PROJECT MANUAL INCLUDING SPECIFICATIONS
FOR

DIABLO VALLEY COLLEGE
AB RESTROOMS

PLEASANT HILL, CALIFORNIA

Diablo Valley College Project # 73301217
LCA Architects Project # 16017.002

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SELECTIVE DEMOLITION

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes: Selective demolition as designated or required to provide for new Work. Refer to Drawings for additional demolition notes. Work includes, but is not necessarily limited to, the following:
   1. Selective demolition of designated construction.
   2. Removal of designated materials and finishes.
   3. Disconnecting and capping identified utilities.
   4. Selective demolition of parts of existing utilities as required to connect to and construct the new facility.
   5. Protection of items to remain as indicated on Drawings.
   6. Removal of demolished materials from site.

1.02 DEFINITIONS

A. Remove: Detach items from existing construction and legally dispose of them off-site unless indicated to be removed and salvaged or recycled.

B. Remove and Salvage: Detach items from existing construction and deliver them to Owner.

C. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or recycled.

1.03 REFERENCE STANDARDS

A. American National Standards Institute
   1. ANSI A10.6 - American National Standard Safety Requirements for Demolition.

1.04 PERFORMANCE REQUIREMENTS

A. Salvage and recycle demolition waste in accordance with Owner’s Construction Waste Management and Disposal plan.

1.05 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate utility and building services interruptions with Owner.
   2. Coordinate Work to ensure fire sprinklers, fire alarms, smoke detectors, emergency lighting, exit signs and other life safety systems remain in full operation in occupied areas.

B. Pre-Demolition Meeting: Conduct pre-demolition meeting in accordance with Owner’s Project Meetings requirements for a pre-installation meeting. Convene pre-demolition meeting one week prior to commencing work of this Section

C. Sequencing:
   1. Sequence operations to maintain safe working conditions and preserve existing work that is to remain.
2. Sequence demolition so as not to undermine or compromise vertical and lateral load carrying capacity of structures that are to remain.

D. Scheduling:
   1. Schedule work at Owner’s convenience to cause minimal interference with Owner’s normal operations.
   2. Schedule utility and building services interruptions with Owner.
      a. Do not disable or disrupt building fire or life safety systems without 7 days prior written notice to Owner.
      b. Schedule tie-ins to existing systems to minimize disruption.
   3. Cooperate with Owner in scheduling noisy, dirty, or wet work.
   4. Cooperate with Owner in scheduling waste removal that may impact Owner’s operations.
   5. Obtain Owner’s approval of times scheduled for jack hammering.

1.06 SUBMITTALS

   A. Program of methods and time schedule for accomplishing this Work.

   B. Existing Building Documentation: Submit the following for existing buildings indicated to remain:
      1. Report of inspections conducted with Owner both before and after performing work.
      2. Survey indicating position and elevation of exterior building features.
      3. Photographic survey indicating conditions before, during, and after demolition work.

1.07 QUALITY ASSURANCE

   A. Requirements of Regulatory Agencies:
      1. Perform Work in accordance with rules and regulations of state and local agencies having jurisdiction for demolition of structures, safety of adjacent structures, dust control, runoff control, and disposal of debris.
      2. Conform to rules and regulations of state and local agencies having jurisdiction when hazardous or contaminated materials are discovered.

1.08 SITE CONDITIONS

   A. Conduct demolition to minimize interference with adjacent [and occupied] building areas.

   B. Owner assumes no responsibility for actual condition of buildings to be demolished.

   C. Conduct demolition and debris removal operations to minimize interference with adjacent roads, streets, walks, and other adjacent occupied and used facilities.

   D. Conduct demolition and debris removal operations with minimum interference to public or private access. Maintain [protected] egress and access from adjacent structures at all times.

   E. Cease demolition immediately if structures appear to be in danger. Notify Owner’s Representative. Do not resume operations until directed.

   F. Where existing conditions conflict with representations of the Contract Documents, notify Owner’s Representative and obtain clarification. See also inspection requirements under Existing Building Documentation Article. Do not perform work affecting the conflicting conditions until clarification of the conflict is received.

   G. Hazardous Materials:
1. Hazardous materials are excluded from work of this Section. Immediately inform Owner’s Representative if hazardous materials are encountered or suspected and stop work in suspect area. Do not proceed with work in suspected area until approved by Owner’s Representative.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION

3.01 EXISTING BUILDING DOCUMENTATION

A. Before performance of work, make inspection and report defects and structural weaknesses of structures to be partially demolished, cut, or removed, of adjacent structures, and of improvements remaining.

