify the electrical requirements.

c. Interior Design drawings specify interior finishes, spatial relationships between items, and specific mounting height.

C. REFERENCES

(1) Requirements, Codes, and Standards

a. Design, manufacture, test, and install telecommunications cabling networks per manufacturer’s requirements and in accordance with latest revision of the NFPA-70 (National Electrical Code®), state codes, local codes, requirements of Authorities Having Jurisdiction (AHJ), and the following standards, including the most current revisions, addendums, and any Technical Service Bulletins (TSBs) that may have been released at the time of bid, including:

b. TIA/EIA-606 – Administration Standard for Commercial Telecommunications Infrastructure

D. SYSTEM DESCRIPTION

E. The Contractor will provide and install identification labeling for the project’s voice and data communications systems, including all components from the TO to the TR and between telecommunications spaces.

2. PRODUCTS

A. GENERAL NOTES

(1) In this section, certain products are specified by manufacturer and part number to establish a level of quality, performance, and consistency. To substitute other products would defeat this effort to the Owner’s detriment. If no manufacturer or part number is specified for a part, then that part is generic, and the Contractor shall submit for approval a part that provides the performance specified herein.

B. IDENTIFICATION
(1) Labels
   a. Shall meet the legibility, defacement, exposure and adhesion requirements of UL 969
   b. Shall be preprinted or computer printed type. Hand written labels are not acceptable
   c. Where insert type labels are used provide clear plastic cover over label
   d. Outside plant labels shall be totally waterproof even when submerged
   e. Equipment Room Copper, Fiber, and Coax Backbone Cable Labels
   f. Equipment Room Copper, Fiber, and Coax Horizontal Cable Labels
   g. Work Area Copper, Fiber, and Coax Riser Cable Labels
   h. Patch Panel Labels

(2) Label Construction
   a. Labels shall be white, manufactured of resilient and flexible vinyl or polyester, die-cut, and have adhesive backing for permanent attachment.
   b. Labels for Data Cables
   c. Labels for data cables shall be:
      i. Self-laminating
      ii. Rotatable/repositionable
      iii. Of appropriate size to completely encircle the cable and completely overlay the identification tag area
   d. Placement of Data Cable Labels
   e. Labels shall be placed within view at the termination points, within 3 inches (75 mm) of each end of each:
      i. Backbone cable
ii. Horizontal cable

iii. Bonding conductor

f. Labels for Data Cable Bundles

i. Cable bundles shall be identified with non-adhesive thermal-transfer-printable marker plates.

ii. Marker plates shall be attached to cable bundles with nylon cable ties or hook and loop ties.


g. Labels for Cabinets and Equipment

i. Cabinets and equipment shall be identified with thermal-transfer-printed, die-cut, microcellular foam labels with a polyester printable surface and high-tack adhesive.

ii. Each outlet, patch panel, and wiring block shall be identified by a label installed on or in the space provided on the device.

h. Label Sizes for Outlets and Termination Hardware

i. Labels for outlets and termination hardware shall be at least 1-1/4 inches wide and 3/8 inch high.

j. Label Sizes for Other Equipment

k. Labels for the following shall be at least 4 inches wide and 1 inch high:

i. Riser cables

ii. Network equipment

iii. Equipment cabinets and racks

iv. Bonding busbars

v. Consolidation point enclosures

vi. Active hardware and equipment
(3) Warning Tags

a. At each location where the fiber cable is exposed to human intrusion, it shall be marked with warning tags. These tags shall:

i. Be yellow or orange

ii. Bear the warning, “CAUTION FIBER OPTIC CABLE”

iii. Have this text in permanent, black, block characters at least 5 mm high

b. A warning tag shall be permanently affixed to each exposed cable or bundle of cables at intervals of not less than 1.5 m.

c. Any section of exposed cable less than 1.5 m long shall have at least one warning tag affixed to it.

(4) Printing of Labels

a. Printing shall be machine-generated in permanent ink that contrasts the background color.

b. All characters shall be block style.

c. The text shall fill the area of the printable field.

3. EXECUTION

A. IDENTIFICATION

(1) Prior to the installation or termination of cabling, confirm all specific labeling requirements with the Owner or the Owner’s Engineer.

(2) Cables

a. Mark backbone cables at each endpoint and at all intermediate pull points, access points, and junction boxes. Labels shall indicate the origination and destination identifier, the sheath identifier, and the strand or pair range.

b. Horizontal cables shall be marked at each end, on the sheath indicating the TR, patch panel and panel port to which the cable is wired. Block terminated cable shall be identified with a V in place of the panel ID.
(3) Faceplates, Patch Panels, and Wiring Blocks

a. Mark Fiber Distribution Enclosures (FDEs) with adhesive labels that indicate the range of circuits installed within. Label each port with the origination and destination grid identifier and the individual strand ID.

b. Label patch panels alphabetically, beginning at the top. Individual ports shall come from the factory labeled with a number designation.

c. Label each faceplate to indicate, for each cable that it houses, the TR, patch panel, and panel port to which the cable is wired. Label block-terminated cables with the Telecommunication Room and “V” cable number.

d. Label each wiring block numerically, beginning at the top left of the termination field. Within each block, identify the individual rows alphabetically, beginning at the top left and proceeding sequentially down and to the right. Label each row with the corresponding cable identifier, and label each pair or circuit on each cable.

e. Fit each cable with a self-laminating label, bearing the appropriate cable identifier, that surrounds the outermost jacket. Place the label at each end of the cable, within 3 inches (75 mm) of the end of the sheath.

f. Fit each equipment enclosure with a self-adhesive label bearing its respective identifier, affixed to the top center of the front and rear doors.

g. Fit each FDE with a self-adhesive label, bear its respective identifier in block characters, affixed at the top center of the front and rear faces.

h. Fit each adapter inside enclosures with a label bearing its identifier, affixed directly adjacent to its shortest side. Rotate characters so that their orientation is kept left to right, top to bottom.

i. Label conduits and pathways within 0.5 m (18 inches) of each end, where exposed and accessible. It is
recommended that additional labeling be provided every 3 m (10 feet) of exposed length.

j. Fit network equipment with a label, placed in an accessible area on the front and rear, bearing the appropriate identifier, MAC address, and date of installation. The label shall not interfere with the operation of or interface to the unit, nor shall it obscure manufacturer's labels.

END OF SECTION
271116 – COMMUNICATIONS CABINETS, RACKS, FRAMES AND ENCLOSURES

1. GENERAL

A. SECTION INCLUDES

(1) Communication Equipment room termination support hardware, backboards
   a. Racks
   b. Equipment Enclosures

B. RELATED SECTIONS

(1) Section 270526 Ground & Bonding for Communications Systems

(2) Section 271123 Communications Cable Management & Ladder Rack

C. SUBMITTALS

(1) See Section 013300 - Administrative Requirements, for submittal procedures.

(2) Product Data: Provide manufacturers catalog data for hardware

(3) Project Record Documents: Prepared and approved by BICSI Registered Communications Distribution Designer (RCDD).

D. QUALITY ASSURANCE

(1) All cable and equipment shall be installed in a neat and workmanlike manner. All methods of construction that are not specifically described or indicated in the contract documents shall be subject to the control and approval of the Owner or Owner Representative. Equipment and materials shall be of the quality and manufacture indicated. The equipment specified is based upon the acceptable manufacturers listed. Where “approved equal” is stated, equipment shall be equivalent in every way to that of the equipment specified and subject to approval.

(2) Strictly adhere to all Building Industry Consulting Service International (BICSI) and Telecommunications Industry Association (TIA) recommended installation practices when installing communications/data cabling.
Material and work specified herein shall comply with the applicable requirements of the current adopted revision of the following:

- ANSI/TIA-568 Series Commercial Building Telecommunications Cabling Standard,
- ANSI/TIA-569 Telecommunications Pathways and Spaces,
- ANSI/TIA-606 Administration Standard for the Telecommunications Infrastructure
- ANSI-J-STD-607 Joint Standard for Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications
- EIA-310-E, Cabinets, Racks, Panels, and Associated Equipment (most recent version) NFPA 70 National Electric Code
- BICSI Telecommunications Distribution Methods Manual

**WARRANTY**

See Section 017700 - Closeout Submittals, for additional warranty requirements.

**PRODUCTS**

**EQUIPMENT ENCLOSURES**

- Model: BGR-41SA-27LRD.
- Type: 19-inch gangable equipment rack.
- Compliance:
  - EIA/TIA 310D.
d. UL Listed: US and Canada.
e. Construction: Fully welded.
f. Weight Capacity: 3,000 pounds UL Listed, 12,000 pounds static.
g. Finish of Structural Elements: Black textured powder coat.
h. Rackrail:
   i. Two pairs of fully adjustable, 11-gauge steel rackrail with tapped 10-32 mounting holes in universal EIA spacing.
   ii. Finish: Black e-coat.
   iii. Rackspace: Numbered.
i. Rear Door: Solid, keylocked, selectively vented with mounting provisions for 4-1/2” fans.
j. Removable Rear Knockout Panel:
   i. 1/2-inch, 5/8-inch, 1-inch, and 1-1/4-inch electrical knockouts and ½” “D” UHF/VHF knockouts on 1-5/16-inch x 7-1/2-inch laser knockout plate installed in top and bottom.
k. Grounding and Bonding Stud: 1/4-20 by 1-inch threaded, installed in top and base, allows installation to conform to NEC.

(2) OPTIONS
a. Front Doors: perforated vented
c. Top Panels: steel, accepts 10-inch fan]
d. Integrated Fan Tops:
   i. Proportional speed, thermostatic fan control.
      1.) Fans: 276 CFM
e. Leveling Feet:
   i. 3/8-inch threaded steel, Heavy Duty adjustable from top or bottom.
f. Removable side panels.
g. Door latch.
h. Rackmount Power Strip
   i. 9 outlet 15A Basic surge

B. RACKS
a. Racks shall be manufactured from aluminum and/or steel extrusion.
b. Each rack will have two L-shaped top angles, two L-shaped base angles and two C-shaped equipment-mounting channels. The rack will assemble with nut and bolt hardware. The base angles will be pre-punched for attachment to the floor.
c. Equipment mounting channels will be punched on the front and rear flange with the EIA-310 Universal Mounting hole pattern.

d. Aluminum Racks will be threaded with 12-24 roll-formed threads and will include 40 each combination pan head, pilot point mounting screws.

e. Steel Racks will have 3/8” square holes and will include 40 each #12-24 x ½” mounting screws and 40 each #12-24 cage nuts.

f. The rack will include assembly and equipment-mounting hardware.

g. The rack will be rated:

h. Two Post Racks: 1,000 lb. (453.6 kg) of equipment

i. Four Post Racks: 2,000 lb. (907.2 kg) of equipment

j. The rack will be UL Listed

k. When assembled with top and bottom angles, equipment-mounting channels will be spaced to allow attachment of 19” EIA rack-mount equipment.

(2) RACK CABLE MANAGEMENT

a. Vertical cable management shall have doors that are lightweight, sturdy, and be available in different sizes to allow flexibility in design.

b. The cable management system shall have a C-Channel bracket that allows for easy access to the cable trough.

c. The vertical cable management system shall allow tool-less installation of Cable Spool.

d. Doors shall come standard with on all cable management and be available in both single and double sided configurations.

e. The door shall have dual hinge design that can be opened to the right or left.
f. The door latching mechanism shall have an easy closing feature.

g. The door shall have one point removal and installation process for door.

h. Horizontal wire managers: The door shall have horizontal cover hinges up or down and be lockable into position with cylindrical finger ends for easy snap on installation.

i. The door shall have a recessed handle to eliminate snag potential for clothes and arms.

j. The Horizontal cable management system shall have an open back on 2U and 3U horizontal troughs for easy pass-through of cables.

C. FREE STANDING TWO POST ALUMINUM RACKS

(1) 45U - 7ft (2134 mm) H x 3in (76 mm) Channel x 19in (482.6 mm) Equipment Rack

(2) Rack is to provide 45 rack-mount spaces in a “7-foot rack” for equipment. Each mounting space will be marked and numbered on the mounting channel.

(3) For the "7-foot rack" the assembled rack will measure 84” (2133.6 mm) high, 20.4” (518 mm) wide and 15” (381 mm) deep. The sides (webs) of the equipment-mounting channels will be punched to allow attachment of vertical cable managers along the sides of the rack or for rack-to-rack baying.

(4) Finish shall epoxy-polyester hybrid powder coat in the color as specified below.

(5) Approved Manufacturer: Chatsworth

D. FREE STANDING FOUR POST ALUMINUM RACKS

(1) 45U - 7ft (2134 mm) H x 3in (76 mm) Channel x 19in (482.6 mm) Equipment Rack

(2) Rack is to provide 45 rack-mount spaces in a “7-foot rack” for equipment. Each mounting space will be marked and numbered on the mounting channel.
For the "7-foot rack" the assembled rack will measure 84" (2133.6 mm) high, 20.4" (518 mm) wide and 29" (736.6 mm) deep. The sides (webs) of the equipment-mounting channels will be punched to allow attachment of vertical cable managers along the sides of the rack or for rack-to-rack baying.

Finish shall be epoxy-polyester hybrid powder coat in the color as specified below.

APPROVED Manufacturer: Chatsworth

E. VERTICAL CABLE MANAGEMENT FOR RACKS

1. The vertical cable management kits are installed on the side of a 19-inch or 23-inch (483 or 584 mm) wide industry standard rack.

2. The door(s) shall be designed to provide a concealed vertical space for organizing patch cables.

3. Cable spools shall be used to organize longer patch cable lengths.

4. Cable managers are to be matched to the cable rack. Cable managers are available in 6 inch (152 mm), 8 inch (203 mm), 10 inch (254 mm), and 12 inch (305 mm) widths and in 7 foot (2.1 m), 8 foot (2.4 m), and 9 foot (2.7 m) heights.

Approved Manufacturer: Chatsworth

6" Double Side, Vertical Cable Management, Black Door

F. HORIZONTAL CABLE MANAGEMENT FOR RACKS

1. The horizontal cable management kits are installed on a 19-inch (483 mm) wide industry standard rack above or below panels to organize patch cables.

2. The kits shall be available in a single-sided and double-sided configuration, and in a 1U-, 2U-, and 3U-height.

3. The units shall include covers that can be opened from the top, the bottom, or removed altogether.

4. The cover hinges shall be designed to hold the cover open from the top or bottom to facilitate faster cabling.
(5) The 2U and 3U cable managers shall have a pass-through feature allowing access to and from the rear for additional cable routing.

(6) The depth of the units shall be

(7) Single-sided: 5-1/2 inches (140 mm) deep from front to back with the cover closed

(8) Double-sided: 11 inches (280 mm) deep from front to back with the covers closed.

(1) Approved Manufacturer: Chatsworth

3. EXECUTION

A. RACKS AND CABLE MANAGEMENT

(1) Assemble racks and cable management per manufacturer’s instructions. Verify that equipment mounting rails are sized properly for rack-mount equipment before attaching the rack to the floor.

(2) All racks must be attached to the floor in four places using appropriate floor mounting anchors. When placed over a raised floor, threaded rods should pass through the raised floor tile and be secured in the structural floor below.

(3) Racks shall be grounded to the TGB using appropriate hardware provided by the contractor. The ground will meet local code requirements and will be approved by the Authority Having Jurisdiction (AHJ).

(4) In seismic areas, the rack should have additional bracing as required by building codes and the recommendations of a licensed structural engineer.

(5) Ladder rack may be attached to the top of the rack to deliver cables to the rack. The rack should not be drilled to attach ladder rack. Use appropriate hardware from the ladder rack manufacturer.

(6) The equipment load should be evenly distributed and uniform on the rack. Place large and heavy equipment towards the bottom of the rack. Secure all equipment to the rack with equipment mounting screws.

B. CLEANING
(1) Remove all unsightly marks and repair any damaged scratched or disfigured work

END OF SECTION
271119 – COMMUNICATIONS TERMINATION BLOCKS & PATCH PANELS

1. GENERAL

A. SECTION INCLUDES

(1) Copper, fiber termination blocks & panels

B. RELATED SECTIONS

(1) Section 270510 Basic Communication Requirements
(2) Section 270526 Ground & Bonding for Communications Systems
(3) Section 271123 Communications Cable Management & Ladder Rack
(4) Section 271116 Communications Cabinets, Racks, Frames & Enclosures
(5) Section 271543 Communications Faceplates & Connectors

C. SUBMITTALS

(1) See Section 013300 - Administrative Requirements, for submittal procedures.
(2) Product Data: Provide manufacturers catalog data for hardware
(3) Project Record Documents: Prepared and approved by BICSI Registered Communications Distribution Designer (RCDD).

D. QUALITY ASSURANCE

(1) Approval by Contracting Officer is required of products of proposed manufacturer, or supplier, and will be based upon submission by Contractor certification.
(2) Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years of documented experience.
(3) Certify materials and equipment shall be the standard products of the manufacturer regularly engaged in the manufacture of the products and shall be the manufacturer’s latest standard design that has been in satisfactory use for at least 2 years prior to bid opening
(4) Installer Qualifications: Company specializing in performing the work of this section with minimum 3 years of experience.

E. DELIVERY, STORAGE, AND PROTECTION

(1) Deliver components to the site in original manufacturers packaging.
(2) Store all materials in a secure place that is weather tight dry, and not exposed to UV radiation.
(3) Protect all components from damages by handling, weather and construction operations before, during and after installation.

F. WARRANTY

G. See Section 017700 - Closeout Submittals, for additional warranty requirements.

2. PRODUCTS

A. MANUFACTURERS

(1) Commscope, Uniprise; www.commscope.com

(2) Corning Cable Systems; www.corning.com

B. PATCH PANELS

(1) Category 6A/Class EA Patch Panels

   a. General specifications: Patch panel shall be constructed of high strength steel with satin chrome finish and designed for wall or 19-inch rack mounting.

   b. Panels shall be available in 24-port and 48-port configurations, with height of 1 Rack Unit (RU) of 44.5 millimeters (1.75 inches) for each group of 24 ports.

   c. Removable rear mounted cable management bar and front and rear identification labels.

   d. Patch panels must be capable of connection to the CommScope Intelligent Patching solution or upgradable to connection to the CommScope Intelligent Patching Solution.

   e. Patch panels shall support 5 meter cables in 3 and 4 connector channels, 3 meter cables in 2 connector channels and cross connect cords down to 1 meter.

   f. Comply with the standards for Category 6A/Class EA patch panels listed in the TIA-568 Series Standards and ISO/IEC 11801.

   g. Approved Manufacturer:

      i. CommScope Uniprise Patch Panels

         1.) CPP-UDDM-SL-1U-24 Uniprise Universal Cat6A Panel 1U 24 Port

         2.) CPP-UDDM-SL-2U-48 Uniprise Universal Cat6A Panel 2U 48 Port

C. FIBER HOUSING
D. FIBER CONNECTORS

(1) Fiber Connectors shall be of the same manufacturer as Optical Fiber Cable

(2) Type: Factory Terminated LC Pigtail

(3) Insertion Loss: 0.3 dB average, FOTP-171

(4) Durability: <= 0.2 dB change, 500 rematings, FOTP-21

(5) Materials

(6) Ferrule: Composite or Ceramic

(7) Housing Composite

E. FIBER COUPLERS-SPLICE HOUSING

(1) OM-4 Duplex LC

(2) CCH-CP12-E4-P03SH - CCH Pigtailed Splice Cassette 12 F, LC UPC duplex shuttered,

F. ACCESSORIES

(1) Fiber: Use all Manufacturer recommended accessories
   a. Breakout Kits
   b. Cable Clamps
   c. Ground Kits
   d. Wrap

3. EXECUTION

A. INSTALLATION

(1) Install in accordance with plans and manufacturer’s instructions.

(2) Leave no gaps or spaces between consecutively mounted panels

B. TERMINATIONS

(1) Fiber Optic
   a. Terminate all fiber with appropriate single or multi-mode connector.
   b. Provide 50’ minimum slack fiber at all fiber terminations and splices.
   c. Ground system as required

END OF SECTION
271123 – COMMUNICATIONS CABLE MANAGEMENT & LADDER RACK

1. GENERAL
   A. SECTION INCLUDES
      (1) Horizontal & Vertical management & support
      (2) Ladder Rack/Tray
   B. RELATED SECTIONS
      (1) Section 270526 Ground & Bonding for Communications Systems
      (2) Section 271116 Communications Cabinets, Racks, Frames & Enclosures
   C. SUBMITTALS
      (1) See Section 013300 - Administrative Requirements, for submittal procedures.
      (2) Product Data: Provide manufacturers catalog data for hardware
      (3) Project Record Documents: Prepared and approved by BICSI Registered Communications Distribution Designer (RCDD).
   D. QUALITY ASSURANCE
      (1) Material and work specified herein shall comply with the applicable requirements of the current adopted revision of the following:
         a. ANSI/TIA-568 Series
         b. ANSI/TIA-569 Telecommunications Pathways and Spaces
         c. ANSI/TIA-606 Administration Standard for the Telecommunications Infrastructure
         d. BICSI Telecommunications Distribution Methods Manual
         e. J-STD-607 Joint Standard for Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications
         f. NFPA 70 National Electric Code
            i. NEMA – VE-1 Metal Cable Tray Systems
      (2) NEMA – VE-2 Metal Cable Tray Installation Guidelines
      (3) Approval by Contracting Officer is required of products of proposed manufacturer, or supplier, and will be based upon submission by Contractor certification.
      (4) Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years of documented experience.
Certify materials and equipment shall be the standard products of the manufacturer regularly engaged in the manufacture of the products and shall be the manufacturer’s latest standard design that has been in satisfactory use for at least 2 years prior to bid opening.