B. After performance of work, make inspection and document conditions including defects and structural weaknesses of:
   1. Adjacent structures indicated to remain.
   2. Structures partially demolished, cut, or removed.
   3. Improvements indicated to remain.

C. Owner will accompany Contractor before and after performance of Work to confirm physical condition of existing structures or improvements indicated to remain.

3.02 EXAMINATION

A. Review Project Record Documents of existing construction provided by Owner’s Representative does not guarantee that existing conditions are same as those indicated in Project Record Documents.

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

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

D. Verify hazardous material abatement is complete before beginning demolition.

E. Examine areas affected by work of this Section and verify following:
   1. [Disconnection of utilities as required.]
   2. Those utilities serving occupied portions of buildings will not be disturbed.
   3. Removal by Owner of Owner’s personal property, movable furniture, and equipment items not designated for relocation.

F. [Inventory and record the condition of items to be removed and salvaged.]

G. When unanticipated mechanical, electrical, or structural elements are encountered, investigate and measure the nature and extent of the element. Promptly submit a written report to Owner.
3.03 PREPARATION

A. Consult with Owner prior to commencing demolition work and determine which existing items are to be salvaged and retained or can be reused in the work. These items shall be carefully removed to avoid damage and shall be delivered to Owner or stored as directed.

B. Lay out work to be demolished at job site and coordinate with related work for which cutting is required.

C. Review proposed layout with Owner's Representative prior to performing demolition.

D. Erection and maintenance temporary enclosures is specified Section 01 50 00 - Temporary Facilities and Controls.

E. Erect and maintain weatherproof closures for exterior openings

F. Erect and maintain temporary partitions to prevent spread of dust, odors, and noise to permit continued Owner occupancy.

G. Existing Utilities:
   1. Notify affected utility companies before starting work and comply with their requirements.
   2. Mark location and termination of utilities.
   3. Refer to Divisions 21, 22, 23, 25, 26, 27, and 28 Sections for shutting off, disconnecting, removing, and sealing or capping mechanical or electrical utilities.
   4. Do not start demolition work until utility disconnection and sealing have been completed and verified in writing.
   5. Take care to ensure that utilities to remain and portions thereof which are not required to be demolished or removed.
   6. Locate, identify, disconnect, and seal or cap off indicated utilities serving areas to be demolished.
   7. Locate, identify, and protect known utilities indicated to remain from damage. Should damage occur, notify Owner's Representative and repair at no additional cost to the Contract.
   8. Verify that those utilities serving occupied portions of buildings will not be disturbed.

H. Prevent movement or settlement of adjacent structures. Provide bracing and shoring.

I. [Protect existing improvements indicated to remain from damage during demolition.]

J. Locate, identify, and protect known utilities indicated to remain from damage. Should damage occur, notify Owner's Representative and repair at no additional cost to the Contract.

3.04 SALVAGE REQUIREMENTS

A. Coordinate with Owner to identify building components and equipment required to be removed and delivered to Owner.

B. Tag components and equipment Owner designates for salvage.

C. Protect designated salvage items from demolition operations until items can be removed.

D. Carefully remove building components and equipment indicated to be salvaged or reinstalled. Remove materials to be reinstalled or retained in a manner to prevent damage.

E. Disassemble as required to permit removal from building.
F. Package small and loose parts to avoid loss.

G. Mark equipment and packaged parts to permit identification and consolidation of components of each salvaged item.

H. Prepare assembly instructions consistent with disassembled parts. Package assembly instructions in protective envelope and securely attach to each disassembled salvaged item.

I. Deliver salvaged items to Owner. Obtain signed receipt from Owner.

J. Carefully store building components and equipment indicated to be reinstalled.

3.05 DEMOLITION REQUIREMENTS

A. Disposition of Existing Improvements:
   1. Materials forming portions of permanent structure designated for demolition shall become Contractor’s property, and Contractor shall be responsible for their removal unless otherwise noted.
   2. Personal property and movable furniture remain Owner’s property. Contractor to store items in future storage area and protect from damage. Consider items not claimed by Owner as debris. Owner’s final verification is required before removal.

B. Sprinkle or wet down Work and areas affected by this Work as required to prevent dust and dirt from rising. Provided hoses and water connections required for this purpose.