(6) Installer Qualifications: Company specializing in performing the work of this section with minimum 3 years of experience.

E. DELIVERY, STORAGE, AND PROTECTION

(1) Deliver components to the site in original manufacturers packaging.

(2) Store all materials in a secure place that is weather tight dry, and not exposed to UV radiation.

(3) Protect all components from damages by handling, weather and construction operations before, during and after installation.

F. WARRANTY

(1) See Section 017700 - Closeout Submittals, for additional warranty requirements.

2. PRODUCTS

A. MANUFACTURERS

(1) Chatsworth Products, Inc.; www.chatsworth.com

(2) Leviton; www.leviton.com

(3) Substitutions: See Section 016000 - Product Requirements.

B. CABLE MANAGEMENT

(1) Horizontal
a. WMPSE- Dual Sided Horizontal Patch Cord Organizers, 1RU, 2" D-Rings
b. WMP1E- Dual Sided Horizontal Patch Cord Organizers, 2RU, 2" D-Rings

(2) Vertical
a. 35521-703 Vertical Front and Rear Cable Management, 6" Channel x 80" Long. Black Hinge Cover
b. 35524-703 Vertical Front and Rear Cable Management, 12" Channel x 80" Long. Black Hinge Cover

(3) Fiber Cable
a. S4DCT-DHC 4x4 Solid Duct w/Hinged Cover Yellow with accessories

(4) Velcro
a. For management only. Not for supporting cables

C. LADDER RACK / TRAY
(1) Ladder rack/tray shall be manufactured from tubular steel. Stringers (sides) will be made from 3/8" wide by 1-1/2" high tubular steel with .065" wall thickness. Cross members (rungs) will be made from 1" wide by ½" high tubular steel with .065" wall thickness.

(2) Ladder rack/tray cross members will be welded in between stringers on 9" centers. There will be 8" of open space in between each cross member.

(3) Design Make:
   a. CPI Universal UL Cable Runway, UL Cable runway Radius Drops - Black
      i. Width 12", 18" as shown
      ii. 11275-712
      iii. 11275-718

(4) Horizontal 90° Turns (Cable Runway E-Bend)

(5) Horizontal 90° turns shall be manufactured from 3/8" wide by 1-1/2" high tubular steel with .065" wall thickness.

(6) Stringers (sides) will be formed in a 90° arc. Cross members will be welded in between stringers on approximate 23° increments so that there are 5 cross members per turn. The welded assembly will have an inside radius that will create a smooth horizontal 90° turn.

(7) Design Make:
   a. CPI 10822-712

(8) Ladder Rack/Tray Splices

(9) Splice kits will provide a method of mechanically connecting ladder rack/tray sections and turns together end-to-end or side-to-end to form a continuous pathway for cables.

(10) Design Make:
   a. CPI
      i. Butt Splice - 16301-701
      ii. Junction Splice – 10302-701

(11) Ladder Rack/Tray Accessories

(12) Cable straps used for attaching cable bundles to the ladder rack/tray cross members must be reusable with a hook and loop-style closure, at least 3/4" wide, and sized for cable bundles that are 2", 3" or 4" in diameter.

(13) Cable retaining posts used to keep cable from falling from the side of the ladder rack/tray shall be manufactured from 1" by ½" tubular
steel with .065" wall thickness. Cable retaining posts will be 8" high and will attach to the side stringer of the ladder rack/tray with included hardware. The top of the cable retaining posts will be fitted with a rubberized end cap to protect cables.

(14) End caps used to cover the ends of ladder rack/tray will be manufactured from a black fire-retardant rubberized material. End caps will be sized for 3/8" wide by 1-1/2" high side stingers and will be sold in pairs.

(15) Radius drops or “waterfalls” used to maintain the bend Radius of the cables as they exit or enter the ladder rack/tray will be manufactured from aluminum extrusion. The extrusion will be formed in a 90° arc with a minimum bend radius of 3". Radius drops will attach to either the side stringer or the cross member of the ladder rack/tray using a clevis pin. Radius drops will include 1-1/2" high cable spools that attach to the top of the radius drop to guide cables.

(16) Auxiliary support brackets used to support cables that should be physically separated from the cables in the ladder rack/tray will be made from 1/8” x 1” steel bar. The bracket will be L-shaped and will attach to the side stringer of the ladder rack/tray. The bracket will hang below the ladder rack/tray a minimum of 4”. The bracket support surface will be 4” long. The bracket will be zinc plated with a gold chem. finish.

(17) Design Make:
   a. CPI
      i. Ladder rack end caps -
      ii. Radius Drops - 12100-712
      iii. Channel Rack-To-Runway Mounting Plate With Bracket - 12731-712

D. ACCESSORIES

(1) Velcro
   a. For management only. Not for supporting cables

3. EXECUTION

A. INSTALLATION

(1) Provide all components of the ladder rack/tray system (ladder rack/tray, turns, splices, supports, and accessories) from a single manufacturer.

(2) Provide all components of the Optical Fiber Protective system, (duct, dropouts, bends, sweeps, cover and accessories) to protect exposed fiber in Comm Rooms.
(3) Install in accordance with plans and manufacturer’s instructions.

(4) Ladder rack/tray shall be supported every 5’ or less in accordance with TIA-569. Ladder rack/tray shall be supported within 2’ of every splice and within 2’ on both/all sides of every intersection. Support ladder rack/tray within 2’ on both sides of every change in elevation. Support ladder rack/tray every 2’ when attached vertically to a wall.

(5) Use a radius drop to guide cables wherever cable exits overhead ladder rack/tray to access a rack, cabinet or wall-mounted rack, and cabinet or termination field. Provide a support other conductors that should be physically separated from cables within the ladder rack/tray as defined by local code or the authority having jurisdiction (AHJ).

(6) The installer will provide touch-up paint color-matched to the finish on the ladder rack/tray and will correct any minor cosmetic damage (chips, small scratches, etc.) resulting from normal handling during the installation process prior to delivery to the owner. If a component is cosmetically damaged to the extent that correction in the field is obvious against the factory finish, the component will be replaced with a new component finished from the factory. If a component is physically damaged due to mishandling or modification during the installation process, it shall not be used as part of the ladder rack/tray system

(7) CABLE LADDER
   a. Install all work plumb and true in alignment and in relation to lines, and grades shown.
   b. Attach ladderway to walls with appropriate ‘L’ bracket
   c. Attach ladderway to racks with appropriate rack to runway mounting plate
   d. Install runway radius drops as needed.
   e. Install ground braids to create a continuous system; ground to MGBB

END OF SECTION
THIS PAGE INTENTIONALLY LEFT BLANK
271323 – COMMUNICATIONS OPTICAL FIBER BACKBONE CABLING

1. GENERAL

A. SECTION INCLUDES

(1) Inside & Outside Optical Fiber cable plant

B. RELATED SECTIONS

(1) Section 270526 Ground & Bonding for Communications Systems
(2) Section 271116 Communications Cabinets, Racks, Frames, and Enclosures
(3) Section 271619 Communications Termination Blocks & Patch Panels

C. SUBMITTALS

(1) See Section 013300 - Administrative Requirements, for submittal procedures.
(2) Product Data: Provide manufacturers catalog data for hardware

D. QUALITY ASSURANCE

(1) Approval by Contracting Officer is required of products of proposed manufacturer, or supplier, and will be based upon submission by Contractor certification.
(2) Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years of documented experience.
(3) Certify materials and equipment shall be the standard products of the manufacturer regularly engaged in the manufacture of the products and shall be the manufacturer’s latest standard design that has been in satisfactory use for at least 2 years prior to bid opening
(4) Installer Qualifications: Company specializing in performing the work of this section with minimum 5 years of experience.

E. DELIVERY, STORAGE, AND PROTECTION

(1) Deliver components to the site in original manufacturers packaging.
(2) Store all materials in a secure place that is weather tight dry, and not exposed to UV radiation.
(3) Protect all components from damages by handling, weather and construction operations before, during and after installation.

F. WARRANTY

(1) See Section 017700 - Closeout Submittals, for additional warranty
requirements.

a. Must be able to provide a 25-year Corning manufacturer’s warranty

2. PRODUCTS

A. GENERAL

(1) All Outside Plant, (OSP,) cables shall be filled or water blocked unless pre-approved by Communication Maintenance

B. MANUFACTURERS

(1) Corning Cable Systems; www.corning.com

C. OPTICAL CABLE

(1) Fiber Parameters

a. OM-4 - Bend-insensitive Laser Optimized 50/125 micron fiber

i. Graded-index optical fiber wave-guide with nominal 50/125micron -core/cladding diameter.

ii. The fiber shall comply with the latest revision of ANSI/EIA/TIA-492AAAD.

iii. Attenuation shall be measured in accordance with ANSI/EIA/TIA-455-78.

iv. Information transmission capacity shall be measured in accordance with the latest revision of ANSI/EIA/TIA-455-204.

v. Maximum attenuation dB/km @ 850/1300 nm: 3.0/1.0

vi. EMB Bandwidth 4700 MHz-km @ 850nm.

vii. OFL Bandwidth 500 MHz-km @ 1300nm.

viii. Optical Fiber shall be Bend-insensitive Laser Optimized and guarantee 1Gigabit Ethernet distances of 1040m/600m for 850nm and 1300nm, respectively.

ix. Optical fiber shall guarantee a 10 Gigabit Ethernet distance of 550m at 850nm.

(2) Corning FREEDM LST

D. RISER CABLE

(1) Corning: MIC

E. CABLE PULLING LUBRICANTS

(1) Type F or J clear

3. EXECUTION

A. PRE-INSTALLTION

(1) WRITTEN CERTIFICATION: Provide written certification
a. Factory Certification showing compliance with all optical, attenuation and bandwidth specifications.

(2) Ensure all cable placing personnel understand the handling requirements, minimum bend diameters, and maximum pull tensions

(3) Swab and clean conduits

B. INSTALLATION OF CABLE

(1) Place fiber optic cables to maintain minimum cable bend radius limits specified by manufacturer or 15 times cable diameter, whichever is larger.

(2) Use care when handling fiber optic cables.

(3) Carefully monitor pulling tension so as not to exceed limits specified by manufacturer.

(4) Do not splice horizontal fiber optic cables.

(5) Where cables are to be routed in pathway, conductor shall supply and install any additional pathway necessary to complete any cable route. Use of existing pathway must comply with EIA/TIA standards and recommendations. Contractor shall ensure fire rating of all Contractors used pathway.

(6) Cables not routed in conduit or tray must be supported each 3' O.C. with an appropriate support.

(7) Seal all openings in conduits, sleeves, and pass thru’s with the required fire stopping material or duct plug as appropriate.

(8) Provide minimum 50' slack cable coiled neatly in each pullbox.

(9) Provide minimum 150' slack cable coiled neatly in each manhole.

END OF SECTION
271513 – COMMUNICATION COPPER HORIZONTAL CABLING

1. GENERAL

A. SECTION INCLUDES

(1) Provision all labor, materials, and equipment for the complete installation of all Copper Horizontal Cabling applications called for in the Bid Documents.

B. RELATED SECTIONS

(1) Section 270510 Basic Communication Requirements
(2) Section 270526 Ground & Bonding for Communications Systems
(3) Section 271123 Communications Cable Management & Ladder Rack
(4) Section 271116 Communications Cabinets, Racks, Frames, and Enclosures
(5) Section 271619 Communications Termination Blocks & Patch Panels

C. SYSTEM DESCRIPTION

(1) This section includes the minimum requirements for Copper Horizontal Cables.

D. SUBMITTALS

(1) See Section 013300 - Administrative Requirements, for submittal procedures.
(2) Product Data: Provide manufacturers catalog data for hardware
   a. Manufacturers cut sheets, specifications and installation instructions for all products
(3) Project Record Documents: Record actual locations of all outlets, cable pathway, sleeves.
(4) Warranty: Submit manufacturer warranty and ensure that forms have been completed in Vail Unified School District’s name and registered with manufacturer.

E. QUALITY ASSURANCE
(1) All cable and equipment shall be installed in a neat and workmanlike manner. All methods of construction that are not specifically described or indicated in the contract documents shall be subject to the control and approval of the Owner or Owner Representative. Equipment and materials shall be of the quality and manufacture indicated. The equipment specified is based upon the acceptable manufacturers listed. Where “approved equal” is stated, equipment shall be equivalent in every way to that of the equipment specified and subject to approval.

(2) Strictly adhere to all Building Industry Consulting Service International (BICSI) and Telecommunications Industry Association (TIA) recommended installation practices when installing communications/data cabling.

F. Material and work specified herein shall comply with the applicable requirements of the current adopted revision of the following:

a. ANSI/TIA-568 Series Commercial Building Telecommunications Cabling Standard
b. ANSI/TIA-568-C.1 – Commercial Building Telecommunications Cabling Standard
c. ANSI/TIA-568-C.2 – Balanced Twisted-Pair Telecommunications Cabling and
d. ANSI/TIA-569 Telecommunications Pathways and Spaces
e. ANSI/TIA-606 Administration Standard for the Telecommunications Infrastructure
g. and Bonding Requirements for Telecommunications
h. BICSI – Telecommunications Distribution Methods Manual
i. Components Standards
j. NFPA 70 – National Electric Code
k. ISO/IEC 11801 - Generic Cabling for Customer Premises
l. CENELEC EN-50173 - Generic Cabling Systems
G. DELIVERY, STORAGE, AND PROTECTION

(1) Deliver components to the site in original manufacturers packaging.

(2) Store all materials in a secure place that is weather tight dry, and not exposed to UV radiation.

(3) Protect all components from damages by handling, weather and construction operations before, during and after installation.

H. WARRANTY

(1) The horizontal communications cabling system installed shall be eligible for coverage by a 25 Year Extended Product and Application Warranty to the end user.

(2) Installer Integrator shall provide labor, materials, and documentation in accordance with Commscope Solutions requirements necessary to ensure that the Owner will be furnished with a Commscope Lifetime Warranty.

(3) The installed structured cabling system shall provide a warranty guaranteeing installed channel performance above the ANSI/TIA 568-C requirements for Cat 6, and/or Cat 6A cabling systems or ISO 11801 requirements for Cass D, Class E, and/or Class Ea.
   a. Standards-compliant channel or permanent link performance tests shall be performed in the field with a Commscope approved certification tester in the appropriate channel or permanent link test configuration.

(4) Necessary documentation for warranty registration shall be provided to the manufacturer by the installer (within 10 days) following 100 percent testing of cables.
   a. Submit test results to Commscope Network Solutions, in the certification tester's original software files.
   b. Installer shall ensure that the warranty registration is properly submitted, with all required documentation within 10 days of project completion.
   c. Contractor Integrator must adhere to the terms and conditions of the respective manufacturer's warranty programs.

(5) Installer shall ensure that the Owner receives the manufacturer issued project warranty certificate within 60 calendar days of warranty registration.

I. Cable Construction (by Type):
(1) Listed CMR cable: Solid copper conductors with high-density polyolefin insulation and an overall low smoke polyvinyl chloride (PVC) jacket to achieve a riser (i.e., non-plenum) rating by applicable NEC requirements.

(2) Listed CMP cable: Solid copper conductors with fluorinated ethylene propylene (FEP) insulation and an overall low smoke PVC jacket to achieve plenum rating by applicable NEC requirements.

(3) LSZH cable: Solid copper conductors with non-halogen high-density polyethylene (HDPE) insulation and a low smoke, zero halogen, compound jacket to achieve a LSZH rating by applicable IEC standards.

(4) LC cable: Solid copper conductors with FEP fluoropolymer insulation and overall FEP fluoropolymer jacket to achieve CMP 50 rating by UL standards.

(5) OSP outdoor cable rated for wet locations: Solid copper conductors with polyethylene insulation, polyolefin fluted center member with flooding compound, and black polyethylene jacket.

(6) Comply with following general physical specifications:
   a. Maximum pulling tension: 110 Newton’s (25 pound-force)
   b. Operating temperature: –20 to 60 degrees C [–4 to 140 degrees F]

2. PRODUCTS
   A. Category 6 Augmented (6A)/Class EA Unshielded Twisted-Pair (UTP) Cable
      (1) All Cables shall be of round construction
      (2) Each cable shall contain 4 color coded pairs
      (3) Cable shall be listed for the environment where it will be installed (Plenum, Riser, LSZH, etc.)
      (4) Approved Manufacturer:
      (5) CommScope Uniprise
         a. **UN884031004/10 CS44R BLU C6A 4/23 U/UTP RL 1KFT**
b. **UN874035104/10 CS44P BLU C6A 4/23 U/UTP RL 1KFT**

(6) Category 6A horizontal cabling shall provide the following Margin to the specification when installed in a 4 connector Channel.

<table>
<thead>
<tr>
<th>Electrical Parameter (1-250MHZ)</th>
<th>Guaranteed Channel Margins to Amendment 1 to ISO/IEC 11801:2002 &quot;Class EA&quot;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Insertion loss</td>
<td>3%</td>
</tr>
<tr>
<td>NEXT</td>
<td>3 dB</td>
</tr>
<tr>
<td>PSNEXT</td>
<td>5 dB</td>
</tr>
<tr>
<td>ACR-N</td>
<td>5 dB</td>
</tr>
<tr>
<td>PSACR-N</td>
<td>6.5 dB</td>
</tr>
<tr>
<td>ACR-F</td>
<td>6 dB</td>
</tr>
<tr>
<td>PSACR-F</td>
<td>8 dB</td>
</tr>
<tr>
<td>Return Loss</td>
<td>1 dB</td>
</tr>
<tr>
<td>Return Loss, PSANEXT, PSACR-F, Avg. PSANEXT, Avg. PSACR-F</td>
<td>2 dB</td>
</tr>
</tbody>
</table>

(7) Category 6A horizontal cabling shall meet or exceed the performance specifications listed in the following table when installed in a 4 connector Channel.

<p>| Guaranteed Channel Performance Specifications for 4-Connection GigaSPEED 360X10D U/UTP Systems |
|-----------------------------------------------|---------------------------------------------------------------------------------------------|</p>
<table>
<thead>
<tr>
<th>Freq (MHz)</th>
<th>Insertion Loss (dB)</th>
<th>PS ANEXT (dB)</th>
<th>Avg. PS ANEXT (dB)</th>
<th>PS ACR-F (dB)</th>
<th>Avg. PS ACR-F (dB)</th>
<th>NEXT (dB)</th>
<th>PS ACR-N (dB)</th>
<th>PS ACR-F (dB)</th>
<th>Return Loss (dB)</th>
<th>Delay (ns)</th>
<th>Delay Skew (ns)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2.2</td>
<td>82.0</td>
<td>84.3</td>
<td>79.0</td>
<td>83.0</td>
<td>75.7</td>
<td>73.5</td>
<td>75.3</td>
<td>73.1</td>
<td>69.3</td>
<td>68.3</td>
</tr>
<tr>
<td>4</td>
<td>4.0</td>
<td>76.0</td>
<td>78.2</td>
<td>72.0</td>
<td>71.0</td>
<td>66.0</td>
<td>62.0</td>
<td>65.5</td>
<td>61.5</td>
<td>57.2</td>
<td>56.2</td>
</tr>
<tr>
<td>8</td>
<td>5.6</td>
<td>73.0</td>
<td>75.2</td>
<td>69.0</td>
<td>64.9</td>
<td>61.2</td>
<td>55.5</td>
<td>60.6</td>
<td>55.0</td>
<td>51.2</td>
<td>50.2</td>
</tr>
<tr>
<td>10</td>
<td>6.3</td>
<td>72.0</td>
<td>74.3</td>
<td>59.0</td>
<td>63.0</td>
<td>59.6</td>
<td>53.3</td>
<td>59.0</td>
<td>52.7</td>
<td>49.3</td>
<td>48.3</td>
</tr>
<tr>
<td>16</td>
<td>7.9</td>
<td>70.0</td>
<td>72.2</td>
<td>54.9</td>
<td>58.9</td>
<td>56.2</td>
<td>48.3</td>
<td>55.6</td>
<td>47.7</td>
<td>45.2</td>
<td>44.2</td>
</tr>
<tr>
<td>20</td>
<td>8.9</td>
<td>69.0</td>
<td>71.2</td>
<td>53.0</td>
<td>57.0</td>
<td>54.6</td>
<td>45.7</td>
<td>54.0</td>
<td>45.1</td>
<td>43.2</td>
<td>42.2</td>
</tr>
<tr>
<td>25</td>
<td>9.9</td>
<td>68.0</td>
<td>70.3</td>
<td>51.0</td>
<td>55.0</td>
<td>53.0</td>
<td>43.1</td>
<td>52.3</td>
<td>42.4</td>
<td>41.3</td>
<td>40.3</td>
</tr>
<tr>
<td>31.3</td>
<td>11.1</td>
<td>67.0</td>
<td>69.3</td>
<td>49.1</td>
<td>53.1</td>
<td>51.4</td>
<td>40.3</td>
<td>50.7</td>
<td>39.6</td>
<td>39.3</td>
<td>38.3</td>
</tr>
<tr>
<td>62.5</td>
<td>15.9</td>
<td>64.0</td>
<td>66.3</td>
<td>43.1</td>
<td>47.1</td>
<td>46.4</td>
<td>30.5</td>
<td>45.6</td>
<td>29.7</td>
<td>33.3</td>
<td>32.3</td>
</tr>
<tr>
<td>100</td>
<td>20.3</td>
<td>62.0</td>
<td>64.3</td>
<td>39.0</td>
<td>43.0</td>
<td>42.9</td>
<td>22.7</td>
<td>42.1</td>
<td>21.8</td>
<td>29.3</td>
<td>28.3</td>
</tr>
<tr>
<td>200</td>
<td>29.2</td>
<td>57.5</td>
<td>59.7</td>
<td>33.0</td>
<td>37.0</td>
<td>37.8</td>
<td>8.6</td>
<td>36.9</td>
<td>7.7</td>
<td>23.2</td>
<td>22.2</td>
</tr>
<tr>
<td>250</td>
<td>32.9</td>
<td>56.0</td>
<td>58.3</td>
<td>31.0</td>
<td>35.0</td>
<td>36.1</td>
<td>3.2</td>
<td>35.2</td>
<td>2.3</td>
<td>21.3</td>
<td>20.3</td>
</tr>
<tr>
<td>300</td>
<td>36.2</td>
<td>54.8</td>
<td>57.1</td>
<td>29.5</td>
<td>33.5</td>
<td>34.7</td>
<td>-1.5</td>
<td>33.8</td>
<td>-2.5</td>
<td>19.7</td>
<td>18.7</td>
</tr>
<tr>
<td>400</td>
<td>42.3</td>
<td>53.0</td>
<td>55.2</td>
<td>27.0</td>
<td>31.0</td>
<td>32.6</td>
<td>-9.8</td>
<td>31.6</td>
<td>-10.8</td>
<td>17.2</td>
<td>16.2</td>
</tr>
<tr>
<td>500</td>
<td>47.8</td>
<td>51.5</td>
<td>53.8</td>
<td>25.0</td>
<td>29.0</td>
<td>30.9</td>
<td>-17.0</td>
<td>29.8</td>
<td>-18.0</td>
<td>15.3</td>
<td>14.3</td>
</tr>
</tbody>
</table>

3. **EXECUTION**

A. **PRE-INSTALLITION**

(1) Prior to placing any cable pathways or cable, the Contractor shall survey the site to determine job conditions will not impose any
obstructions that would interfere with the safe and satisfactory placement of the cables. The arrangements to remove any obstructions with the Project Manager need to be determined at that time.

(2) Ensure all cable placing personnel understand the handling requirements, minimum bend diameters, and maximum pull tensions

(3) Swab and clean conduits

B. INSTALLATION

(1) Install communications horizontal cabling in accordance with manufacturer’s instructions, ANSI/TIA-568-C.0, ANSI/TIA-568-C.1, ANSI/TIA-569-C, BICSI TDMM, and NFPA 70

(2) To each Information Outlet, supply and install Data Cables, as indicated, from the CER.
   a. To each Information Outlet, supply and install (1), four pair Category 6A-Blue,
   b. To each Wall Phone Outlet, supply and install (1) four pair Category 6A-Blue,
   c. To each Duplex Data, supply and install (2) four pair Category 6A-Blue,
   d. To each Apple TV, supply and install (1) four pair Category 6A-White
   e. To each CCTV outlet, supply and install (1) four pair Category 6A-Red
   f. To each WiFi outlet supply and install (1), four pair Category 6A-Yellow.
   g. To each Bell/PA outlet, supply and install (1) four pair Category 6A-Grey

(3) Where information Outlets are surface mountable, supply, install the proper raceway, and surface mounted box.

(4) Horizontal cabling shall be installed in raceways, cable trays, or other approved support systems and terminated at station locations indicated.

(5) All cable shall be routed parallel and perpendicular to the building supporting steel structure

(6) Cabling shall take the form of a “Universal Cabling Plan” where station cables are wired directly, home run fashion, from a
distribution point to the appropriate Information Outlet supporting the specified Data capabilities.

(7) Horizontal cables not installed in conduit or wireways shall be properly secured and neat in appearance.

(8) All cabling shall be supported at least 15cm above the drop ceiling.

(9) All cabling shall be supported a minimum of 1.5m O.C. via the means of ‘J’ hooks or other approved method.

(10) All cabling shall be neatly organized using Velcro. NO cinch-type cable ties.

(11) Label each cable ends with computer generated permanent ink permanent label per TIA-606-B.

C. CLEANING

(1) Remove all unsightly marks and repair any damaged scratched or disfigured work.

END OF SECTION
271543 – COMMUNICATIONS FACEPLATES & CONNECTORS

1. GENERAL

A. RELATED SECTIONS

(1) Section 270500 Basic Communication Requirements
(2) Section 270526 Ground & Bonding for Communications Systems
(3) Section 271123 Communications Cable Management & Ladder Rack
(4) Section 271116 Communications Cabinets, Racks, Frames, and Enclosures
(5) Section 271119 Communications Termination Blocks & Patch Panels

B. SYSTEM DESCRIPTION

(1) This section includes the minimum requirements for Fiber Connectors, Adapters and Adapter Panels.
(2) The performance for the installation shall meet or exceed the requirements of ANSI/TIA-568 and ISO/IEC 11801 and other requirements as noted in this specification for the specified Fiber Type.
(3) The connectors and adapters shall match the fiber type of the cabling
(4) All connectors and adapters shall meet UL 94 V-O

C. SUBMITTALS

(1) See Section 013300 - Administrative Requirements, for submittal procedures.
(2) Product Data: Provide manufacturers catalog data for hardware
(3) Project Record Documents: Record actual locations of All outlets, cable pathway, sleeves.
(4) Warranty: Submit manufacturer warranty and ensure that forms have been completed in City of Tucson’s name and registered with manufacturer.

D. QUALITY ASSURANCE

(1) Approval by Contracting Officer is required of products of proposed manufacturer, or supplier, and will be based upon submission by Contractor certification.
(2) Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years of documented experience.
(3) Certify materials and equipment shall be the standard products of the manufacturer regularly engaged in the manufacture of the products and shall be the manufacturer’s latest standard design that has been in satisfactory use for at least 2 years prior to bid opening.

(4) Installer Qualifications: Company manufacturer certifies specializing in performing the work of this section with minimum 5 years of experience.

E. DELIVERY, STORAGE, AND PROTECTION
(1) Deliver components to the site in original manufacturers packaging.
(2) Store all materials in a secure place that is weather tight dry, and not exposed to UV radiation.
(3) Protect all components from damages by handling, weather and construction operations before, during and after installation.

F. COORDINATION
(1) Coordinate installation of Jack/Information outlets and connectors with other trades.

2. PRODUCTS
A. INFORMATION OUTLETS
(1) USL10G Cat 6A Information Outlet;
   a. Data: Blue
   b. Voice: White
   c. Security: Red
   d. PA: Yellow
(2) USL10G-SHLD, GY Shielded Cat 6 Connector
   a. AV: Grey

B. FACEPLATES
(1) Stainless Steel with ID window
   a. Port count as required

3. EXECUTION
A. PRE-INSTALLTION
(1) Clean cable to remove construction materials

B. INSTALLATION
(1) Contractor shall comply applicable codes, standards and with all local codes and requirements. It is the responsibility of the
contractor to identify and adhere to any unique codes or requirements governed by the region where the work is to be performed.

(2) Jack/Information outlets and Connectors shall be installed following industry standard practices.

(3) Horizontal cabling shall be terminated on a Jack/Information outlet which is the same category rating as the Cable.

(4) Contractor shall not exceed the maximum pulling tension or the minimum bending radius for twisted pair cables per manufacturer’s specifications.

(5) Contractor shall test all horizontal links per the ANSI/TIA-568 Requirements.

C. WORKSTATION TERMINATIONS

(1) Use manufacturers recommend termination tool. Stuffer cap impact not acceptable

(2) Terminate fiber connectors where appropriate

(3) Label each cable ends with computer generated permanent ink permanent label per diSTRICT standard labeling scheme.

(4) Install appropriate faceplate.

(5) Label outlet per specification

D. RACK TERMINATIONS

(1) Terminate differing systems on their own patch panel

(2) Termination shall occur from the lowest information Outlet number to the highest Information Outlet number.

(3) Contractor shall take great care to route cabling and ensure clearance for maintenance.

E. CLEANING

(1) Remove all unsightly marks and repair any damaged scratched or disfigured work

END OF SECTION
DIVISION 28

282129 – VIDEO SURVEILLANCE CAMERAS, REMOTE DEVICES & SENSORS

1. GENERAL
   A. SECTION INCLUDES
      (1) Cameras.
      (2) Switches
      (3) Cable and accessories.
      (4) Licenses
   B. REFERENCES
   C. SYSTEM DESCRIPTION
      (1) Description: Provide video communications between points of surveillance indicated on Drawings and Central recording/distribution system.
   D. SUBMITTALS
      (1) See Section 013300 - Administrative Requirements, for submittal procedures.
      (2) Shop Drawings: Indicate electrical characteristics and connection requirements, including system wiring diagram.
      (3) Product Data: Provide showing electrical characteristics and connection requirements for each component.
      (4) 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.
      (5) Project Record Documents: Record actual locations of cameras and routing of cable.
      (6) Operation Data: Instructions for starting and operating system.
      (7) Maintenance Data: Routine trouble shooting procedures.
   E. QUALITY ASSURANCE
      (1) Conform to requirements of NFPA 70.
      (2) Installer Qualifications: Authorized installer of specified manufacturer with service facilities within 50 miles of Project.
2. PRODUCTS

A. COMPONENTS

(1) Manufacturers:
(2) Arecontvision; www.arecontvision.com
(3) Domes/Enclosures
(4) Application: Indoor or Outdoor as environment dictates
(5) Outdoor Domes/Enclosures
   a. Operating Temperature: +40º F(+4ºC) to +150ºF (+66ºC)
   b. Input Voltage: 12VDC, 24VAC, 110-220VAC
   c. Vandal proof IP.v66
   d. Pressurized
   e. Built-in surge & lightning protection
   f. System Components and Supplied Accessories:
(6) Camera enclosure, camera bracket, fan, humidity absorber, thermostat, thermo-dynamic cooling module

B. Indoor Domes/Enclosures

(1) OptiClear polycarbonate 7" dome,
(2) Housing extends maximum 3.5" below ceiling
(3) Fixed mount camera bracket
(4) Plenum rated metal top
(5) System Components and Supplied Accessories:
   a. Camera enclosure, camera bracket, fan, humidity absorber, thermostat, thermo-dynamic cooling module

C. Cameras

(1) Application: Indoor or Outdoor as noted
(2) Megapixels: 5MP/12MP as noted
(3) Resolution: no less than 2560(H) x 1920(V) pixels relative.
(4) Remote Zoom/Autofocus
(5) Aspect Ratio: user configurable and not limited to 4:3 or 16:9 aspect ratios.
(6) Light Requirement: Minimum light requirement to produce a color image shall be approximately 0.30 lux (0.03 fc) with a f1.2 lens.
(7) Night mode: less than 0.05 lux (.005 fc) shall be required to produce a black and white image.
(8) Automatic white balance, automatic exposure, gain control, electronic shutter, and backlight compensation.
(9) Memory: at least 64MB of RAM and 4MB of flash memory.
(10) Remote Zoom: Digital
(11) Power: IEEE 802.3af Power-over-Ethernet ready and can also be powered directly using 12-24 VDC or 24 VAC
(12) Authentication: Digital image authentication shall be available and licensed to verify that images have not been altered, manipulated,
or tampered with, in any way.

(13) Progressive scan CMOS imager with a 1/2-inch optical format
(14) Dual encoder MJPEG, H264 compatible
(15) built-in web server and FTP server
(16) HTTPS encryption with IP filtering
(17) IK-10 Impact Resistant
(18) LUX
   i. Color: 0.3 @ f1.4
   ii. B&W: 0.005 @ f1.4
(19) Iris: Auto
(20) Frame Rate: 25/30 per second at highest resolution
(21) Flash upgradeable

(22) Approved Camera:
   a. Arecontvision - AV12276DN-## appropriate lenses and all accessories
   b. Arecontvision – AV5555DN-F-## appropriate lenses and all accessories

3. ACCESSORIES
A. Licenses:
B. Provide license & 3 year support for each camera installed. Add licenses to existing Owner contract

4. Main Video Cable: Category 6A for cameras under 90 meters- Multimode fiber for cameras over 90 meters.

5. EXECUTION

6. INSTALLATION
A. Install in accordance with manufacturer’s instructions.

7. ADJUSTING
A. Adjust lens to meet lighting conditions. All lenses to maximize depth of field and field of view
B. Coordinate with owner for coverage of cameras adjust per owners requirements
C. Ensure all cameras communications to central NVR

8. 3.03 DEMONSTRATION
A. Conduct walking tour of project and briefly describe function, operation, and maintenance of each component.

END OF SECTION

END OF DIVISION
283100 FIRE ALARM SYSTEM

PART 1 - GENERAL

1.1 GENERAL

A. Drawings, Section I - Legal Documents and Division 1 Specification Sections, apply to this Section.

1.2 SCOPE AND GENERAL REQUIREMENTS

A. The contractor shall provide all equipment and accessories for expansion of the existing electrically supervised Class "B" fire alarm system with addressable initiating circuits as described herein and as shown on the plans.

B. The new addition shall have emergency voice alarm notification as described herein and as shown on the plans.

C. All equipment, wiring and operation of the system shall comply with Local and National Codes and Ordinances. Specific reference is made to current adopted editions of:

1. Underwriters Laboratory listing and labeling of equipment.
2. NFPA 70.
4. NFPA 72.
7. Requirements of the State of Arizona Fire Marshal.
8. Americans with Disabilities Act (ADA).

C. Equipment and accessories furnished under the terms of this specification shall be the standard products of a single manufacturer where possible and shall be U.L. listed and labeled.

D. Main Fire Alarm Control Panel (FACP) is existing and shall be modified and upgraded as required to provide coordinated fire safety features as described herein.

E. No signal circuit shall be initially loaded in excess of 85% of its rated ampere capacity.

F. Fire Alarm equipment and panels shall be powered from dedicated 20 ampere, 120 volt circuits. The circuit breakers in the panel feeding the equipment shall have a handle lock-on device and shall be identified in the circuit directory. The panel name and circuit number shall also be identified on the fire alarm equipment.
G. The system shall contain battery backup power. The batteries shall be rechargeable and be of a gel-cell type. The panel shall contain a battery charger to insure fully powered batteries at all times. It shall be supervised and indicate system trouble when the batteries are not capable of supplying power under demand.

H. Field devices (manual stations, horns, bells, strobes, smoke and heat detectors) shall have four (4) screw terminals for wiring connections for a true four (4) wire system throughout. Do not T-tap to any device. All devices except smoke and heat detectors shall be red in color.

I. Provide a digital alarm communicating transmitter for transmission of alarm and supervisor signals to an approved central monitoring station. Provide 3/4” conduit with telephone cables from fire alarm panel to the telephone terminal board for the wiring to the alarm transmitter.

J. A floor plan map of the building shall be made and reference made to zone location wording to geographic location within the building. The map shall be color coded and protected by a glassed frame securely fastened to the wall in the immediate area of the fire alarm panel. If an annunciator panel is used, a similar map shall be furnished and mounted in the immediate area of the annunciator.

K. Contractor shall submit plans to the Authority Having Jurisdiction (AHJ) for approval prior to installation. Comply with all AHJ requirements at no additional cost to the contract. Submit shop drawings on same size drawing sheets as the bid documents.

1.3 SYSTEM OPERATION

A. Activation of any fire alarm station, fire sprinkler flow switch, heat detector or smoke detector circuit shall cause the following to happen:

1. Sound a pre-recorded evacuation message over all audible signals. (General Alarm) Evacuation message shall continue sounding until manually silenced or reset at the panel.
2. Visual alarm signals shall flash.
3. Light the control panel mounted red alarm lamp to indicate the zone initiating the alarm.
4. Provide contact closure for Central Monitoring Station signal.
5. Shut down or redirect HVAC systems when so scheduled and described on the drawings.

B. Activation of any HVAC duct smoke detector circuit shall cause the following to happen:
1. Open the holding coil circuit to all HVAC fan starters in the building.
2. Light the control panel mounted amber alarm lamp to indicate the zone causing the alarm and activate a buzzer at the control panel.
3. Send trouble signal (dry contacts for trouble signal close) to central monitor station.
4. HVAC fans shall not restart until the FACP is reset.
5. Do not sound audio alarms or flash visual alarm signals unless specifically indicated.

C. The system shall be fully supervised and cause the following to happen:

1. When a ground fault occurs within the fire alarm panel, it shall illuminate the panel (amber) ground fault lamp. Also, a local sounding device within the panel only shall sound, indicating a trouble condition.
2. When a ground fault occurs within zone or signal circuit wiring, the amber zone or circuit module lamp shall illuminate indicating which zone or circuit the ground fault occurred. Also, a local sounding device within the panel only shall sound, indicating a trouble condition.
3. When an open circuit occurs within zone or signal circuit wiring, the amber zone or circuit module lamp shall illuminate, indicating which zone or circuit the open occurred, as well as the system trouble amber lamp. Also, a local sounding device within the panel only shall sound, indicating a trouble condition.
4. When the battery backup supply has become inadequate to power the system, the system trouble amber lamp shall illuminate. Also, a local sounding device within the panel only shall sound, indicating a trouble condition.
5. Indication shall be given at the fire alarm panel when A.C. power to the fire alarm panel has been removed.

1.4 SUBMITTALS

A. Submit for approval complete shop drawings for system. This to include drawings of panel layout, component list, and system wiring diagram prepared by equipment supplier for submittal to AHJ. Submit shop drawings to Architect prior to making submittal to AHJ. Catalog cuts only are not acceptable.

B. As part of Maintenance and Operating Instructions, include schematic wiring diagrams and parts lists for all components and assemblies.

C. Submittals shall be in accordance with Division 1 and Section 16100 requirements.

PART 2 PRODUCTS

2.1 APPROVED MANUFACTURERS
A. The catalog numbers listed are those of the Simplex division of Johnson Controls and indicate design, quality and type of material as well as operating characteristics. New equipment shall be same manufacturer, type and ratings as the existing fire alarm system and new installation shall maintain the listing of the existing system.

2.2 FIRE ALARM CONTROL PANEL

A. Existing Simplex Type 4010ES panel.

B. Batteries shall be sealed gel-cell type of sufficient capacity to provide power for the entire system upon loss of normal 120V AC power for a period of 24 hours with ten minutes of alarm signaling at the end of the 24 hour period. Batteries shall be housed within the panel cabinet when possible or in a separate enclosure of identical design to the FACP cabinet, mounted adjacent to FACP main cabinet.

C. Notification Appliance Circuit Power Extender Panel shall be Simplex type 4009-9002 panel complete with power supply, batteries and four (4) style Y 2A notification appliance circuits. This panel to be used to power alarm strobe lights only.

D. Provide type 4003-9002 voice control panel to provide voice and tone generation, 75W of amplifier power to supply four (4) style Z Audio Notification Appliance Circuits.

2.3 NOTIFICATION APPLIANCES

A. Speaker/Strobe devices

   1. With 15cd strobe -- type 4903-9350. Use for all speaker/strobe applications except where high cd output strobes are indicated or required. Strobe operating current shall not exceed 60mA average.

   2. With 75cd strobe -- type 4903-9351. Strobe operating current shall not exceed 155mA average.

   3. With 110cd strobe -- type 4903-9352. Strobe operating current shall not exceed 200mA average.

B. Strobe devices:

   1. Wall Mounted -- type 4906-9101. Device operating current shall not exceed 60mA, 94mA, 186mA and 252mA for 15cd, 30cd, 75cd and 110cd strobe settings, respectively.

   2. Ceiling Mounted -- type 4906-9102. Device operating current shall not exceed 75mA, 125mA, 233mA and 316mA for 15cd, 30cd, 75cd and 110cd strobe settings, respectively.
3. Provide type 4905-9926 wire guard for ceiling mount devices mounted in areas subject to damage such as Toilet Rooms.

C. All visual alarm signals shall be synchronized. If necessary, provide sync modules as needed.

D. Speaker (only) devices:

1. Type 4902-9703.
2. When mounted outside or in high humidity location provide type 4902-9703H with 4905-9907 gasket kit.

2.4 EXTERIOR BELLS

A. Simplex type 2901-9322 with weatherproof back box and type 2905-0051 dome guard.

2.5 COMMUNICATING DEVICES

A. Individual Addressable Module (IAM):

1. Type 2190-9172. Mount in outlet box at contact type device to connect contact type device to MAPNET addressable initiating circuit.
2. Use only to connect individual contact device to MAPNET circuit. When two (2) or more contact devices are connected as a single initiating point provide Contact Monitor ZAM.