3.06 DEMOLITION

A. Perform work in accordance with ANSI A10.6 unless otherwise noted.

B. Conduct demolition to minimize interference with adjacent [and occupied] building areas.

C. Maintain protected egress from and access to adjacent existing buildings at all times.

D. Cease operations immediately when structure appears to be in danger and notify Owner’s Representative

E. Disconnect, cap, and identify designated utilities within demolition areas.

F. Remove designated interior structures, parts, and finishes at beginning of work to minimize hazardous working conditions and to provide comparatively clean surfaces for installation of new work.

G. Perform demolitions as much as possible with small tools. Demolish in small sections. Remove loading before cutting or removing structural members.

H. Demolish in an orderly and careful manner. Protect existing supporting structural members.

I. Concrete:
   1. Demolish by means of saw cutting, drilling, chipping, breaking, or a combination thereof, as indicated or required to satisfactory accomplish the Work without damage to existing improvements not being removed.
   2. [If jack hammering is permitted do not jack hammer within 2 inches of reinforcing or structural steel; remove final 2 inches of material with chipping gun.]
   3. Demolish concrete and masonry in small sections, less than 3 feet in any direction.
4. Cut concrete at nearest control joint to line shown on the Drawings, so that new concrete can be installed continuing the adjacent existing joint pattern.

J. At concrete and other materials where edges of cuts and holes will remain exposed in the completed work, make cuts using power sawing and coring equipment. Do not over cut at corners of cut openings.

K. Where existing resilient flooring, carpeting, carpet padding, tile and other similar adhesive or mortar applied finishes are required to be removed to permit application of new finishes, grind, stone, sand or otherwise remove all adhesives, mortar, fasteners, and similar materials to the extent that no ridges, lumps or other protrusions will telegraph through surface of new finish or be apparent when the substrate is left exposed.

L. Lower heavy structural framing members by hoist or crane.

3.07 CUTTING

A. Cutting of concrete and asphalt shall be made clean and neat.

B. At limits of demolition Work shown or specified, provide neat, orderly, and clean joints, lines, and edges of surfaces, whether for junctions with new materials or surfaces or whether to be left as existing. Where demolitions methods or controls may not permit the intended jointure, submit conditions and alternatives to Owner’s Representative, and obtain resolutions prior to commencing.

C. Cutting of concrete and asphalt shall be made clean and neat.

D. Do not cut or alter structural members unless indicated to do so on the Drawings or written approval is received from Owner’s Representative.

E. Take care not to damage reinforcing or structural steel scheduled to remain in place.

3.08 REMOVAL OF DEBRIS

A. Remove debris in accordance with requirements of Section 01 74 29 - Construction Waste Management and Disposal.

B. Remove demolished materials from site except where specifically noted otherwise.

C. Remove materials as Work progresses. Upon completion of Work, leave areas in clean condition.

D. Remove salvage and debris as they accumulate. Do not permit presence of debris to delay progress of related work.

E. Remove materials in a manner to prevent spillage.

F. Nothing to be removed from site shall be stored, sold, burned, or buried on site.

3.09 REPAIRS

A. Promptly repair damage to adjacent construction caused by demolition operations.

B. Where repairs to existing surfaces are required, patch to restore surface to original or better condition.
C. Restore exposed finishes of patched areas and extend restoration into adjoining construction in a manner that eliminates evidence of patching and refinishing.

3.10 CLEANING

A. Clean adjacent improvements scheduled to remain of dust, dirt, and debris caused by demolition operations. Return adjacent areas to condition existing before building demolition operations began.

END OF SECTION
SECTION 03 10 00

FORMWORK

PART 1 - GENERAL

1.1 DESCRIPTION


B. Related Sections:

1. Section 032000 - Concrete Reinforcement.
2. Section 033000 - Cast-In-Place Concrete.

1.2 REFERENCES

A. Requirements of GENERAL CONDITIONS and DIVISION NO. 1 apply to all Work in this Section.

B. Published specification, standards, tests, or recommended methods of trade, industry, or governmental organizations apply to Work of this Section where cited by abbreviations noted below (latest editions apply).

3. American Concrete Institute’s “Recommended Practice for Concrete Formwork,” (ACI 347).
6. West Coast Lumber Inspection Bureau’s “Standard Grading Rules No. 16” (WCLIB).

1.3 QUALITY ASSURANCE

A. Design Criteria: Formwork shall conform to ACI 347.

1. Formwork:
   a. Shall prevent leakage or washing out of cement mortar.
   b. Shall resist spread, shifting, and settling.
   c. Shall reproduce accurately required lines, grades, and surfaces within tolerances specified.