B. Zone Adapter Module (ZAM):

1. Contact Monitor Module, style D type 2190-9153 (surface) or 2190-9154 (flush).
2. Control Signal Module, style Z type 2190-9159 (surface) or 2190-9160 (flush).
3. Control Relay Module, type 2190-9163 (surface) or 2190-9164 (flush).
4. Use specific type ZAM as indicated on drawings.

2.6 MANUAL ALARM STATIONS

A. Semi-flush, non-coded, type 2099-9761 double action non-breakglass alarm stations where shown on plans. Manual alarm stations shall be red color molded polycarbonate construction. Force required to activate the station shall not exceed 5 pounds and shall be in conformance with ADA. Suitable for individual addressable communication on MAPNET initiating circuit.

2.7 SMOKE DETECTORS
A. Spot type smoke detectors shall be type 4098-9714 analog photoelectric detector head with type 4098-9792 addressable base. Smoke detectors shall comply with U.L. Standard 268.

2.8 SPRINKLER SYSTEM FLOW SWITCH

A. Sprinkler flow switches shall be furnished and installed by fire sprinkler contractor and wired under this Division.

B. Provide IAM or ZAM to connect to IdNET addressable initiating circuit.

2.9 SPRINKLER SYSTEM SUPERVISORY SWITCH

A. Sprinkler gate valve supervisory switches shall be type OSYS-B designed for universal mounting.

B. Sprinkler post indicator valve switches shall be type PIVS-B.

C. Provide IAM or ZAM to connect to IdNET addressable initiating circuit.

2.10 CONDUIT AND BOXES FOR FIELD DEVICES

A. Conduit shall be as specified in Section 16100 for electrical work.

B. Provide a green insulated 14AWG solid copper equipment grounding conductor in all fire alarm conduits.

C. Boxes shall be as specified in Section 260500 for electrical work. Minimum size box shall be 4 inch square, 1-1/2 inch deep. See PART 3 of this section for additional requirements on box sizing.

2.11 LIGHTNING PROTECTION

A. Provide lightning protection on all circuits entering control panel or annunciator from separate building when wiring path runs underground.

2.12 TERMINAL STRIPS

A. When required, terminal strips in junction boxes shall be as manufactured by Cinch-Jones, or equivalent and shall be securely mounted to the junction box.

2.13 CONDUCTORS

A. Conductors for system shall be 98% minimum conductivity copper.
B. IDNet initiating circuit shall use West Penn #1975 cable, #18 AWG solid twisted, shielded pair (TSP) installed in raceway.

C. For 24V DC circuits use #14 AWG solid conductor. Stranded wire not acceptable. Insulation for all circuits type "THHN" except for underground circuits use type "THW" or "XHHW." Do not use type "THHN" or "THWN" wire for underground circuits. See PART 3 of this section for color coding.

D. For 120V AC circuits conductors shall be as specified in Section 260500.

E. Listed Fire Alarm Cables installed without conduits or raceways may be used for horizontal wiring in accessible above ceiling spaces.

PART 3 EXECUTION

3.1 INSTALLATION OF EQUIPMENT

A. Installation shall be accomplished in a professional manner by qualified personnel regularly engaged in and experienced in this type of work.

3.2 INSTALLATION OF CONDUIT AND JUNCTION BOXES

A. Do not change conduit layouts or wiring from that indicated when a specific circuit/conduit layout is shown on drawings. In this instance, shop drawings shall reflect the circuit/conduit layout per the engineer’s design drawings. When no circuit layout is shown on drawings, provide shop drawings indicating specific circuit and conduit layout. Actual installation shall be as indicated on the shop drawings.

C. Junction boxes shall be sized so that when covered, the wires occupy only 50% of the box area. (Boxes must reasonably be capable of housing twice the number of wires.)

D. All junction and pull boxes and their covers shall be painted red. Painting shall be done prior to box installation.

E. No junction box, pull box or auxiliary box shall be without cover.

F. When more than eight (8) conductors are spliced in a box, provide a terminal strip. For eight (8) or less conductors, wire nut splices are acceptable.

G. Installation requirements of Section 260500 shall apply to this work.

H. EMT raceways used for fire alarm system shall be factory color coded red color.
I. All continuous raceways shall have electrical (ground) continuity back to the F.A.C.P. Isolated sections of metallic raceways used as sleeves for cable type wiring methods in inaccessible spaces shall be grounded.

J. All back boxes for devices (pull stations, notification appliances, etc.) shall be appropriate boxes as designed by manufacturer. (Extension boxes bolted to back boxes to achieve sufficient depth are not acceptable.)

3.3 FIELD WIRING INSTALLATION

A. Install all system wiring in raceways per paragraph 3.2 and as indicated on the drawings, or Fire Alarm Cables without raceways only in accessible ceilings. Fire Alarm Cables installed without raceways may be used only above accessible t-grid ceilings, never in walls or in inaccessible hard ceiling spaces or otherwise closed-up where the cables cannot be accessed.

B. When more than one zone or circuit occupies a junction or pull box, all conductors shall be identified with zone numbers.

C. Field wiring shall be color coded and be consistent throughout the entire installation.

These colors shall be used:

- Red and Black = signal devices (horns and bells)
- Yellow and Blue = initiating devices (manual station, heat and smoke detectors)
- Orange and Brown = flow and tamper switches
- White and Violet = auxiliary (door release/door latch release and HVAC shutdown and annunciator)
- Green = equipment ground

D. Wire color code shall be White and Violet wires for any function other than Signal Devices, Initiating devices, flow and tamper switches.

E. Any wire pulled from a spool and field installed either internal or external to the F.A.C.P. shall comply with the color coding requirements in the specifications and "C" above. Any wire used within the F.A.C.P. for interconnection shall not use the same colors as the field wiring unless approval from the Architect is obtained.

F. Wiring carrying line voltage (120V AC) and wiring carrying low voltage (24V AC or DC) shall not share the same conduit.

G. Provide conduit sleeves in walls and through inaccessible ceiling spaces when Fire Alarm Cable type wiring methods are used. All outlet boxes in
walls shall have EMT conduit sleeves from the box up to ceiling space. Minimum size 3/4” EMT. Provide larger conduit if needed for wire fill.

3.4 INSTRUCTION TO OWNER

A. Contractor shall provide instruction to Owner with regard to proper use and operation of system. This to include not less than four hours time with manufacturer/supplier's representative on site to demonstrate all aspects of the system.

3.5 WARRANTY

A. Refer to Division 1.

B. When manufacturer's standard warranty exceeds the requirements stated in Division 1 the full manufacturer's warranty shall apply.

3.6 TESTING AND ACCEPTANCE

A. Contractor shall conduct a complete and thorough test to insure that the system will satisfy all the requirements of the National and Local Codes, as well as this specification. The test and acceptance shall be scheduled at a time when the building is not occupied or shall be scheduled so as to have the least amount of interruption to building occupants. Test shall be coordinated with and witnessed by the AHJ and Architect.

B. After the AHJ and Architect have been satisfied that the installation meets all requirements, an instructional session shall be scheduled with the Owner demonstrating the operation and the function of the system.

C. The following test procedures shall be performed:

1. Fire alarm system shall be tested on battery operation (AC power removed).
2. All sprinkler flow switches shall be tested to verify that they will create alarm condition and sound fire horns.
3. All sprinkler tamper switches shall be tested to verify that they will create a trouble condition in the zone module.
4. At random, wiring to initiating and signaling circuits shall be tested for ground faults. (Ground faults will be simulated to verify that the panel will detect them and indicate ground fault trouble condition.)
5. A visual inspection of conduit and wiring will be made to insure all junction and pull boxes are covered and painted red.

E. It is the responsibility of the general contractor that these test procedures be satisfied.
END OF SECTION
END OF DIVISION
DIVISION 31 – EARTHWORK

311000 – EARTHWORK

1. GENERAL:

A. SCOPE: This section of the specifications includes furnishing all labor, materials and equipment necessary to complete all site and earthwork as indicated on the drawings and/or as hereinafter specified including but not necessarily limited to the following:

(1) Project layout and verification
(2) General protection responsibilities
(3) Site preparation and rough grading
(4) Earth excavation, filling and compaction
(5) Finished grading

B. Related Sections:

(1) 015100 – Site Protection
(2) 312150 - Excavation, Filling and Backfilling
(3) 312210 - Trenching and Backfilling

C. Related Documents: Drawings and general provisions of the Contract, including general and supplementary conditions, apply to the work of this section. Other related documents include:

(1) Storm Water Pollution Prevention Plan
(2) Pima County / City of Tucson (PC/COT) Standard Specifications for Public Improvements (2003 edition), hereafter referenced as PC/COT SSPI.

D. Geotechnical Engineering Report: The Owner has secured a Geotechnical Engineering Report from Terracon Consultants, Inc.; Report #63185108, dated January 10, 2019, for this project. A copy is included at the end of this section for reference. The Contractor shall adhere to all recommendations contained therein.

E. Project Layout: Contractor shall employ and pay for the services of
a registered surveyor licensed to practice in the State of Arizona to lay out the work and check and verify all elevations, dimensions, etc., prior to starting construction. Any discrepancies in the above shall be immediately reported to the Architect. All grades, lines, levels and benchmarks shall be established by the general Contractor who shall be responsible for same. From time to time, the surveyor shall check the work for proper alignment, location, elevations, etc.

G. General Protection Responsibilities:

1. Engineering Responsibility: Contractor for this work shall be responsible for all engineering and safety for execution of his work. Provide and install shoring, needles, bracing and wedging to support or protect any excavation, banks, sidewalks, walls and other structures. All shores, needles or braces shall be located so as not to interfere with the construction. Work shall be done in accordance with competent engineering practices and local building codes. Location of cuts, fills, and excavations shall be the responsibility of the Contractor.

2. Protection of Persons: Protection of all persons shall be provided at all times. The work shall proceed in such manner as to prevent the undue spread of dust and flying particles. Provide all necessary temporary protective barriers and fencing as required.

3. Preservation and Restoration of Property: The Contractor shall be responsible for the preservation of all public and private property on the surface or underground, along and adjacent to the work, and shall conduct his operation so as to insure the prevention of injury or damage thereto. No land monuments or similar property shall be disturbed or moved until an authorized agent of the Architect has witnessed or otherwise referenced their location. When or where any direct or indirect damage or injury is done to public or private property by or on account of any act, or as the consequence of the non-execution thereof on the part of the Contractor, such property shall be restored by the Contractor, at his own expense, to a condition equal to that existing before rebuilding, or otherwise restoring same, or he shall make good such damage or injury in an acceptable manner.
(4) Existing Utilities: The existing utilities service lines and utilities structures, whether shown on the drawings or not, shall be protected and safeguarded from damage during earthwork operations and, if damaged, shall be repaired by the Contractor at his expense.

   a. The above provisions are applicable to all or any portion of utilities service lines and utilities structures which project above the original surface or lie beneath the ground surface within any grading area.

(5) Landscape Protection: Contractor shall take all necessary precautions to preserve without damage any trees or landscaping within the property lines, except those specifically designated for removal and disposal. Verify with Architect.

(6) Burning Debris: No materials or debris shall be burned on the premises.

(7) Dynamite and Powder: No dynamite or powder shall be used or brought to the site.

(8) Dust Control: Contractor is responsible for water and equipment required to keep dust to a minimum during grading and excavation.

H. Soils Engineering and Tests:

(1) Qualified Soils Testing agency shall be employed to observe the placement and compaction of all fill at the site, to take all samples required for tests as required. Testing shall be done by an approved and independent testing laboratory.

(2) Payment of tests and services of testing agency shall be the responsibility of the Owner.

(3) Test reports shall be delivered to the Owner and duplicate copies to the Architect and Engineer.

(4) Contractor's Responsibility: To notify the soils testing agency when filling and compaction are to take place and know that tests are taken.
2. PRODUCTS:

A. Fill and Backfill:

(1) Fill required to backfill walls or to construct building site shall conform to the referenced geotechnical engineering report for the project.

B. Base Course: An aggregate base course of 4" thickness (compacted thickness) shall be placed under all on-grade concrete slabs, consisting of sand and gravel as directed by the soils report and shall be compacted to a minimum 95% of the ASTM D698.

3. EXECUTION:

A. Site Preparation:

(1) General: The site, where indicated on the drawings, shall be cleared of all natural obstructions and any other items which will interfere with the construction operations or as designated for removal a minimum of 5' beyond the perimeter of the new buildings as directed by this specification and the soils report.

(2) Grubbing: All stumps and subsurface roots larger than three inches (3") in diameter and matted roots existing within the area bounded by lines five feet (5') outside of structure foundations shall be removed. In other areas of construction all stumps and subsurface roots larger than three inches (3") in diameter and all matted roots shall be removed to a depth of 18" below any sub-grade shoulder slope or existing grade.

(3) Strip and remove all existing rubble, debris, vegetation, obviously loose surface soils from the building areas. Any depressions, ditches, trenches, etc. should be cleaned and widened to accommodate compaction equipment.

(4) The criteria provided in the geotechnical engineering report should be used in determining the minimum depth of any over-excavation and engineered fill required below the shallow footings and the minimum distance it should extend beyond the footing edges. It may be more practical to remove soils to the maximum depth beneath all portions of the structure area. If this is done, the removal and re-compaction should extend at least five feet beyond the perimeter footings.
(5) After any over excavation has been accomplished, the exposed soils should be scarified, moistened, or dried as required, and compacted to a minimum depth of 10 inches. If clay soils are exposed at finished sub-grade in floor slab areas, the clayey soils shall be removed replaced with engineered fill to the depths indicated in the geotechnical engineering report.

(6) Place fill in maximum 10-inch loose lifts and compact the fill such that specified densities are achieved. All earthwork for the building pad should extend at least 5 feet beyond the perimeter footings.

(7) Separate Topsoil: All topsoil affected by rough grading, and/or excavations shall be stockpiled on site separately and shall not be used for backfill, but shall be conserved as directed by the Architect and utilized for topsoil in rough and final grading as specified herein.

(8) Planting Areas: All foreign matter shall be removed to a depth of at least two feet (2') below the new finish grade.

(9) Rough Grading: Uniformly smooth grading of all areas covered by the project, including excavated and filled sections and adjacent transition areas shall be accomplished. The finished surface shall be reasonably smooth, compacted, and free from irregular surface changes. The degree of finish shall be that ordinarily obtainable from either blade-grader or scraper operations, except as otherwise specified. All ditches shall be finished so as to drain readily.

B. Compaction:

(1) The sub-grade shall be scarified, moistened (or dried, as required), and re-compacted for a minimum depth of 10 inches before placement of fill materials.

(2) Compaction of backfill and fill shall be performed in horizontal lifts not exceeding 10" loose thickness, and shall attain the following specified percent of maximum density at the appropriate optimum moisture content as determined in accordance with ASTM Designation D698.
### Materials and Compaction

<table>
<thead>
<tr>
<th>MATERIAL</th>
<th>% COMPACTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>On-site sub-grade soils (reworked) and sub-base fill:</td>
<td></td>
</tr>
<tr>
<td>Below footings</td>
<td>95</td>
</tr>
<tr>
<td>Below slabs -on-grade</td>
<td>95</td>
</tr>
<tr>
<td>Below pavement</td>
<td>95</td>
</tr>
</tbody>
</table>

Imported fill:
| Below footings                                | 95           |
| Below slabs-on-grade                          | 95           |
| Below pavement                                | 95           |

<table>
<thead>
<tr>
<th>MATERIAL</th>
<th>% COMPACTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Base course (beneath floor slabs)</td>
<td>95</td>
</tr>
<tr>
<td>Base course (beneath pavements)</td>
<td>100</td>
</tr>
<tr>
<td>Miscellaneous backfill</td>
<td>90</td>
</tr>
</tbody>
</table>

Any soil disturbed during construction should be re-compacted to the percent compaction as specified above.

Soils below paved areas in which moisture contents have been increased above in-situ moistures, shall be compacted to full depth and width of the increased moisture. Compaction shall be in accordance with the above or to the satisfaction of the soils engineer.

(3) Moisture Content: On-site clayey soils and approved import fill soils should be compacted at moisture contents outline below.

<table>
<thead>
<tr>
<th>MATERIAL</th>
<th>% Range of Moisture Contents</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Minimum</td>
</tr>
<tr>
<td>Below footings</td>
<td>-3</td>
</tr>
<tr>
<td>Below slabs -on-grade</td>
<td>-1</td>
</tr>
<tr>
<td>Below pavement</td>
<td>-3</td>
</tr>
<tr>
<td>Base course (beneath floor slabs)</td>
<td>-3</td>
</tr>
<tr>
<td>Base course (beneath pavements)</td>
<td>-3</td>
</tr>
<tr>
<td>Miscellaneous backfill</td>
<td>-3</td>
</tr>
</tbody>
</table>

(4) Preparation and placement of fill materials: Fill materials shall be thoroughly mixed to a uniform moisture content. Materials shall be placed and compacted in 10” maximum horizontal lifts at a depth compatible with the compaction equipment being used.
C. All excavation of the building site and for footings shall be carried to a depth as shown on the plans.

Bottoms of all footings shall be finished by hand to insure solid bearing free of loose earth. All debris and large stones uncovered shall be removed from the premises. Earth obtained from excavation and not used as fill for other parts of the site shall be removed from the premises, unless directed by the Architect.

(1) Excavation shall comprise and include the satisfactory removal and disposition of all materials excavated regardless of the nature of materials encountered and which shall therefore be understood to include both rock excavation and common excavation when both classes are present. All suitable excavated materials shall be transported to and placed in the fill areas within the limits of the work except as otherwise directed by the Soils Testing Agency and/or Architect.

(2) Where material encountered within the limits of the work is considered unsuitable by the Soils Testing Agency and/or Architect, such material shall be excavated below the grade shown on the drawings as directed, and the excavation shall be re-compacted with suitable material to the compaction required in structural notes. Native soils are considered suitable for use in compacted fills below building areas, if the criteria of Paragraph 2.a.(2)(a) are met.

(3) Excavation and filling shall be performed in a manner and sequence that will provide drainage at all times.

(4) Excavation shall extend a sufficient distance from walls and footings to allow for placing and removal of forms, installation of services, and for inspection, except where the concrete for walls and footings is authorized to be deposited directly against excavated surfaces. Undercutting will not be permitted.

(5) Shoring, including sheet piling, shall be installed to protect workmen and the banks, adjacent paving structures, and utilities.

D. Fill and Backfill:

(1) Sub-base fill shall be placed in lifts thin enough that at least
the minimum recommended density is obtained throughout each lift.

(2) Except for otherwise specified, each layer shall be spread uniformly by the use of a road machine or other approved device and rolled with an approved tamping roller, heavy pneumatic roller, 3-wheeled power roller or by other suitable equipment sufficient to compact as specified.

(3) After completion of foundation footings and walls, and other construction below the elevation of the final grade and prior to backfilling, all forms shall be removed and the excavation shall be cleaned of all trash and debris.

(4) Material for backfilling shall conform with the specification for the "Sub-base Fill" herein before specified.

(5) No backfill to be placed against footings or walls until concrete is thoroughly set. Backfill shall be placed symmetrically to prevent eccentric loading upon or against structures. Backfill, including utility trench backfill, shall be placed in six inch (6") horizontal layers, and compacted to 95% of the maximum density of the optimum moisture content as determined in accordance with ASTM D-698.

(6) All topsoil secured from rough grading and/or excavation operations shall be distributed on the site during finish grading operations as directed by the Soils Testing Agency and/or Architect.

(7) Topsoil: Previously stockpiled shall be used for backfill in planters. Six inch (6") minimum thickness, finishing level with finish grades required, and a surplus shall be used on areas designated for lawns, also finishing level with the finish grades required.

E. Grading:

(1) Existing and finish grades are indicated on the plans. The site where shown on the plans only shall be rough graded with ground surface being cut or filled as required to meet the finished grades shown, leaving no depressions in which water may puddle.

(2) Finish grading around the building shall be reasonably smooth and carried out from the building in a manner to
provide uniform drainage way from the building.

(3) Grading required for paved areas shall be done in a manner that the specified thickness of paving will meet the finish grades shown. This area shall be compacted with water and a heavy roller before paving.

(4) Newly graded areas shall be protected from the action of the elements and any settlement or washing that may occur from that or any other cause, prior to acceptance of the work shall be required and grades re-established to the required elevations and slopes.

END OF SECTION
THIS PAGE INTENTIONALLY LEFT BLANK
GEOTECHNICAL EVALUATION
PROPOSED NEW SCHOOLS
HOUGHTON ROAD SOUTH OF DAWN ROAD
TUCSON, ARIZONA

Submitted To:

Swaim Associates Ltd.
7350 East Speedway Boulevard, Suite 210
Tucson, Arizona 85710

Submitted By:

ConformaTech, Inc.
1425 East Apache Park Place
Tucson, Arizona 85714

25 March 2011
CTEC Job No. 11-0103
25 March 2011
CTEC Job No. 11-0103

Swaim Associates Ltd.
7350 East Speedway Boulevard, Suite 210
Tucson, Arizona 85710

Attention: Kevin Barber
Project Architect

Re: Geotechnical Evaluation
Proposed New Schools
Houghton Road South of Dawn Road
Tucson, Arizona

Our geotechnical evaluation for the referenced project is herewith submitted. The report includes the results of test drilling, laboratory testing and engineering analyses. Recommendations for site grading and foundation, slab-on-grade and pavement design, based on the analyses, are presented.

This report was performed in general accordance with our proposal TG 11 02 01, dated 25 February 2011.

Should any questions arise concerning this report, we would be pleased to discuss them with you.

Respectfully submitted,
ConformaTech, Inc.

Clyde L. Pretti, P.E.
Geotechnical Engineer
Expires 12/31/2012

copies: Addressee (2)
       File (1)

ConformaTech, Inc.
1425 East Apache Park Place
Tucson, Arizona 85714

Phone 1.520.573.2045
Fax 1.520.573.0528
## TABLE OF CONTENTS

1.0 INTRODUCTION .................................................. 1
2.0 PROPOSED SITE IMPROVEMENTS ................................ 1
3.0 SITE EXPLORATION ............................................. 2
4.0 LABORATORY TESTING .......................................... 2
5.0 SITE CONDITIONS ................................................ 3
   5.1 SURFACE CONDITIONS ....................................... 3
   5.2 SUBSURFACE CONDITIONS ................................... 3
6.0 ANALYSIS & RECOMMENDATIONS ................................. 3
   6.1 ANALYSIS ................................................... 3
   6.2 SHALLOW FOUNDATIONS ..................................... 4
       6.2.1 Design Criteria for Downward School Building Loads 4
       6.2.2 Lateral Loads .......................................... 5
       6.2.3 Estimated Settlements ................................... 6
       6.2.4 Seismic Design Values .................................. 7
       6.2.5 Design Criteria for Post Tensioned Basketball Court Slab 7
6.3 CONCRETE CAST-ON-GRADE SLABS ............................. 7
   6.3.1 Slab Support ............................................. 7
   6.3.2 Structural Design of Slabs ................................ 7
   6.3.3 Moisture Protection of Slabs ............................ 8
   6.3.4 Slab Construction and Curing ............................ 8
6.4 PAVEMENT DESIGN .............................................. 9
7.0 EARTHWORK ....................................................... 10
   7.1 Earthwork Construction .................................... 10
   7.2 Site Clearing ............................................... 10
   7.3 Removal of Existing Surface Soils ......................... 10
   7.4 Surface Preparation ........................................ 10
   7.5 Foundation Area Treatment ................................ 11
   7.6 Structural Fill Below Post Tensioned Basketball Court 11
   7.7 Structural Fill ............................................. 11
   7.8 Use of Onsite Soils as Structural Fill .................... 12
   7.9 Granular Base Below Floor Slabs .......................... 12
   7.10 Fill Placement, Moisture and Compaction ............... 13
   7.11 Excavation Conditions ................................... 13
   7.12 Compliance ............................................... 13
8.0 SITE DRAINAGE & MOISTURE PROTECTION ..................... 14
9.0 SLOPE RATIO FOR PERMANENT CUT OR FILL SLOPES ............ 14
10.0 LIMITATIONS .................................................... 14

## APPENDICES

APPENDIX A Field Exploration
APPENDIX B Laboratory Testing Results
1.0 INTRODUCTION

This report presents the results of a geotechnical evaluation performed by ConformaTech, Inc. (CTEC) at the site of two proposed new schools located on the west side of Houghton Road approximately one mile south of Dawn Road, in Tucson, Arizona. The purpose of the CTEC geotechnical services was to evaluate the physical properties of the soils underlying the site, in order to develop recommendations for site grading and foundation, slab-on-grade and pavement design.

This report was prepared for the exclusive use of our client for application only to the project discussed in the report. If changes in the nature, design or location of the site improvements as discussed in this report are planned or occur, the conclusions and recommendations of this report shall not continue to remain valid unless CTEC reviews the changes and provides a written verification or modification of the conclusions and recommendations of this report.

2.0 PROPOSED SITE IMPROVEMENTS

Two new schools are proposed for construction at the site. The Andrada Polytechnic High School will be located at the northeast corner of the site and the Pantano High School will be located on the southeast corner of the site.

The Andrada school will one to two stories in height with masonry and steel stud walls. The ground level floor will be a concrete slab-on-grade with a finish floor elevation of 3118.0 feet. Maximum wall walls should not exceed 10 kips per foot and maximum column loads should not exceed 200 kips.

The Pantano school will be of single story construction and with wood frame walls and a concrete slab-on-grade floor with a finish floor elevation of 3123.5 feet. Light foundation loads are anticipated at this school.

Paved parking and drive areas will be located at both school sites.

The Andrada school site will have a maximum earthwork cut of approximately 3 feet and a fill of approximately 6 feet. The Pantano school site will have a maximum earthwork cut of approximately 2 feet and a fill of approximately 2 feet.

An post tensioned concrete outdoor basketball court will be constructed west of the new school location.
We understand the areas of site development:

- are not subject to flooding
- will not have retention or detention basins or water harvesting basins within 10 feet of foundations

CTEC should be advised if the above understandings change so that additional design and earthwork recommendations can be provided.

3.0 SITE EXPLORATION

Twelve exploratory borings were drilled to depths of approximately 15 to 20 feet below existing grade at the two school sites. Ten shallow test excavations were made in planned pavement areas. The exploratory borings were drilled with a CME-75 truck-mounted drill rig advancing a 7 inch diameter, continuous flight, hollow stem auger.

Standard penetration testing and sampling and open-end drive sampling were performed at selected intervals in the borings. Due to the lime cementation and gravel content of the site soils, undisturbed sampling using a ring sampler could not be done at many locations. Upon completion of the drilling operation, the boreholes were backfilled with the drill cuttings.

The pavement excavations were dug with a backhoe. Bulk soil samples were taken in these excavations for soil classification purposes.

The results of the field exploration are presented in Appendix A, which includes a brief description of drilling and sampling equipment and procedures, a site plan showing the boring locations and logs of the test borings.

4.0 LABORATORY TESTING

The laboratory analysis included testing for the following:

- insitu dry density and moisture content
- grain size analysis and Atterberg limits
- maximum density/optimum moisture (ASTM D698 Standard Proctor)
- consolidation
- remolded swell

The laboratory test results are presented in Appendix B. The insitu moisture and dry density results are shown on the boring logs.
5.0 SITE CONDITIONS

5.1 SURFACE CONDITIONS

Vegetation at the site was moderate and consisted of annual plants, cactus, brush and trees common to the area.

There are barbed wire fences on the east and a portion of the north property boundaries. There is a water well site north of the Andrada school site on an adjoining piece of land. There is an overhead power line servicing the water well site. There is a below ground high pressure natural gas pipe and a below ground telephone cable run on the east property boundary just west of the fence. There are a few small piles of debris along the dirt road that runs from Houghton Road to the above noted water well site.

There is a shallow wash at the south boundary of the new construction area. There are smaller and more shallow washes in the proposed construction area. The site slopes gradually to the northwest.

The project site was previously State of Arizona Trust Land and there is little site disturbance.

5.2 SUBSURFACE CONDITIONS

Based on the exploratory borings and the results of the laboratory analyses, the geotechnical profile underlying the project site generally consists of a deposit of clayey sand with some sandy clay and some silty sands. All of the soils were weakly lime cemented. The soils contain varying amounts of gravel and some small cobbles. The soil plasticity was generally low or moderate.

No free groundwater was encountered in the borings advanced for this project.

The subsurface conditions described are based in part on the observations of the soils in widely spaced borings. Variations in the soils between borings can occur.

6.0 ANALYSIS & RECOMMENDATIONS

6.1 ANALYSIS

The near surface soils of low plasticity and density have a low settlement potential at the in situ moisture conditions under the anticipated foundation loading conditions. When wetted, these soils should have a low to moderate additional settlement potential.
The near surface insitu soils of moderate plasticity and greater density have a moderate to high swell potential under the anticipated floor slab loading conditions when wetted. When remolded and tested at the anticipated density and moisture conditions of structural fill, these soils have a high swell potential when wetted under the anticipated floor slab loading conditions. These soils are not recommended for use as structural fill.

The proposed foundations should be supported on structural fill to help minimize the potential for excessive settlements.

The EARTHWORK portion of this report presents recommendations regarding placement of structural fill for foundation support and for removal of swelling soils from below the new buildings.

6.2 SHALLOW FOUNDATIONS

6.2.1 Design Criteria for Downward School Building Loads

The recommended design criteria for shallow foundations are as follows:

<table>
<thead>
<tr>
<th>Minimum Foundation Depth (feet)</th>
<th>Allowable Soil Bearing Pressure (psf)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.5</td>
<td>2,000</td>
</tr>
<tr>
<td>2.0</td>
<td>2,500</td>
</tr>
<tr>
<td>2.5</td>
<td>3,000</td>
</tr>
</tbody>
</table>

The foundation depths noted above are referenced below lowest adjacent grade. For interior foundations, lowest adjacent grade is finish slab grade. For exterior foundations, lowest adjacent grade is defined as the lowest exterior finish grade within 5 feet of the foundation elements.

The minimum recommended widths of square and continuous footings are 2.0 and 1.33 feet, respectively.

The bearing pressures apply to dead loads plus design live loads. The above bearing pressures may be increased by one-third when considering total loads that include short term wind or seismic loads.

Where foundations adjoin nearby sloping ground, a minimum horizontal setback of 5 feet should be maintained between the slope face and the edge of the footing adjoining the slope.

Foundation excavations should be observed by the geotechnical engineer during construction to verify bearing on structural fill.
If, during site inspections, soil conditions significantly different from those described in this report are found, additional recommendations will be provided.

Thickened slab sections may be used to support interior partitions, provided that:

- partition loads do not exceed 900 plf
- the thickened slab sections have a minimum width of 12 inches
- the thickness and reinforcing are determined by structural design
- appropriate slab control jointing is determined by structural design
- the thickened slab sections are supported on firm native soils or structural fill

### 6.2.2 Lateral Loads

The following lateral load values:

- do not include the effects of hydrostatic conditions
- do not apply for submerged or partially submerged conditions
- apply only for level backfill and do not apply for sloping backfill conditions (either positive or negative slope)
- do not apply for vibration or dynamic loading conditions
- do not apply for surcharge loading conditions
- do not apply for swelling soil pressure on walls

The passive resistance of properly compacted backfill or undisturbed native soils against the edges of footings, stem walls, and similar vertical foundation elements should be considered equivalent to the forces exerted by a fluid of 300 pounds per cubic foot (pcf/ft) unit weight.

The active earth pressure for properly compacted backfill or undisturbed native soils against the edges of footings, stem walls, and similar vertical foundation elements should be considered equivalent to the forces exerted by a fluid of 35 pcf/ft for unrestrained walls and 55 pcf/ft for restrained walls.

A coefficient of friction of 0.40 (if no passive resistance is used) is recommended for computing lateral resistance between the bases of footings and slabs and the soil in analyzing lateral loads. If passive resistance is used in lateral load calculations, the coefficient of friction should be reduced to 0.35.

Free-draining granular backfill should be utilized behind retaining walls. The backfill should be a minimum one foot thick and should be placed adjacent to the wall. The granular material should extend from the bottom of the wall to within one foot of the top of the backfill surface. The top foot of backfill should be comprised of the soil backfill materials and not the free-draining granular backfill materials.

A layer of filter fabric should be placed between the free draining granular materials and the wall backfill soils. A preliminary recommendation for the filter fabric is Mirafi 180N which should be verified during construction when the backfill soils can be tested.
The grading requirements for the free-draining backfill material, as determined by ASTM C136, should be as follows:

<table>
<thead>
<tr>
<th>Sieve Size (square openings)</th>
<th>Percent Passing by Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/4 inch</td>
<td>100</td>
</tr>
<tr>
<td>No. 4</td>
<td>10-60</td>
</tr>
<tr>
<td>No. 200</td>
<td>0-2</td>
</tr>
</tbody>
</table>

The plasticity index of the fraction of material passing the No. 40 sieve should be nonplastic when tested by ASTM D4318.

Granular material should be placed in lifts no thicker than 8 inches and mechanically compacted. If the gradation of the fill is generally fine enough to permit testing by conventional means, the fill should be compacted to densities as recommended in the Fill Placement, Moisture and Compaction portion of this report.

A perforated drain pipe should be installed in the retaining wall granular fill running along the bottom of the granular material layer. The drain pipe should drain into a daylight point or to a sump(s) that will allow the water to be pumped out. Weep holes may also be used to drain water out of the granular fill. The weep holes should be a minimum 2 inches in diameter and should be spaced a maximum of 10 feet center-to-center. The weep holes should be placed a maximum of 6 inches above finished grade at the bottom of the wall. The weep holes should be sloped to drain at a pitch of 1/2 inch per foot.

In lieu of the granular drainage layer discussed above, a geocomposite drain material may be used. The material should be placed from the top of the wall footing to within one foot of the top of the wall. A drain pipe (or weep holes) should be installed along the bottom of the geocomposite that drains to a daylight point or to a sump(s) as discussed above.

If drainage from the weep holes or the drain daylight point or into the sump occurs, the source of the water should be located and eliminated.

6.2.3 Estimated Settlements

It is estimated that settlements of foundations designed in accordance with the criteria presented in this report should not exceed 1 inch for the soil moisture conditions encountered in native soils at the time of our field exploration, or for specified moisture contents anticipated in compacted site soils or structural fill. It is further anticipated that about 50 percent of the anticipated settlement will occur during construction.

Significant moisture increases in the structural fills and/or the native soils below foundations could result in additional settlements of footings. Therefore, recommendations for site drainage and moisture protection, as presented in this report, are critical elements of design.
6.2.4 Seismic Design Values

Based on the nature of the subsoils encountered, a site class designation of D should be used for design per Table 1613.5.2 Site Class Definitions of the 2006 International Building Code.

6.2.5 Design Criteria for Post Tensioned Basketball Court Slab

Post-tensioned slab construction is planned for support of the new outdoor basketball court. To provide more uniform bearing conditions and reduced settlement or heave potential, post-tensioned slab systems should be founded on a minimum of 2.0 feet of structural fill. The structural fill should be placed and compacted as recommended in the EARTHWORK section of this report. Post-tensioned slabs should be designed using criteria outlined by the Post-Tensioning Institute\(^1\) based on a maximum allowable bearing pressure of 1000 psf.

A coefficient of subgrade reaction, \(k_{11}\), of 250 pci is representative of properly prepared native soil or structural fill. This coefficient should be corrected to account for the width (B) of the slab. The width B is the least dimension of the slab foundation. The correction factor is as follows:

\[
k = k_{11} \left(\frac{(B + 1)}{(2B)}\right)^2
\]

6.3 CONCRETE CAST-ON-GRADE SLABS

6.3.1 Slab Support

Where structural fills and/or compacted native soils are maintained at or below the compaction water contents, they will afford as firm or firmer slab support as would be provided with a granular base course. Thus, the use of granular base is not considered necessary for the structural support of slabs. However, granular base provides a more desirable working surface, reduces capillary rise of moisture to slabs, and reduces warping stresses in concrete. A 4-inch course of material meeting the requirements of this report is recommended for placement beneath floor slabs.

6.3.2 Structural Design of Slabs

A modulus of subgrade reaction (k) of 250 pounds per square inch per inch of deflection (pci) is recommended for the structural design of cast-on-grade concrete slabs constructed on structural fill or compacted native soils. This recommended value is dependent on completion of the site grading as recommended in this report.

\(^{1}\) Design and Construction of Post-Tensioned Slabs-on-Ground, Post-Tensioning Institute, Latest Edition
6.3.3 Moisture Protection of Slabs

Granular base would tend to act as a capillary barrier to moisture, but would not provide a positive barrier against the rise of moisture through the slabs. If impervious or moisture-sensitive floor coverings are used, an impervious membrane vapor barrier is recommended. The construction of and materials comprising the vapor barrier should comply with the recommendations of the manufacturer(s) of the various components of the floor covering(s).

The floor covering manufacturer’s recommended testing procedures and frequency should be used to identify unacceptable slab moisture conditions. Floor coverings should not be installed until satisfactory slab moisture readings are documented in writing from the manufacturer and installer.

6.3.4 Slab Construction and Curing

Concrete placement and curing should follow the recommendations of the American Concrete Institute. Improper placement and/or curing of slab concrete could cause excessive shrinkage, cracking and/or curling.

6.3.5 Slab Construction Recommendations

Provide control/construction joints in slabs. Separation or isolation joints between slabs and all slab penetrations should be provided so as to allow for the independent movement of the slab. The recommendations of the American Concrete Institute should be followed regarding joints in concrete slabs.

6.3.6 Exterior Slab Construction

Some of the site soils are expansive. Some heaving (upward movement) of the exterior slabs and sidewalks may occur if expansive native soils below the slabs are wetted. Precautions which would help minimize the upward movement would include:

- placing a minimum 18 inches of low expansion potential structural fill below the slabs
- restricting landscape irrigation near the slabs
- providing positive drainage away from the slabs so water does not pond
- added maintenance to replace portions of the slabs when upward moving is excessive
6.4 PAVEMENT DESIGN

The following conventional asphaltic concrete over granular base pavement structures are recommended:

<table>
<thead>
<tr>
<th>Area</th>
<th>Area</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Asphalitic ConcreteThickness (inches)</td>
</tr>
<tr>
<td>Passenger car parking and traffic lanes</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Aggregate Base Course Thickness (inches)</td>
</tr>
<tr>
<td></td>
<td>4</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Busses per day</th>
<th>Trucks per day</th>
<th>Asphalitic concrete thickness (inches)</th>
<th>Aggregate base course thickness (inches)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 max</td>
<td>2 max</td>
<td>3</td>
<td>6</td>
</tr>
<tr>
<td>11 to 20</td>
<td>2 max</td>
<td>3.5</td>
<td>6</td>
</tr>
<tr>
<td>21 to 30</td>
<td>2 max</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>31 to 40</td>
<td>2 max</td>
<td>4</td>
<td>6</td>
</tr>
<tr>
<td>41 to 50</td>
<td>2 max</td>
<td>4</td>
<td>7</td>
</tr>
</tbody>
</table>

At trash pickup areas, a concrete slab should be placed to support the trash truck. The concrete should be a minimum 6 inches thick and should have a minimum compressive strength of 4,500 psi at 28 days. Place a minimum 4 inches of aggregate base course below the slab. This concrete slab should be designed and constructed per the recommendations of the Portland Cement Association.

Where heavy static loads are applied to the pavement, such as truck parking and load/unload areas, a concrete slab is recommended for vehicle support. The slab may be constructed as described above.

Where bus traffic will use the circular drive areas of the site pavement, very slow speeds are recommended to avoid shoving or rutting of the asphalt. If shoving/rutting becomes excessive, the use of concrete replacement pavement may be needed.

The asphaltic concrete and aggregate base course materials should comply with the latest requirements of the Standard Specifications for Public Improvements for Pima County/City of Tucson (PC/COT). Mix number 2 of Table 406-2 is recommended for the asphaltic concrete. For drive areas and parking lots, the mix design properties for local streets are recommended-see Table 406-1.
A maintenance program should be implemented for the site pavement. Periodic sealing of the asphaltic concrete pavement structure will be required to extend the pavement life. With time, the pavement will age and there will be cracking. Cracks should be sealed to prevent water infiltration. Eventually there would be a requirement for reconstruction or overlay of the original pavement.

Water should not be allowed to pond on or near the pavement surfaces. Intrusion of water into the subgrade soils below the pavement can cause failure.

7.0 EARTHWORK

7.1 Earthwork Construction

Areas of earthwork disturbance, trenching or excavation of fills that occur after completion of the earthwork should be backfilled and compacted in accordance with the recommendations of this report.

7.2 Site Clearing

The site should be cleared of all vegetation and debris. All loose, soft or wet soils and all deleterious materials should also be removed. The extent of the site clearing should extend a minimum 5 feet beyond the perimeter of the new buildings.

Mounds and depressions should be removed to allow for uniform fill placement and compaction.

Ground sloping steeper than 5 Horizontal to 1 Vertical (5H:1V) should be benched. The benches should be level and of sufficient width to accommodate the earthwork equipment.

7.3 Removal of Existing Surface Soils

The native surface soils should be removed to a minimum depth of 3 feet below the bottom of the new building floor slabs. The removal of the soils should extend a minimum 5 feet laterally beyond the perimeter of the new school buildings. The soil engineer should be called to observe the removal of the soils during construction. If low swelling on nonswellling soils are found, the depth of removal can be changed.

Where deep fills will be placed for floor slab and foundation support, some changes to the above depth of removal can be made by the geotechnical engineer when the grading and foundation plans are complete.

7.4 Surface Preparation

Upon completion of the site clearing and removal of swelling soils, the ground surface should be scarified, moisture conditioned and compacted to a minimum depth of 8 inches. The soil should be compacted to a minimum 95% (100% if greater than 5 feet below the bottom of foundations) of the maximum dry density determined per ASTM D698 at optimum moisture ±3%.
7.5 Foundation Area Treatment

Structural fill should be placed for foundation support. The depth of structural fill constructed below the bottom of continuous foundations should be equal to the width of the foundation but not less than 2 feet. The depth of structural fill constructed below the bottom of isolated column foundations should be equal to half the width of the foundation but not less than 2 feet. The structural fill should extend laterally beyond the perimeters of all foundations a minimum distance equal to the depth of fill placed below the foundation but not less than 2 feet.