2. Safety: The Contractor shall be responsible for adequate strength and safety of all formwork including falsework and shoring.

B. Allowable Tolerances: Formwork shall produce concrete within tolerance limits recommended in ACI 347, unless otherwise noted.

1.4 SUBMITTALS
A. Samples: Only as requested by the Architect.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use.

1.6 JOB CONDITIONS

A. Sequencing Schedule:

1. Ensure timely delivery of embedded items. Be responsible for cutting and patching necessitated by failure to place embedded items.

2. Plan erection and removal to permit proper sequence of concrete placing without damage to concrete.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Forming Materials:

1. Panel or board forms at the Contractor’s option.
   a. Panel Forms: Minimum 5/8-inch thick exterior grade plywood with sealed edges, PS 1 grade Plyform Class I and II B-B Exterior or HDO Exterior.
   b. Board Forms: Shiplap or tongue and groove lined with PS 1 grade Plyform Class I and II Exterior ½-inch or HDO Exterior ½-inch or 3/16-inch thick fiberboard conforming to FS LLL-B-810a(1), type I.

2. Forms for Exposed Finish Concrete: Plywood, metal, metal-framed plywood faced, or other acceptable panel-type materials, to provide continuous, straight, smooth, exposed surfaces. Furnish in largest practicable sizes to minimize number of joints and to conform to joint system shown on Drawings.
   a. Use Plywood complying with U.S. Product Standard PS-1 “B-B (Concrete Form) Plywood,” Class I, Exterior Grade or better, with each piece bearing legible inspection trademark. Panels to receive specified form sealer to ensure uniform finish of exposed surfaces.

3. Chamfer Strips: Burke Concrete Accessories’ PVC type CSF ½-inch, all exposed corners.

B. Wood Framing: WCLIB standard grade or better Douglas Fir.
C. **Form Ties and Spreaders:** Metal type acting as spreaders, leaving no metal within one inch of concrete face and no fractures, spalls, depressions or other surface disfigurements greater than 3/4-inch in diameter.

D. **Form Sealer:** Same as Grace Construction Material’s “Formfilm”; or equal product substituted per Section 01630.

E. **Release Agent:** Must not stain or otherwise adversely affect architectural concrete surfaces. Same as The Nox-Crete Co.’s “Nox-Crete Form Coating”; Industrial Synthetics Corp.’s “Synthex;” or equal product substituted per Section 01630.

F. **Foam Board:** Extruded close cell polystyrene foam, channeled for drainage, with a minimum compressive strength of 25 psi at 0.1-inch deformation when tested in accordance with ASTM D1621-73, and meeting requirements of FS-HH-I-524b, Type II, Class B. Same as The Dow Chemical Co.’s “Styroform PD Brand” or equal product substituted per Section 01630.

2.2 **SOURCE QUALITY CONTROL**

A. Plywood shall bear APA grade-trademark.

**PART 3 - EXECUTION**

3.1 **EXAMINATION**

A. Examine areas where formwork will be constructed and verify that:

1. Excavations are sufficient to permit placement, inspection and removal of forms.
2. Excavations for earth forms have been neatly and accurately cut.
3. Conditions are otherwise proper for formwork construction.

B. Do not start work until unsatisfactory conditions have been corrected.

3.2 **PREPARATION**

A. Obtain necessary information for coordination of formwork with items to be embedded in concrete and other related work.

3.3 **CONSTRUCTION**

A. General:

1. Design, erect, support, brace and maintain formwork to support vertical and lateral, static, and dynamic loads that might be applied until concrete structure can support such loads. Construct formwork so concrete members and structures are of correct size, shape, alignment, elevation and position. Maintain formwork construction tolerances complying with ACI 347.
2. Construct forms to sizes, shapes, lines and dimensions shown, and to obtain accurate alignment, location, grades, level and plumb. Work in finished structures.
Provide for openings, offsets, sinkages, keyways, recesses, moldings, rustications, reglets, chamfers, blocking, screeds, bulkheads, anchorages and inserts, and other features required in Work. Use selected materials to obtain required finishes. Solidly butt joints and provide back-up at joints to prevent leakage of cement paste.

3. Frame openings where indicated on Architectural, Structural, Mechanical, Plumbing and Electrical drawings.

B. Earth Forms:

1. Construct wood edge strips at top sides of excavations.
2. Provide forms for footings wherever concrete cannot be placed against solid earth excavation.
3. Remove loose dirt and debris prior to concrete pours.
4. Foundation concrete may be placed directly into neat excavations provided the foundation trench walls are stable as determined by the Architect, subject to the approval of DSA. In such case, minimum formwork shown on the drawings is mandatory to ensure clean excavations immediately prior to and during the placing of concrete.