7.6 Structural Fill Below Post Tensioned Basketball Court

Structural fill should be placed for support of the new basketball court. A minimum 2 feet of low expansion potential structural fill should be placed for support of the new basketball court post tensioned concrete slab. The structural fill should comply with the recommendations for imported structural fill (see below). The structural fill should extend a minimum distance of 2 feet laterally beyond the perimeter of the post tensioned slab.

A minimum 4 inches of granular fill should be placed directly below the basketball court concrete. The granular fill should comply with the recommendations below regarding granular fill placed below floor slabs. The 4 inches of granular fill may be included in the minimum 2 feet of structural fill recommended for placement below the slab.

Some removal of the native soils at the basketball court location may be necessary. The native soils are not recommended for use as structural fill unless approved during construction by the geotechnical engineer.

Prior to placing structural fill for basketball court support, the native subgrade soils should be scarified to a minimum depth of 8 inches and compacted to a minimum 95% of the maximum dry density determined per the ASTM D698 test method at optimum moisture ±3%.

7.7 Structural Fill

Imported soils and native onsite soils to be used as structural fill should be free of vegetation, debris, and other deleterious materials. These soils should contain no particles larger than 3 inches in any dimension and should have a gradation that will allow material to be placed and compacted with no significant voids or nesting as determined by the geotechnical engineer.
Imported soils and onsite native soils used as structural fill should also conform to the following unless otherwise determined by the geotechnical engineer:

<table>
<thead>
<tr>
<th>Sieve Size</th>
<th>Percent Finer by Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>3&quot;</td>
<td>100</td>
</tr>
<tr>
<td>No. 4</td>
<td>50-100</td>
</tr>
<tr>
<td>No. 40</td>
<td>20-65</td>
</tr>
<tr>
<td>No. 200</td>
<td>maximum of 30</td>
</tr>
</tbody>
</table>

Maximum expansive potential: 1.5% (see note * below)
Maximum soluble sulfates: 0.10%

*The maximum expansive potential is measured on a soil sample compacted to approximately 95 percent of the maximum dry density determined per ASTM D698 at approximately 3 percent below optimum moisture. The compacted soil sample is confined under a 100 psf surcharge load and submerged in water.

7.8 Use of Onsite Soils as Structural Fill

Clean, onsite soils of low expansion potential may be used as structural fill. Prior to using onsite soils as structural fill, the soils should be cleaned of deleterious materials and screened to remove all materials greater than 3 inches in any dimension.

The results of the laboratory testing and site observations indicate it is unlikely the surface soils will be useable as structural fill below the new school building slabs and foundations. Additional testing should be done during construction to determine if onsite soils are useable as structural fill.

7.9 Granular Base Below Floor Slabs

Granular base below floor slabs should meet the following gradation requirements as determined by ASTM C136:

<table>
<thead>
<tr>
<th>Sieve Size (square openings)</th>
<th>Percent Passing by Dry Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 inch</td>
<td>100</td>
</tr>
<tr>
<td>3/4 inch</td>
<td>90-100</td>
</tr>
<tr>
<td>1/4 inch</td>
<td>45-75</td>
</tr>
<tr>
<td>No. 200</td>
<td>0-10</td>
</tr>
</tbody>
</table>

The plasticity index of the fraction of material passing the No. 40 sieve should not exceed 5 when tested by ASTM D4318. The coarse aggregate should have a percent of wear, when subjected to the Los Angeles Abrasion Test (ASTM C131) of no greater than 40 at 500 revolutions. Granular base should be free of vegetation, debris and other deleterious material.
7.10 Fill Placement, Moisture and Compaction

Fill material should be placed in lifts no thicker than 8 inches where heavy compaction equipment is used. Where hand operated compactors are used, lifts should not exceed 6 inches in thickness. Fill lifts should be of uniform thickness when compacted.

The compacted moisture content of structural fills, granular base below floor slabs and aggregate base below pavement should be maintained at optimum moisture content ± 3%. If pumping of the fill or subgrade soils occurs during compaction, the pumping soils should be removed and replaced with new structural fill materials. The moisture content of the compacted fill soils should be reduced so that a pumping condition does not develop.

Fill materials and native soils should be compacted to the following minimum percent compaction per ASTM D698:

<table>
<thead>
<tr>
<th>Structural fill and native soils</th>
<th>Structural fill and native soils</th>
</tr>
</thead>
<tbody>
<tr>
<td>below foundations at a depth greater than 5 feet below bottom-of-foundation</td>
<td>100%</td>
</tr>
<tr>
<td>below foundations at a depth less than 5 feet below bottom-of-foundation</td>
<td>95%</td>
</tr>
<tr>
<td>below pavement, curb and gutter</td>
<td>95%</td>
</tr>
<tr>
<td>below floor slabs, post tensioned slabs and exterior slabs</td>
<td>95%</td>
</tr>
<tr>
<td>all other fills</td>
<td>95%</td>
</tr>
</tbody>
</table>

Granular base below floor slabs | 95%
Aggregate base below pavement | 100%

7.11 Excavation Conditions

All prospective contractors and/or subcontractors should visit the site and determine the proper equipment and excavation techniques. It appears that excavations to depths anticipated for the construction area can be accomplished with standard equipment.

All excavations should be sloped or braced in accordance with the applicable state or federal regulations.

This report was not prepared for use as a bidding document.

7.12 Compliance

The recommendations of this report for design of foundations, slabs-on-grade, pavement and other site improvements that are supported on prepared subgrade or compacted fills are dependent on compliance with the earthwork recommendations of this report. To assess compliance with the recommendations, a qualified geotechnical engineer should be retained to observe the preparation of subgrade soils and the placement and compaction of fills during project earthwork.
8.0 SITE DRAINAGE & MOISTURE PROTECTION

Proper site drainage and moisture protection are important design considerations. Positive site drainage should be provided during construction and maintained thereafter. During construction, water should not be allowed to infiltrate into foundation or utility excavations.

Planter and surface features in the area of the new buildings that can retain water should be sealed or eliminated. Water accumulating in the planters should not be allowed to infiltrate below slabs, foundations or pavement.

Where sidewalks or pavement do not immediately adjoin the buildings, the ground surface should slope away from the buildings at a minimum 5% slope for at least 10 feet away from the buildings.

Roof drainage through down spouts, scuppers or off roof lines should discharge onto a protected surface or into drain lines. The water should drain freely away from the buildings with no ponding.

Landscape irrigation systems should not be constructed within 5 feet of foundations. Landscape planting within 15 feet of the structures should be restricted to native, drought resistant vegetation requiring only shallow, light watering. Landscape irrigation adjacent to foundations should be minimized or eliminated.

9.0 SLOPE RATIO FOR PERMANENT CUT OR FILL SLOPES

Permanent cut and fill slopes that will not be submerged under water should be constructed at a slope ratio of 2:1 (horizontal to vertical) or flatter. Where cut or fill slopes will be temporarily submerged under water, the slope ratio should be 4:1 (horizontal to vertical) or flatter.

The above recommendations do not apply for temporary construction excavations. These excavations should be constructed and maintained in accordance with the applicable provisions of the OSHA and State of Arizona regulations.

10.0 LIMITATIONS

The services performed for this project included analysis of the field and laboratory data and presentation of professional opinions and recommendations based, in part, on the data collected. The nature and extent of the actual site conditions may vary from those presented in this report. If such variations become evident during later phases of this project, we should be notified to review and possibly modify our conclusions and recommendations.

Our services were performed using that degree of care and skill ordinarily exercised, under similar circumstances, by reputable geotechnical engineers practicing in this or similar localities. No warranty, express or implied, is made. We prepared the report as an aid in the design of the proposed project. This report is not a bidding document. Contractors reviewing this report must draw their own conclusions regarding site conditions and specific construction techniques to be used on this project.
This report is for the exclusive purpose of providing geotechnical engineering and/or testing information and recommendations. The scope of services for this project does not include, either specifically or by implication, any biological (e.g. mold, fungi, bacteria, endangered species) or environmental assessment of the site or identification of contaminated or hazardous materials or conditions. If the owner is concerned about the potential for such contamination, other studies should be undertaken. This report does not address the propensity, or lack thereof, of mold growth within or beneath any current or future structure located on the site.

Also, our services do not include evaluation of the consequences or effects of underlying geologic hazards or regional groundwater withdrawal.

Changes to site geotechnical conditions can be influenced by nearby construction. Also, the broadening of knowledge in engineering applications affects the information and recommendations of the profession. Accordingly, this document should not be used for design or construction after a period of three years beyond the report date.
APPENDIX A
<table>
<thead>
<tr>
<th>Depth (ft)</th>
<th>Sample Type</th>
<th>Graphical Log</th>
<th>Sample</th>
<th>Blow Count</th>
<th>Dry Density (pcf)</th>
<th>Moisture (%)</th>
<th>Unified Soil Classification</th>
<th>Sample ID</th>
<th>Visual Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td></td>
<td></td>
<td>U</td>
<td>35</td>
<td>104.7</td>
<td>4.2</td>
<td>SC</td>
<td></td>
<td>medium dense</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>becomes light brown below 3 feet</td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
<td>S</td>
<td>15</td>
<td>19</td>
<td>3.6</td>
<td></td>
<td></td>
<td>dense</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td></td>
<td></td>
<td>S</td>
<td>21</td>
<td>26</td>
<td>5.8</td>
<td></td>
<td></td>
<td>very dense</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td></td>
<td></td>
<td>S</td>
<td>11</td>
<td>14</td>
<td>2.3</td>
<td></td>
<td></td>
<td>dense</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>some nonplastic silty sand at 15 feet</td>
</tr>
<tr>
<td>20</td>
<td></td>
<td></td>
<td>S</td>
<td>14</td>
<td>22</td>
<td>10.4</td>
<td></td>
<td></td>
<td>hard</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Sandy Clay, some occasional gravel, medium plasticity, weak lime cementation, brown to dark brown</td>
</tr>
</tbody>
</table>

**GROUNDWATER**

**SAMPLE TYPE**

A - Auger cuttings, NR - No Recovery
S - 2" O.D. 1.38" I.D. tube sample
U - 3" O.D. 2.42" I.D. tube sample
T - 1" O.D. thin-walled tube sample
H - Hand Auger sample
C - Concrete Core sample
**LOG OF TEST BORING NO. B2**

**JOB NO.** 11-0103  **DATE** 3/18/11

<table>
<thead>
<tr>
<th>Depth (Feet)</th>
<th>Sampler Drive Recovery (Inches)</th>
<th>Graphical Log</th>
<th>Sample</th>
<th>Sample Type</th>
<th>Blow Count</th>
<th>Dry Density (pcf)</th>
<th>Moisture (%)</th>
<th>Unified Soil Classification</th>
<th>Location</th>
<th>Visual Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>SC</td>
<td>See Site Plan</td>
<td>Clayey Sand, some gravel and small cobbles, weak lime cementation, low or medium plasticity, brown to red brown, becomes light brown below 3 feet</td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>S 8</td>
<td></td>
<td>dense</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>11</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>13</td>
<td></td>
<td></td>
<td>S 18</td>
<td></td>
<td>dense</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>16</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>some silty sand with gravel below 9 feet</td>
</tr>
<tr>
<td>15</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>17</td>
<td></td>
<td></td>
<td>U 85</td>
<td></td>
<td>dense</td>
</tr>
<tr>
<td>15</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>sample loose in rings</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>25</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>30</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**GROUNDWATER**

<table>
<thead>
<tr>
<th>Depth</th>
<th>Hour</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>30</td>
<td></td>
<td>3-18-2011</td>
</tr>
</tbody>
</table>

**SAMPLE TYPE**

- A - Auger cuttings; NR - No Recovery
- S - 2" O.D. 1.38" I.D. tube sample
- U - 3" O.D. 2.42" I.D. tube sample
- T - 1" O.D. thin-walled tube sample
- H - Hand Auger sample
- C - Concrete Core sample
# LOG OF TEST BORING NO. B3

<table>
<thead>
<tr>
<th>Depth (ft)</th>
<th>Sample ID</th>
<th>Sample Type</th>
<th>Graphical Log</th>
<th>Sample</th>
<th>Blow Count</th>
<th>Dry Density (pcf)</th>
<th>Moisture (%)</th>
<th>Unified Soil Classification</th>
<th>Visual Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>CL</td>
<td>U</td>
<td>66</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Sandy Clay, some occasional gravel, medium plasticity, weak lime cementation, brown to dark brown</td>
<td>hard</td>
</tr>
<tr>
<td>5</td>
<td>SC</td>
<td>U</td>
<td>55</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Clayey Sand, some gravel and small cobbles, weak lime cementation, low or medium plasticity, brown to red brown</td>
<td>dense, becomes light brown with decrease in plasticity below 3 feet</td>
</tr>
<tr>
<td>10</td>
<td></td>
<td>S</td>
<td>19</td>
<td>32</td>
<td>27</td>
<td></td>
<td></td>
<td>very dense</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td></td>
<td>S</td>
<td>22</td>
<td>32</td>
<td>34</td>
<td></td>
<td></td>
<td>very dense</td>
<td></td>
</tr>
<tr>
<td>20</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>25</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>30</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**GROUNDWATER**

- **A**: Auger cuttings, NR: No Recovery
- **S**: 2" O.D. 1.38" I.D. tube sample
- **U**: 3" O.D. 2.42" I.D. tube sample
- **T**: 1" O.D. thin-walled tube sample
- **H**: Hand Auger sample
- **C**: Concrete Core sample
**LOG OF TEST BORING NO. B4**

**PROJECT**  Proposed New School  
**Location**  South Houghton Road  
**Tucson, Arizona**

**JOB NO.**  11-0103  
**DATE**  3/18/11  

**LOCATION**  See Site Plan  
**RIG TYPE**  CME 75  
**BORING TYPE**  HSA  
**SURFACE ELEV.**  3117 feet  
**DATUM**  Mean Sea Level

<table>
<thead>
<tr>
<th>Depth (Feet)</th>
<th>Sample ID</th>
<th>Sample Type</th>
<th>Graphical</th>
<th>Sample Type</th>
<th>Blow Count</th>
<th>Dry Density (pcf)</th>
<th>Moisture (%)</th>
<th>Unified Soil Classification</th>
<th>Visual Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>U</td>
<td>38</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>SC</td>
<td>medium dense</td>
</tr>
<tr>
<td></td>
<td>U</td>
<td>24</td>
<td>106.5</td>
<td>5.0</td>
<td></td>
<td></td>
<td></td>
<td>medium dense</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td>S</td>
<td>18</td>
<td></td>
<td></td>
<td>very dense</td>
<td>increase in cementation at 4 feet</td>
</tr>
<tr>
<td>10</td>
<td></td>
<td></td>
<td></td>
<td>S</td>
<td>17</td>
<td></td>
<td></td>
<td>very dense</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td></td>
<td></td>
<td></td>
<td>S</td>
<td>15</td>
<td></td>
<td></td>
<td>dense</td>
<td></td>
</tr>
<tr>
<td>20</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>25</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>30</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**GROUNDWATER**

<table>
<thead>
<tr>
<th>DEPTH</th>
<th>HOUR</th>
<th>DATE</th>
</tr>
</thead>
<tbody>
<tr>
<td>30</td>
<td>None</td>
<td>3-18-2011</td>
</tr>
</tbody>
</table>

**SAMPLE TYPE**

A - Auger cuttings; NR - No Recovery  
S - 2" O.D. 1.38" I.D. tube sample  
U - 3" O.D. 2.42" I.D. tube sample  
T - 1" O.D. thin-walled tube sample  
H - Hand Auger sample  
C - Concrete Core sample
<table>
<thead>
<tr>
<th>Depth (ft)</th>
<th>Sample Code</th>
<th>Sample Type</th>
<th>Sample</th>
<th>Sorting</th>
<th>Gravel</th>
<th>Clay</th>
<th>Silt</th>
<th>Sand</th>
<th>Moisture (%)</th>
<th>Utilized Soil Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td></td>
<td></td>
<td>SC</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>S</td>
<td></td>
<td>6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>7</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>S</td>
<td></td>
<td>16</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>23</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>35</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>S</td>
<td></td>
<td>14</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>26</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>30</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>25</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>30</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**GROUNDWATER**

**SAMPLE TYPE**

- **A** - Auger cuttings; **NR** - No Recovery
- **S** - 2" O.D. 1.38" I.D. tube sample
- **U** - 3" O.D. 2.42" I.D. tube sample
- **T** - 1" O.D. thin-walled tube sample
- **H** - Hand Auger sample
- **C** - Concrete Core sample

**LOCATION**

- See Site Plan

**RIG TYPE**

- CME 75

**BORING TYPE**

- HSA

**SURFACE ELEV.**

- 3120 feet

**DATUM**

- Mean Sea Level

**VISUAL CLASSIFICATION**

- Clayey Sand, some gravel and small cobbles, weak lime cementation, low or medium plasticity, brown to red brown

- Increase in gravel at 4 feet

- Very dense

- Dense
**LOG OF TEST BORING NO. B 6**

**JOB NO.** 11-0103  **DATE** 3/17/11

<table>
<thead>
<tr>
<th>Depth (ft)</th>
<th>Sample Recovery</th>
<th>Graphical Log</th>
<th>Sample Type</th>
<th>Blow Count</th>
<th>Dry Density (pcf)</th>
<th>Moisture (%)</th>
<th>Unified Soil Classification</th>
<th>Sample ID</th>
<th>VISUAL CLASSIFICATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>SC</td>
<td>SC</td>
<td>medium dense</td>
</tr>
<tr>
<td>5</td>
<td>S 26</td>
<td></td>
<td>U 22</td>
<td>4.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>very dense</td>
</tr>
<tr>
<td>10</td>
<td>S 28 50</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>very dense</td>
</tr>
<tr>
<td>15</td>
<td>S 5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>medium dense</td>
</tr>
<tr>
<td>GROUNDWATER</td>
<td>SAMPLE TYPE</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>very dense broken</td>
</tr>
<tr>
<td>30</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>gravel in sampler at 20 feet</td>
</tr>
</tbody>
</table>

**LOCATION** See Site Plan  **RIG TYPE** CME 75  **BORING TYPE** HSA  **SURFACE ELEV.** 312.1 feet  **DATUM** Mean Sea Level

**GROUNDWATER**

<table>
<thead>
<tr>
<th>DEPTH (ft)</th>
<th>HOUR</th>
<th>DATE</th>
</tr>
</thead>
<tbody>
<tr>
<td>30</td>
<td>None</td>
<td>3-17-2011</td>
</tr>
</tbody>
</table>

- **A** - Auger cuttings; **NR** - No Recovery
- **S** - 2" O.D. 1.38" I.D. tube sample
- **U** - 3" O.D. 2.42" I.D. tube sample
- **T** - 1" O.D. thin-walled tube sample
- **H** - Hand Auger sample
- **C** - Concrete Core sample

*Page 1 of 1*
<table>
<thead>
<tr>
<th>Depth (ft)</th>
<th>Sample Type</th>
<th>Sample ID</th>
<th>Blown Count</th>
<th>Dry Density (pcf)</th>
<th>Moisture (%)</th>
<th>Unified Soil Classification</th>
<th>Visual Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>S</td>
<td>6</td>
<td>9</td>
<td>11</td>
<td>3.2</td>
<td>SC</td>
<td>Clayey Sand, some gravel and small cobbles, weak lime cementation, low or medium plasticity, brown to red brown</td>
</tr>
<tr>
<td></td>
<td></td>
<td>18</td>
<td>22</td>
<td></td>
<td></td>
<td></td>
<td>medium dense becomes light brown below 2 feet</td>
</tr>
<tr>
<td>5</td>
<td>S</td>
<td>11</td>
<td>18</td>
<td>22</td>
<td>5.8</td>
<td>dense</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>9</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>S</td>
<td>8</td>
<td>9</td>
<td>19</td>
<td>4.2</td>
<td>medium dense</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>23</td>
<td>23</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>S</td>
<td>8</td>
<td>23</td>
<td>23</td>
<td>8.0</td>
<td>dense</td>
<td>some clay at 15 feet</td>
</tr>
<tr>
<td>20</td>
<td>S</td>
<td>13</td>
<td>13</td>
<td>27</td>
<td>4.5</td>
<td>dense</td>
<td></td>
</tr>
<tr>
<td>25</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>30</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**GROUNDWATER**

**SAMPLE TYPE**

- A - Auger cuttings; NR - No Recovery
- S - 2" O.D. 1.38" I.D. tube sample
- U - 3" O.D. 2.42" I.D. tube sample
- T - 1" O.D. thin-walled tube sample
- H - Hand Auger sample
- C - Concrete Core sample
## LOG OF TEST BORING NO. B 8

**PROJECT**
Proposed New School
South Houghton Road
Tucson, Arizona

**DATE**
3/18/11

**LOCATION**
See Site Plan

**RIG TYPE**
CME 75

**BORING TYPE**
HSA

**SURFACE ELEV.**
3121 feet

**DATUM**
Mean Sea Level

### Depth Log

<table>
<thead>
<tr>
<th>Depth (Feet)</th>
<th>Sample</th>
<th>Dry Density (pcf)</th>
<th>Moisture (%)</th>
<th>Unified Soil Classification</th>
<th>Visual Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>U</td>
<td>104.5</td>
<td>3.7</td>
<td>SC</td>
<td>Clayey Sand, some gravel and small cobbles, weak lime cementation, low or medium plasticity, brown to red brown</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>medium dense</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>becomes light brown below 3 feet</td>
</tr>
<tr>
<td>5</td>
<td>S</td>
<td>27</td>
<td></td>
<td></td>
<td>very dense</td>
</tr>
<tr>
<td>10</td>
<td>S</td>
<td>11</td>
<td></td>
<td></td>
<td>dense</td>
</tr>
<tr>
<td>15</td>
<td>S</td>
<td>11</td>
<td></td>
<td></td>
<td>dense</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Sandy Clay, some occasional gravel, medium plasticity, weak lime cementation, brown to dark brown</td>
</tr>
<tr>
<td>20</td>
<td>S</td>
<td>12</td>
<td></td>
<td></td>
<td>dense</td>
</tr>
</tbody>
</table>

### Groundwater

<table>
<thead>
<tr>
<th>DEPTH (Feet)</th>
<th>SAMPLE TYPE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A - Auger cuttings; NR - No Recovery</td>
</tr>
<tr>
<td></td>
<td>S - 2&quot; O.D. 1.38&quot; I.D. tube sample</td>
</tr>
<tr>
<td></td>
<td>U - 3&quot; O.D. 2.42&quot; I.D. tube sample</td>
</tr>
<tr>
<td></td>
<td>T - 1&quot; O.D. thin-walled tube sample</td>
</tr>
<tr>
<td></td>
<td>H - Hand Auger sample</td>
</tr>
<tr>
<td></td>
<td>C - Concrete Core sample</td>
</tr>
</tbody>
</table>

**Sample ID**

**Visual Classification**

**Sample Type**

**Date**
3-18-2011
**LOG OF TEST BORING NO. B 9**

**PROJECT**

Proposed New School
South Houghton Road
Tucson, Arizona

**JOB NO.** 11-0103  **DATE** 3/17/11

**LOCATION**

See Site Plan

**RIG TYPE**

CME 75

**BORING TYPE**

HSA

**SURFACE ELEV.** 3123 feet

**DATUM** Mean Sea Level

<table>
<thead>
<tr>
<th>Depth (ft)</th>
<th>Sample ID</th>
<th>Graphical Log</th>
<th>Sample Type</th>
<th>Sample</th>
<th>Sample Type</th>
<th>Blown Count</th>
<th>Dry Density (pcf)</th>
<th>Moisture (%)</th>
<th>Unified Soil Classification</th>
<th>Visual Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>U</td>
<td></td>
<td></td>
<td>16</td>
<td>111.4</td>
<td>2.7</td>
<td></td>
<td></td>
<td>SC</td>
<td>loose</td>
</tr>
<tr>
<td>5</td>
<td>S</td>
<td></td>
<td></td>
<td>19</td>
<td>23</td>
<td>7.5</td>
<td></td>
<td></td>
<td></td>
<td>dense</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>becomes light brown below 4 feet with increase in gravel</td>
</tr>
<tr>
<td>10</td>
<td>S</td>
<td></td>
<td></td>
<td>11</td>
<td>9</td>
<td>4.3</td>
<td></td>
<td></td>
<td>medium dense</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>easier drilling below 8 feet</td>
</tr>
<tr>
<td>15</td>
<td>S</td>
<td></td>
<td></td>
<td>24</td>
<td>27</td>
<td>5.9</td>
<td></td>
<td></td>
<td>very dense</td>
<td></td>
</tr>
<tr>
<td>20</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>25</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>30</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**GROUNDWATER**

**DEPT** | **HOUR** | **DATE** |
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td></td>
<td>3-17-2011</td>
</tr>
</tbody>
</table>

**SAMPLE TYPE**

A - Auger cuttings, NR - No Recovery
S - 2" O.D. 1.38" I.D. tube sample
U - 3" O.D. 2.42" I.D. tub sample
T - 1" O.D. thin-walled tube sample
H - Hand Auger sample
C - Concrete Core sample

Page 1 of 1
<table>
<thead>
<tr>
<th>Depth (ft)</th>
<th>Sampler Drive (ft/rev)</th>
<th>Graphical Log</th>
<th>Sample Type</th>
<th>Blow Count</th>
<th>Dry Density (pcf)</th>
<th>Moisture (%)</th>
<th>Unified Soil Classification</th>
<th>Visual Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>SC</td>
<td>Clayey Sand, some gravel and small cobbles, weak lime cementation, low or medium plasticity, brown to red brown</td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
<td>U</td>
<td>17</td>
<td></td>
<td></td>
<td></td>
<td>loose</td>
</tr>
<tr>
<td>10</td>
<td></td>
<td></td>
<td>S</td>
<td>18</td>
<td></td>
<td></td>
<td></td>
<td>dense</td>
</tr>
<tr>
<td>15</td>
<td></td>
<td></td>
<td>S</td>
<td>20</td>
<td></td>
<td></td>
<td></td>
<td>very dense</td>
</tr>
<tr>
<td>15</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>broken gravel in sampler at 15 feet</td>
</tr>
<tr>
<td>20</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>25</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>30</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GROUNDWATER</td>
<td>SAMPLE TYPE</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3-17-2011</td>
<td>None</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>A - Auger cuttings; NR - No Recovery</td>
</tr>
</tbody>
</table>

- **A**: Auger cuttings
- **NR**: No Recovery
- **S**: 2" O.D. 1.38" I.D. tube sample
- **U**: 3" O.D. 2.42" I.D. tube sample
- **T**: 1" O.D. thin-walled tube sample
- **H**: Hand Auger sample
- **C**: Concrete Core sample
<table>
<thead>
<tr>
<th>Depth (Feet)</th>
<th>Sample ID</th>
<th>Graphical Log</th>
<th>Sample Type</th>
<th>Blow Count</th>
<th>Dry Density (pcf)</th>
<th>Moisture (%)</th>
<th>Unified Soil Classification</th>
<th>Visual Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>SC</td>
<td></td>
<td>U 51</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Clayey Sand, some gravel and small cobbles, weak lime cementation, low or medium plasticity, brown to red brown</td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
<td>S 8 15 16</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>medium dense</td>
</tr>
<tr>
<td>10</td>
<td></td>
<td></td>
<td>S 17 25 49</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>increase in gravel from 7 to 13 feet</td>
</tr>
<tr>
<td>15</td>
<td></td>
<td></td>
<td>S 35 51</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>very dense</td>
</tr>
</tbody>
</table>

**GROUNDWATER**

**SAMPLE TYPE**

A - Auger cuttings; NR - No Recovery
S - 2" O.D. 1.38" I.D. tube sample
U - 3" O.D. 2.42" I.D. tube sample
T - 1" O.D. thin-walled tube sample
H - Hand Auger sample
C - Concrete Core sample
**LOG OF TEST BORING NO. B 12**

**PROJECT**
Proposed New School South Houghton Road
Tucson, Arizona

**DATE**
3/17/11

**LOCATION**
See Site Plan

**RIG TYPE**
CME 75

**BORING TYPE**
HSA

**SURFACE ELEV.**
3114 feet

**DATUM**
Mean Sea Level

<table>
<thead>
<tr>
<th>Depth (ft)</th>
<th>Sample Type</th>
<th>Sample ID</th>
<th>Blow Count</th>
<th>Dry Density (pcf)</th>
<th>Moisture (%)</th>
<th>Unified Soil Classification</th>
<th>Visual Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>SC</td>
<td>U 19</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>medium dense</td>
</tr>
<tr>
<td>5</td>
<td></td>
<td>S 30</td>
<td>50/4*</td>
<td></td>
<td></td>
<td></td>
<td>very dense</td>
</tr>
<tr>
<td>10</td>
<td></td>
<td>S 41</td>
<td>52</td>
<td></td>
<td></td>
<td></td>
<td>very dense</td>
</tr>
<tr>
<td>15</td>
<td></td>
<td>S 26</td>
<td>51</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>25</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>30</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**GROUNDWATER**

<table>
<thead>
<tr>
<th>Depth (ft)</th>
<th>Sample Type</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>30</td>
<td>None</td>
<td>3-17-2011</td>
</tr>
</tbody>
</table>

**SAMPLE TYPE**
- A - Auger cuttings; NR - No Recovery
- S - 2" O.D. 1.38" I.D. tube sample
- U - 3" O.D. 2.42" I.D. tube sample
- T - 1" O.D. thin-walled tube sample
- H - Hand Auger sample
- C - Concrete Core sample
UNIFIED CLASSIFICATION SYSTEM FOR SOILS

Soils are visually classified by the Unified Soil Classification System on the boring logs presented in this report. Grain-size analysis and Atterberg Limits Tests are often performed on selected samples to aid in classification. The classification system is briefly outlined on this chart. For a more detailed description of the system, see "The Unified Soil Classification System" ASTM Designation: D2487.

<table>
<thead>
<tr>
<th>MAJOR DIVISION</th>
<th>TYPICAL DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>CLEAN GRAVELS (Less than 5% passes No. 200 sieve)</td>
<td>Well graded gravels, gravel-sand mixtures or sand-gravel-cobble mixtures.</td>
</tr>
<tr>
<td>GRAVELS WITH FINES (More than 12% passes No. 200 sieve)</td>
<td>Poorly graded gravels, gravel-sand mixtures, or sand-gravel-cobble mixtures.</td>
</tr>
<tr>
<td>CLEAN SANDS (Less than 5% passes No. 200 sieve)</td>
<td>Silty gravels, gravel-sand-silt mixtures.</td>
</tr>
<tr>
<td>SANDS WITH FINES (More than 12% passes No. 200 sieve)</td>
<td>Clayey gravels, gravel-sand-clay mixtures.</td>
</tr>
<tr>
<td>SILTS OF LOW PLASTICITY (Liquid Limit Less Than 50)</td>
<td>Well graded sands, gravelly sands.</td>
</tr>
<tr>
<td>SILTS OF HIGH PLASTICITY (Liquid Limit More Than 50)</td>
<td>Poorly graded sands, gravelly sands.</td>
</tr>
<tr>
<td>CLAYS OF LOW PLASTICITY (Liquid Limit Less Than 50)</td>
<td>Silty sands, sand-silt mixtures.</td>
</tr>
<tr>
<td>CLAYS OF HIGH PLASTICITY (Liquid Limit More Than 50)</td>
<td>Clayey sands, sand-clay mixtures.</td>
</tr>
</tbody>
</table>

NOTE: Coarse-grained soils with between 5% & 12% passing the No. 200 sieve and fine-grained soils with limits plotting in the hatched zone on the plasticity chart to have dual symbol.

DEFINITIONS OF SOIL FRACTIONS

<table>
<thead>
<tr>
<th>SOIL COMPONENT</th>
<th>PARTICLE SIZE RANGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boulders</td>
<td>Above 300mm (12in.)</td>
</tr>
<tr>
<td>Cobbles</td>
<td>300mm to 75mm (12in. to 3in.)</td>
</tr>
<tr>
<td>Gravel</td>
<td>75mm (3in.) to No. 4 sieve</td>
</tr>
<tr>
<td>Coarse gravel</td>
<td>75mm to 15mm (3in. to 3/4in.)</td>
</tr>
<tr>
<td>Fine gravel</td>
<td>19mm (3/4in.) to No. 4 sieve</td>
</tr>
<tr>
<td>Sand</td>
<td>No. 4 to No. 80</td>
</tr>
<tr>
<td>Coarse</td>
<td>No. 80 to No. 200</td>
</tr>
<tr>
<td>Medium</td>
<td>No. 200 to No. 600</td>
</tr>
<tr>
<td>Fine</td>
<td>Below No. 200 sieve</td>
</tr>
</tbody>
</table>

Conformatech
**Terminology Used on Boring Logs to Describe the Relative Density or Relative Consistency of Soils**

The terminology used on the boring logs to describe the relative density or relative consistency of soils relative to the standard penetration resistance is presented below. The standard penetration resistance (N value) in blows per foot is determined according to the ASTM D 1586 test method using 2 inch outside diameter (1 3/8 inch inside diameter) soil sampling tools.

1. Terms describing the relative density of coarse grained sand and gravel soils

<table>
<thead>
<tr>
<th>N</th>
<th>Relative Density</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 - 4</td>
<td>Very Loose</td>
</tr>
<tr>
<td>5 - 10</td>
<td>Loose</td>
</tr>
<tr>
<td>11 - 30</td>
<td>Medium Dense</td>
</tr>
<tr>
<td>31 - 50</td>
<td>Dense</td>
</tr>
<tr>
<td>&gt;50</td>
<td>Very Dense</td>
</tr>
</tbody>
</table>

2. Terms describing the relative consistency of fine grained clay and silt soils

<table>
<thead>
<tr>
<th>N</th>
<th>Relative Consistency</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 - 2</td>
<td>Very soft</td>
</tr>
<tr>
<td>3 - 4</td>
<td>Soft</td>
</tr>
<tr>
<td>5 - 8</td>
<td>Medium Stiff</td>
</tr>
<tr>
<td>9 - 15</td>
<td>Stiff</td>
</tr>
<tr>
<td>16 - 30</td>
<td>Very Stiff</td>
</tr>
<tr>
<td>&gt;30</td>
<td>Hard</td>
</tr>
</tbody>
</table>
Test Drilling Equipment & Procedures

Description of Subsurface Exploration Methods

Auger Boring  Drilling through overburden soils is performed with 7" O.D., 3.25" I.D. hollow stem auger or 4.5" solid stem continuous flight auger. Carbide insert teeth are normally used on bits so they can penetrate soft rock or very strongly cemented soils. Generally, a CME-55 or CME-75 truck-mounted drill rig is used to advance the auger. Refusal to drilling indicates the auger was unable to penetrate the materials. Further drilling would require extraordinary methods. Grab samples or auger cuttings may be taken as necessary. Standard penetration tests or 2.42" diameter ring samples are taken in conjunction with the auger borings as needed, with the sampling interval and type being indicated on the boring logs.

Sampling Procedures  Dynamically driven tube samples are usually obtained at selected intervals in the borings by the ASTM D 1586 test procedure. In many cases, 2" O.D., 1 3/8" I.D. samplers are used to obtain the standard penetration resistance. "Undisturbed" samples of firmer soils are often obtained with 3" O.D. samplers lined with 2.42" I.D. brass rings. The driving energy is generally recorded as the number of blows of a 140-pound, 30-inch free fall drop hammer required to advance the samplers in 6-inch increments. These values are expressed in blows per 6 inches or per 12 inches on the boring logs. "Undisturbed" sampling of softer soils is sometimes performed with thin walled Shelby tubes (ASTM D1587), pitcher samplers, Denison samplers or continuous CME samplers. Where samples of rock are required, they are obtained by NQ diamond core drilling (ASTM D2113). When necessary for testing, larger bulk samples are taken from auger cuttings.

Boring Records  Drilling operations are directed by our field person who examines soil recovery and prepares the boring logs. Soils are visually classified in accordance with the Unified Soil Classification System (ASTM D2487).
APPENDIX B
### MECHANICAL ANALYSIS

<table>
<thead>
<tr>
<th>SIEVE SIZE</th>
<th>% PASSING</th>
</tr>
</thead>
<tbody>
<tr>
<td>6 in / 152mm</td>
<td>100</td>
</tr>
<tr>
<td>4 in / 100mm</td>
<td>100</td>
</tr>
<tr>
<td>3 in / 75mm</td>
<td>100</td>
</tr>
<tr>
<td>2 in / 50mm</td>
<td>100</td>
</tr>
<tr>
<td>1 1/2 in / 37.5mm</td>
<td>100</td>
</tr>
<tr>
<td>1 1/4 in / 32 mm</td>
<td>100</td>
</tr>
<tr>
<td>1 in / 25 mm</td>
<td>100</td>
</tr>
<tr>
<td>3/4 in / 19 mm</td>
<td>100</td>
</tr>
<tr>
<td>1/2 in / 12.5 mm</td>
<td>99</td>
</tr>
<tr>
<td>3/8 in / 9.5 mm</td>
<td>98</td>
</tr>
<tr>
<td>1/4 in / 6.4 mm</td>
<td>97</td>
</tr>
<tr>
<td>#4, 4.75mm</td>
<td>96</td>
</tr>
<tr>
<td>#8, 2.36mm</td>
<td>91</td>
</tr>
<tr>
<td>#10, 2.00mm</td>
<td>90</td>
</tr>
<tr>
<td>#16, 1.18mm</td>
<td>84</td>
</tr>
<tr>
<td>#30, 0.80mm</td>
<td>76</td>
</tr>
<tr>
<td>#40, 0.425mm</td>
<td>72</td>
</tr>
<tr>
<td>#50, 0.300mm</td>
<td>67</td>
</tr>
<tr>
<td>#100, 0.150mm</td>
<td>59</td>
</tr>
<tr>
<td>#200, .075mm</td>
<td>50.9</td>
</tr>
</tbody>
</table>

- Liquid Limit (LL): 35
- Plasticity Index (PI): 19
- USCS Soil Classification: CL
### SIEVE ANALYSIS OF FINE AND COARSE AGGREGATES (ASTM C136/C117)

#### MECHANICAL ANALYSIS

<table>
<thead>
<tr>
<th>SIEVE SIZE</th>
<th>% PASSING</th>
</tr>
</thead>
<tbody>
<tr>
<td>6 in / 152mm</td>
<td>100</td>
</tr>
<tr>
<td>4 in / 100mm</td>
<td>100</td>
</tr>
<tr>
<td>3 in / 75mm</td>
<td>100</td>
</tr>
<tr>
<td>2 in / 50mm</td>
<td>100</td>
</tr>
<tr>
<td>1 1/2 in / 37.5mm</td>
<td>100</td>
</tr>
<tr>
<td>1 1/4 in / 32 mm</td>
<td>100</td>
</tr>
<tr>
<td>1 in / 25 mm</td>
<td>100</td>
</tr>
<tr>
<td>3/4 in / 19 mm</td>
<td>97</td>
</tr>
<tr>
<td>1/2 in / 12.5 mm</td>
<td>92</td>
</tr>
<tr>
<td>3/8 in / 9.5 mm</td>
<td>88</td>
</tr>
<tr>
<td>1/4 in / 6.4 mm</td>
<td>83</td>
</tr>
<tr>
<td>#4, 4.75mm</td>
<td>80</td>
</tr>
<tr>
<td>#8, 2.38mm</td>
<td>70</td>
</tr>
<tr>
<td>#10, 2.00mm</td>
<td>68</td>
</tr>
<tr>
<td>#16, 1.18mm</td>
<td>60</td>
</tr>
<tr>
<td>#30, 0.60mm</td>
<td>52</td>
</tr>
<tr>
<td>#40, .425mm</td>
<td>49</td>
</tr>
<tr>
<td>#50, .300mm</td>
<td>45</td>
</tr>
<tr>
<td>#100, .150mm</td>
<td>37</td>
</tr>
<tr>
<td>#200, .075mm</td>
<td>28.3</td>
</tr>
</tbody>
</table>

Liquid Limit (LL)  32  
Plasticity Index (PI)  19  
USCS Soil Classification  SC
### SIEVE ANALYSIS OF FINE AND COARSE AGGREGATES (ASTM C136/C117)

#### MECHANICAL ANALYSIS

<table>
<thead>
<tr>
<th>Sieve Size</th>
<th>% Passing</th>
</tr>
</thead>
<tbody>
<tr>
<td>6 in / 152mm</td>
<td>100</td>
</tr>
<tr>
<td>4 in / 100mm</td>
<td>100</td>
</tr>
<tr>
<td>3 in / 76mm</td>
<td>100</td>
</tr>
<tr>
<td>2 in / 50mm</td>
<td>100</td>
</tr>
<tr>
<td>1 1/2 in / 37.5mm</td>
<td>100</td>
</tr>
<tr>
<td>1 1/4 in / 32 mm</td>
<td>100</td>
</tr>
<tr>
<td>1 in / 25 mm</td>
<td>98</td>
</tr>
<tr>
<td>3/4 in / 19 mm</td>
<td>98</td>
</tr>
<tr>
<td>1/2 in / 12.5 mm</td>
<td>96</td>
</tr>
<tr>
<td>3/8 in / 9.5 mm</td>
<td>93</td>
</tr>
<tr>
<td>1/4 in / 6.4 mm</td>
<td>86</td>
</tr>
<tr>
<td>#4, 4.75mm</td>
<td>82</td>
</tr>
<tr>
<td>#8, 2.36mm</td>
<td>70</td>
</tr>
<tr>
<td>#10, 2.00mm</td>
<td>67</td>
</tr>
<tr>
<td>#16, 1.18mm</td>
<td>57</td>
</tr>
<tr>
<td>#30, 0.60mm</td>
<td>49</td>
</tr>
<tr>
<td>#40, .425mm</td>
<td>44</td>
</tr>
<tr>
<td>#50, .300mm</td>
<td>39</td>
</tr>
<tr>
<td>#100, .150mm</td>
<td>30</td>
</tr>
<tr>
<td>#200, .075mm</td>
<td>20.9</td>
</tr>
</tbody>
</table>