C. Walls and Other Formed Elements:

1. Erect outside forms for exposed exterior walls first and obtain the Architect’s approval before reinforcement is placed. Obtain Architect’s approval of the reinforcement before interior form is erected.
2. Carefully align inside and outside forms before tightening ties.
3. Plywood Forms: Insure vertical joints are plumb and horizontal joints are level; arrange joints and ties in geometrical pattern as approved by the Architect.
4. Form inside corners at exposed conditions with mitered boards or plywood so that no concrete is placed against form ends.
5. After erection, seal all cracks, holes, slits, gaps, and apertures in forms so that they will withstand the pressure and will remain completely watertight.
6. Provide a means to seal the bottom of forms at construction joints such as foam tape or other gasket devices.
7. Apply a coating of release agent prior to the erection of formwork. Follow approved manufacturer’s recommendations.

D. Slab Forms:

1. Establish levels and set screeds.
2. Depress slabs where required to receive special floor finishes.

E. Cleanouts and Openings: Provide on interior face of wall forms as required for effective removal of loose dirt, debris and waste material, for inspection of reinforcing and for introduction of vibrators where the Architect deems necessary.

F. Construction Joints:

1. Provide where shown on the drawings as directed by the Architect and per CBC Section 1906A.4.
2. Provide key indentations at all joints.
3. Provide pour strips on inside face of forms at horizontal joints, but remove strips and thoroughly clean out reglets before placing subsequent portions of wall.
4. Prevent formations of shoulders and ledges.
5. Provide means for drawing forms into firm contact with concrete before placing additional concrete over previous pours where shrinking and warping has separated concrete from forms.

G. Embedded Items:

1. Properly locate, unless locating is specified elsewhere, and place inserts and embedded items required by other trades prior to casting concrete.

3.4 REMOVAL

A. Secure the Architect’s approval for time and sequence of form removal.

B. Form Removal: Forms shall be removed without damage to the concrete, and in no case shall they be removed prior to the concrete member attaining the specified strength.

<table>
<thead>
<tr>
<th>MEMBER</th>
<th>STRENGTH</th>
<th>MINIMUM TIME*</th>
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<tbody>
<tr>
<td>Vertical surfaces of</td>
<td>0.60 f’c</td>
<td>7 days</td>
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<tr>
<td>walls, columns, beams,</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Beams, slab</td>
<td>0.75 f’c</td>
<td>14 days</td>
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*Estimated curing time required to obtain desired strength. Results of the 7-day test cylinder break shall be presented to the Architect to demonstrate compliance with above specified strength requirements prior to form removal. If a 7-day test cylinder break demonstrates strength that is less than that specified, the Contractor may elect to take additional cylinders at the time of next pour to demonstrate strength requirements. The Contractor shall bear the cost of taking and testing the additional samples.

C. Forms:

1. Remove forms carefully to avoid damaging corners and edges of exposed concrete.
2. Reuse:
   a. The Architect will approve reuse of forms provided they are straight, clean, free from nails, dirt, hardened concrete, or other injurious matter and edges and surfaces are in good condition.
   b. Clean and repair any damage caused by placing, removal, or storage. Reuse of formwork with repairs or patches which would result in adverse effects to architectural concrete finish will not be permitted.
   c. Store formwork in manner to prevent damage or distortion.
   d. Reseal as required to achieve concrete of specified quality.
SECTION 03 20 00
CONCRETE REINFORCEMENT

PART 1 - GENERAL

1.1 DESCRIPTION

   A. Section Includes: Provision of reinforcement for all concrete unless specifically noted otherwise.

   B. Related Sections:
      1. Section 031000 - Formwork.
      2. Section 033000 - Cast-In-Place Concrete.

1.2 REFERENCES

   A. Requirements of the GENERAL CONDITIONS and DIVISION NO. 1 apply to all Work in this Section.

   B. Published specifications, standards, tests, or recommended methods of trade, industry, or governmental organizations apply to Work of this Section where cited by abbreviations noted below (latest editions apply).