- Liquid Limit (LL) = 26
- Plasticity Index (PI) = 11
- USCS Soil Classification = SC
STANDARD EFFORTS (12,400ft-lb/ft/cu.ft) (ASTM D698A)
SIEVE ANALYSIS OF FINE AND COARSE AGGREGATES (ASTM C136/C117)

Maximum dry density: 110.1pcf
Optimum moisture: 15.5%

<table>
<thead>
<tr>
<th>SIEVE SIZE</th>
<th>PERCENT PASSING</th>
</tr>
</thead>
<tbody>
<tr>
<td>6 in / 152mm</td>
<td>100</td>
</tr>
<tr>
<td>4 in / 100mm</td>
<td>100</td>
</tr>
<tr>
<td>3 in / 75mm</td>
<td>100</td>
</tr>
<tr>
<td>2 in / 50mm</td>
<td>100</td>
</tr>
<tr>
<td>1 1/2 in / 37.5mm</td>
<td>100</td>
</tr>
<tr>
<td>1 1/4 in / 32 mm</td>
<td>100</td>
</tr>
<tr>
<td>1 in / 25 mm</td>
<td>99</td>
</tr>
<tr>
<td>3/4 in / 19 mm</td>
<td>96</td>
</tr>
<tr>
<td>1/2 in / 12.5 mm</td>
<td>94</td>
</tr>
<tr>
<td>3/8 in / 9.5 mm</td>
<td>91</td>
</tr>
<tr>
<td>1/4 in / 6.4 mm</td>
<td>88</td>
</tr>
<tr>
<td>#4, 4.75mm</td>
<td>86</td>
</tr>
<tr>
<td>#8, 2.36mm</td>
<td>76</td>
</tr>
<tr>
<td>#10, 2.00mm</td>
<td>73</td>
</tr>
<tr>
<td>#16, 1.18mm</td>
<td>64</td>
</tr>
<tr>
<td>#30, 0.60mm</td>
<td>56</td>
</tr>
<tr>
<td>#40, 0.425mm</td>
<td>52</td>
</tr>
<tr>
<td>#50, 0.300mm</td>
<td>46</td>
</tr>
<tr>
<td>#100, .150mm</td>
<td>39</td>
</tr>
<tr>
<td>#200, .075mm</td>
<td>30.8</td>
</tr>
</tbody>
</table>

LL: 38
PI: 20

USCS: SC
## SIEVE ANALYSIS OF FINE AND COARSE AGGREGATES (ASTM C136/C117)

### MECHANICAL ANALYSIS

<table>
<thead>
<tr>
<th>SIEVE SIZE</th>
<th>% PASSING</th>
</tr>
</thead>
<tbody>
<tr>
<td>6 in / 152mm</td>
<td>100</td>
</tr>
<tr>
<td>4 in / 100mm</td>
<td>100</td>
</tr>
<tr>
<td>3 in / 75mm</td>
<td>100</td>
</tr>
<tr>
<td>2 in / 50mm</td>
<td>100</td>
</tr>
<tr>
<td>1 1/2 in / 37.5mm</td>
<td>100</td>
</tr>
<tr>
<td>1 1/4 in / 32 mm</td>
<td>100</td>
</tr>
<tr>
<td>1 in / 25 mm</td>
<td>100</td>
</tr>
<tr>
<td>3/4 in / 19 mm</td>
<td>100</td>
</tr>
<tr>
<td>1/2 in / 12.5 mm</td>
<td>99</td>
</tr>
<tr>
<td>3/8 in / 9.5 mm</td>
<td>98</td>
</tr>
<tr>
<td>1/4 in / 6.4 mm</td>
<td>95</td>
</tr>
<tr>
<td>#4, 4.75mm</td>
<td>92</td>
</tr>
<tr>
<td>#8, 2.36mm</td>
<td>82</td>
</tr>
<tr>
<td>#10, 2.00mm</td>
<td>80</td>
</tr>
<tr>
<td>#16, 1.18mm</td>
<td>71</td>
</tr>
<tr>
<td>#30, 0.60mm</td>
<td>65</td>
</tr>
<tr>
<td>#40, .425mm</td>
<td>62</td>
</tr>
<tr>
<td>#50, .300mm</td>
<td>56</td>
</tr>
<tr>
<td>#100, .150mm</td>
<td>47</td>
</tr>
<tr>
<td>#200, .075mm</td>
<td>44.2</td>
</tr>
</tbody>
</table>

Liquid Limit (LL) 34
Plasticity Index (PI) 18
USCS Soil Classification SC
## SIEVE ANALYSIS OF FINE AND COARSE AGGREGATES (ASTM C136/C117)

### MECHANICAL ANALYSIS

<table>
<thead>
<tr>
<th>SIEVE SIZE</th>
<th>% PASSING</th>
</tr>
</thead>
<tbody>
<tr>
<td>6 in / 152mm</td>
<td>100</td>
</tr>
<tr>
<td>4 in / 100mm</td>
<td>100</td>
</tr>
<tr>
<td>3 in / 75mm</td>
<td>100</td>
</tr>
<tr>
<td>2 in / 50mm</td>
<td>100</td>
</tr>
<tr>
<td>1 1/2 in / 37.5mm</td>
<td>100</td>
</tr>
<tr>
<td>1 1/4 in / 32 mm</td>
<td>100</td>
</tr>
<tr>
<td>1 in / 25 mm</td>
<td>99</td>
</tr>
<tr>
<td>3/4 in / 19 mm</td>
<td>98</td>
</tr>
<tr>
<td>1/2 in / 12.5 mm</td>
<td>96</td>
</tr>
<tr>
<td>3/8 in / 9.5 mm</td>
<td>93</td>
</tr>
<tr>
<td>1/4 in / 6.4 mm</td>
<td>90</td>
</tr>
<tr>
<td>#8, 4.75mm</td>
<td>88</td>
</tr>
<tr>
<td>#10, 2.00mm</td>
<td>80</td>
</tr>
<tr>
<td>#16, 1.18mm</td>
<td>78</td>
</tr>
<tr>
<td>#30, 0.80mm</td>
<td>71</td>
</tr>
<tr>
<td>#40, 0.425mm</td>
<td>94</td>
</tr>
<tr>
<td>#50, 0.300mm</td>
<td>59</td>
</tr>
<tr>
<td>#100, 0.150mm</td>
<td>54</td>
</tr>
<tr>
<td>#200, 0.075mm</td>
<td>46.7</td>
</tr>
</tbody>
</table>

- Liquid Limit (LL): 25
- Plasticity Index (PI): 9
- USCS Soil Classification: SC
### SIEVE ANALYSIS OF FINE AND COARSE AGGREGATES (ASTM C136/C117)

#### MECHANICAL ANALYSIS

<table>
<thead>
<tr>
<th>SIEVE SIZE</th>
<th>% PASSING</th>
</tr>
</thead>
<tbody>
<tr>
<td>6 in / 152mm</td>
<td>100</td>
</tr>
<tr>
<td>4 in / 100mm</td>
<td>100</td>
</tr>
<tr>
<td>3 in / 75mm</td>
<td>100</td>
</tr>
<tr>
<td>2 in / 50mm</td>
<td>100</td>
</tr>
<tr>
<td>1 1/2 in / 37.5mm</td>
<td>100</td>
</tr>
<tr>
<td>1 1/4 in / 32 mm</td>
<td>100</td>
</tr>
<tr>
<td>1 in / 25 mm</td>
<td>100</td>
</tr>
<tr>
<td>3/4 in / 19 mm</td>
<td>96</td>
</tr>
<tr>
<td>1/2 in / 12.5 mm</td>
<td>90</td>
</tr>
<tr>
<td>3/8 in / 9.5 mm</td>
<td>89</td>
</tr>
<tr>
<td>1/4 in / 6.4 mm</td>
<td>86</td>
</tr>
<tr>
<td>#4, 4.75mm</td>
<td>83</td>
</tr>
<tr>
<td>#8, 2.36mm</td>
<td>75</td>
</tr>
<tr>
<td>#10, 2.00mm</td>
<td>74</td>
</tr>
<tr>
<td>#16, 1.18mm</td>
<td>67</td>
</tr>
<tr>
<td>#30, 0.60mm</td>
<td>61</td>
</tr>
<tr>
<td>#40, 0.425mm</td>
<td>58</td>
</tr>
<tr>
<td>#50, 0.300mm</td>
<td>50</td>
</tr>
<tr>
<td>#100, 0.150mm</td>
<td>50</td>
</tr>
<tr>
<td>#200, 0.075mm</td>
<td>43.2</td>
</tr>
</tbody>
</table>

Liquid Limit (LL) 34  
Plasticity Index (PI) 16  
USCS Soil Classification SC
Project: Proposed High School
Location: Tucson, Arizona
Job No.: 11-0103
Sample: Boring 11 at 1 foot

In-situ Dry Density: 105.9pcf
In-situ Moisture: 7.7%
Project: Proposed High School
Location: Tucson, Arizona
Job No.: 11-0103
Sample: Boring 4 at 3 feet

Insitu Dry Density: 106.5 pcf
Insitu Moisture: 5.0%

Curve Explanation:
- In-situ
- Saturated
Project: Proposed High School
Location: Tucson, Arizona
Job No.: 11-0103
Sample: Boring 8 at 2 feet

Insitu Dry Density: 104.5 pcf
Insitu Moisture: 3.7 %

**Diagram:**

- **X-axis:** Vertical Load (ksf)
- **Y-axis:** Percent (+)Swell/(-)Consolidation

**Curve Explanation:**
- In-situ
- Saturated
EXPANSION (SWELL) TEST

Remolded Dry Density 104.6 pcf
Remolded Moisture Content 12.5 %
Swell (% Initial Height) 3.3

Swell test of sample remolded to approximately 95% of maximum ASTM D698 density at approximately 3% below optimum moisture. Sample confined under a 100 psf surcharge pressure and submerged in water.
LABORATORY TESTING PROCEDURES

Consolidation Tests  Testing apparatus of the "floating-ring" type are employed for the one-dimensional consolidation tests. They are designed to receive one inch high 2.5 inch O.D. brass liner rings with soil specimens as secured in the field. Procedures for the tests generally are those outlined in ASTM D2435. Loads are applied in several increments to the upper surface of the test specimen and the resulting deformations are recorded. Generally, the applied loads are such that each new increment is equal to the total previously applied loading. Porous stones are placed in contact with the top and bottom of the specimens to permit the free addition or expulsion of water. For partially saturated soils, the tests are normally performed at in situ moisture conditions until consolidation is complete under the applied stresses. The samples are then submerged to show the effect of moisture increase and the test is continued to the final stress level.

Expansion Tests  The same type of consolidometer apparatus described above is used in expansion testing. Samples contained in brass liner rings are placed in the consolidometers, subjected to appropriate surcharge loads and submerged. The loads are maintained until the test indicates the completion of "primary swell".
312150 – EXCAVATION, FILLING, AND BACKFILLING

1. GENERAL:

A. Description of Work:

(1) Work as evident on drawings and specified herein or required by the Geotechnical Report to accomplish the excavation, filling and backfilling, and all operations pertaining thereto for buildings, complete.

(2) The Geotechnical Report by Terracon Consultants, Inc., Report #63185108, dated January 10, 2019 included after section 311000 of the Specifications, is the governing requirement for all earthwork associated with the site.

   a. Borings and subsurface data indicated in the Geotechnical Report shall be general information only and variation therefrom shall not affect the terms of the contract.

B. Work Excluded

(1) Site excavation and backfilling for plumbing, heating and electrical work beyond 5 feet from the building is included in Section 312210, Trenching and Backfilling.

C. Inspections and Tests

(1) Inspections and Tests: The Geotechnical Engineer of record shall inspect, and test the preparation of excavations, filling, stripping of existing fill, compaction, and soil materials as described in ‘Excavation, Soil Materials and Placing And Compaction’ herein. A letter of compliance, together with copies of inspection reports and test reports, stating conformance to the Geotechnical Engineering Evaluation and Specifications shall be submitted to the Architect/Engineer in triplicate for approval.

(2) The Owner shall pay all testing agency charges for these services. Costs of any re-testing required due to improper compaction shall be accomplished by the same laboratory of record and shall be paid for by the Contractor.

2. PRODUCTS

A. Soil Materials

(1) Fill material shall consist of suitable material removed from
excavated areas and imported borrow material as required. Fill materials shall be free of roots and other organic materials, trash, frozen material, and particles having a dimension greater than 6". Imported fill shall be compatible with approved on site materials. Materials shall be in conformance with the referenced Geotechnical Report.

(2) Base course shall conform to the referenced Geotechnical Report.

3. EXECUTION

A. Excavation

(1) Perform all excavations as indicated on the drawings or as required for a complete installation. All foundations shall bear on materials and at minimum depths as indicated in the Geotechnical Report.

(2) The subgrade within the building pad shall be prepared as indicated in the Geotechnical Report.

(3) Bottom of all excavations shall be level and true. If by error, portions of the excavations are extended too deep, only concrete will be permitted for refill material. No compensation will be allowed for such material.

(4) All foundation excavations shall be reviewed and accepted by the Geotechnical Engineer/Representative before foundation reinforcing and concrete is placed. Architect shall be given at least 24 hours notice before any concrete is placed.

(5) Where suitable supporting soils are encountered at different elevations than those indicated, the Architect and Geotechnical Engineer may direct in writing that the excavations be carried to elevations above or below those indicated. An extra or credit, as the case may warrant, shall be based on a unit price for such excavation and concrete work.

(6) Grading in vicinity of structure shall be controlled to prevent surface water from running into excavated areas or across the building pad. The Contractor shall provide and maintain at all times during construction ample means and devices with which to promptly remove and properly dispose of all water entering the excavation or other parts of the work. If water enters excavations after having been completed to establish bearing levels, additional excavation may be required to a depth exposing dry, firm bearing soils as determined by the Geotechnical Engineer. The excavation shall be filled to original bearing levels with concrete as specified unless
otherwise approved by the Geotechnical Engineer. No foundations or floors shall be constructed on disturbed soils or in water.

(7) Where necessary, excavations shall be properly sheeted and braced to furnish safe and acceptable working conditions. The bracing shall be so arranged as not to place any stress on portions of the completed work, without special written approval of the Architect.

(8) All excess materials from excavations shall be disposed of by the Contractor off the building site.

B. Placing and Compaction

(1) Each lift shall be uniformly compacted to not less than the percentage of the maximum density specified below before another lift is placed. Minimum compaction requirements are indicated in the referenced Geotechnical Report.

(2) Where backfill is required on both sides of construction, keep backfill at approximately the same elevation on both sides.

(3) Backfill around all building foundation walls and footings shall be placed and compacted at near optimum moisture content, but shall not be saturated or at a moisture content that results in pumping. In no case shall backfill be water-settled. Non-structural concrete is acceptable for use as back fill (see Section 033000).

(4) Grade to finished elevations as shown on Drawings, or as necessary to provide positive drainage away from the building as approved by Architect. Finish grading within 20 feet of building shall be hand-raked for "fine" finish. Contractor shall coordinate and verify elevations required in landscaped areas, paving, etc.

C. Base Course

(1) Under all interior concrete floors on grade and under all exterior concrete slabs on grade, place a minimum 4 inch thick layer of base course. This material shall not be placed until all work of other trades which passes through or under this work has been properly placed and approved and not until foundations are completed and surface receiving this material is finished as specified. Base course shall be compacted in accordance with the referenced Geotechnical Report.

END OF SECTION
312210 – TRENCHING AND BACKFILLING

1. GENERAL:

   A. Related Documents:

      (1) Drawings and general provisions of Contract, including General
          and Supplementary Conditions and Division 1 Specifications
          sections, apply to work in this section.

   B. Description of Work:

      (1) Work as evident on drawings and specified herein or required to
          accomplish the designated excavation, trenching and backfilling for
          site utilities systems, to the points of connection with the building
          utilities 5 feet outside the building.

2. PRODUCTS:

   A. Fill Material:

      (1) See Section 311000 Earthwork.

3. EXECUTION:

   A. Excavation:

      (1) General: All excavation of every description of whatever
          substances encountered shall be performed to the depths indicated
          or as otherwise specified. During excavation, material suitable for
          backfilling shall be piled in an orderly manner a sufficient distance
          from the banks of the trench to avoid overloading and to prevent
          slides or cave-ins. All excavated materials not required or suitable
          for backfill shall be removed and wasted as indicated or as
          directed. Grading shall be done as may be necessary to prevent
          surface water from flowing into trenches or other excavations, and
          any water accumulating therein shall be removed by pumping or by
          other approved methods. All trenching must be shored and/or
          otherwise protected as required to meet all local and OSHA Safety
          Standards.

      (2) Trench Excavation: Trenches shall be of the necessary width for
          proper laying of pipe. The banks of pipe trenches shall be as
          nearly vertical as practicable. Care shall be taken not to over-
          excavate. The bottom of the trenches shall be accurately graded.
          Clean coarse sand, well graded gravel or well graded crushed rock
must be used as trench bedding. The trench must be filled with this material to the springline of the pipe, placed in 6" maximum lifts and compacted to 95% maximum density - ASTM D-1557. The remainder of the trench shall be backfilled with specific backfill material. The width of the trench at and below the top of the pipe shall be such that the clear space between the barrel of the pipe and the trench wall shall not exceed 8 inches on either side of the pipe. The width of the trench above that level shall be as wide as necessary for sheeting and bracing and the proper performance of the work.

B. Removal of Utility Lines:

(1) When utility lines that are to be removed are encountered within the area of operations, the Contracting Officer's Representative shall be notified in ample time for the necessary measures to be taken to prevent interruption of the service.

C. Backfilling:

(1) The trenches shall not be backfilled until all required pressure tests are performed and until the utilities systems as installed conform to the requirements specified in the several sections covering the installation of the various utilities. Where, in the opinion of the Architect, damage is likely to result from withdrawing sheeting, the sheeting shall be left in place and the contract price will be adjusted accordingly. Except as otherwise specified for special conditions of overdepths, trenches improperly backfilled shall be reopened to the depth required for proper compaction, then refilled and compacted as specified, or the condition shall be otherwise corrected as approved.

(2) The surface shall be restored to its original condition as near as practicable and as hereinafter specified. Pavement, base course, and compacted subgrade disturbed by trenching operations shall be replaced in an acceptable manner with materials equal to the adjacent compacted subgrade, base course, and pavement for a minimum distance of 12 inches on each side of the trench.

(3) Lower Portion of Trench: Backfill material shall be deposited in 6-inch-maximum-thickness layers and compacted with suitable tampers to density of the adjacent soil or graded as hereinafter specified until there is a cover of not less than 2 feet over sewers and 1 foot over other utility lines. The backfill material in this portion of the trench shall consist of a selected material at a moisture content that will facilitate compaction, free from stones.
larger than 3 inches in any dimension and hard clods and frozen conglomerates larger than 3 inches in any dimension, except that where the pipe is coated or wrapped for protection against corrosion the backfill material shall be free from stones larger than 1 inch in any dimension. If any portion of the cover in the lower portion of the trench is in the depth of special compaction and materials requirements under pavement the special requirements shall control. Special care shall be taken not to damage the coating or wrapping of pipes.

(4) Remainder of Trench: Except for special materials for pavements, the remainder of the trench shall be backfilled with material that is free of stones larger than 3 inches or 1/2 the layered thickness, whichever is smaller, in any dimension. Backfill material shall be deposited in layers not exceeding the thickness specified, and each layer shall be compacted to the minimum density specified as applicable to the particular areas (except that in areas other than under parking areas, and other paved areas subject to vehicular movement, settling of granular, noncohesive material with water will be permitted). Degree of compaction shall be as follows, expressed as a percentage of the maximum density obtained by the test procedure presented in ASTM D-698.

   a. Under Pavements: Six-inch layers, 95 percent maximum density up to the elevations at which the requirements for pavement subgrade materials and compaction control.
   b. Under Sidewalks: Six-inch layers, 95 percent maximum density.
   c. Under Other Areas: Six-inch layers, 90 percent maximum density.

(5) Testing: All trench backfill material shall be tested as indicated in Division 1.

END OF SECTION
313116 – TERMITE TREATMENT

1. GENERAL:
   A. Treat all areas under building and footings to form an impermeable barrier and as required to provide warranty.

   B. Warranty:
      
      (1) New Structures: Furnish Owner with Certificate of Performance from approved company insuring Owner against damage from termites for five (5) years.

   C. All chemicals shall meet all EPA regulations.

   D. Submit information on proposed chemicals.

2. PRODUCTS:
   A. The Contractor shall propose the termiticide to be utilized.

3. EXECUTION:
   A. Apply solution along the inside of foundation walls, both sides of interior partitions and expansion joints and around all plumbing and other utilities that penetrate the slab at a rate of two (2) gallons per five (5) linear feet or as required by manufacturer.

   B. Apply in strict accordance with all manufacturer's labeled directions and Federal regulations.

END OF SECTION
END OF DIVISION