      3. American Concrete Institute’s:
         b. “Building Code Requirements for Structural Concrete” (ACI 318).
      4. Concrete Reinforcing Steel Institute (CRSI):
         b. “Recommended Practice for Placing Reinforcing Bars.”
      5. American Welding Society’s:

1.3 QUALITY ASSURANCE

   A. Welders’ Qualifications: Welders shall be qualified in accordance with AWS D1.4.

   B. Reinforcing steel shall not be permitted to rust where there is danger of staining exposed surfaces of adjacent concrete. The Contractor shall replace rust-stained concrete at his expense.
C. Allowable Tolerances: Reinforcing steel shall be placed within tolerances permitted by ACI 318, Section 7.5 unless otherwise approved by the Architect.

D. The Owner’s Testing Agency will provide tests in accordance with CBC Section 1913A.
   1. Collect mill test reports for reinforcement.
   2. Take samples from bundles at fabricators.
      a. When bundles are identified by heat number and accompanied by mill analysis, two specimens shall be taken from each ten (10) tons, or fraction thereof, of each size and grade.
      b. When reinforcement is not positively identified by heat numbers or when random sampling is intended, two specimens shall be taken from each 2½ tons, or fraction thereof, of each size and grade.
   3. Test for tensile and bending strengths.
   4. Provide inspection of welding, including prior fit-up, welding equipment, weld quality and welder certification in accordance with AWS D1.4. Chemical analysis sufficient to determine carbon equivalent and minimum preheat temperature shall be performed when reinforcement does not conform to low-alloy steel requirements per CBC Section 1903A.8.

1.4 SUBMITTALS
   A. Shop Drawings: Show bending and placing details, size and location of reinforcing steel. Include diagrammatic wall elevations at 1/4-inch equals one foot scale to clearly show position and erection marks of bars including marginal bars around openings with dowels, splices, etc.
   B. Certified mill test reports (tensile and bending) for each heat or melt of steel prior to delivery of material to the job site. Where reinforcing is to be welded, mill test reports shall verify the weldability of the steel.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING
   A. Deliver reinforcement and accessories to site not more than 48-hours before placement.
   B. Store in manner to prevent excessive rusting and fouling with grease, dirt, or other bond-weakening coatings.
   C. Take precautions to maintain identification after bundles are broken.

PART 2 - PRODUCTS

2.1 MATERIALS
   A. Bars: New billet steel, ASTM A615 Grade 60.
   B. Bar Supports: As required for assembling and supporting reinforcement in place.
1. **CRSI Class 3:** Where bar supports do not come in contact with exposed concrete surfaces.

2. **CRSI Class 1 plastic-protected; or Class 2 stainless steel wire:** Interior and Exterior Soffits and Other Exposed Conditions:

3. **Precast Concrete Wired Block:** At slabs-on-grade and as necessary at other locations.

C. **Threaded coupler:** Lenton Standard coupler by ERICO or equal product substituted per Section 2.11. Couplers may be Type 1 except where otherwise noted.

   1. **Type 1 Couplers** shall develop 125-percent of specified yield strength reinforcement.

   2. **Type 2 Couplers** shall develop 160-percent of the tensile strength or 200-percent of the yield strength of the reinforcement.

D. **Product Substitutions:**

   1. **Other manufacturers’ materials, articles, and methods not named** will be considered as substitutions provided required information is submitted on “FORM FOR SUBSTITUTIONS FOR SPECIFIED ITEMS” and will not require substantial revisions of Contract Documents;

   2. **Whenever material, article, or method is specified or described without phrase “or equal,”** no substitutions will be allowed.

   3. **Costs for redsins due to substituted items are responsibility of Applicant.**

   4. **In making request for substitution,** Applicant/Contractor represents that he:

      a. **Has personally investigated proposed product or method** and determined that it is equal in all respects to that specified.

      b. **Will provide same guarantee for substitution as for product or method specified.**

      c. **Will coordinate installation of accepted substitution into work,** making design and construction changes to complete work in all respects following the Contract Documents.

   5. **In order for substitutions that do not change design intent to be considered,** submit no later than 30 days after date of Notice to Proceed, 3 copies of complete data set forth herein to permit complete analysis of proposed substitutions listed on submitted “FORM FOR SUBSTITUTIONS FOR SPECIFIC ITEMS”.

      a. **Identification including manufacturer’s name and address.**

      b. **Manufacturer’s literature,** including but not necessarily limited to:
i. Product description, performance, and test data.

ii. Reference standards.

iii. Samples where appropriate.

iv. Name and address of similar projects on which product was used and dates of installation with contact name and telephone number.

c. Approval of Substitution:

i. Contract Manager’s decision regarding evaluation of substitutions will be final and binding.

ii. Commission will not be responsible for delays and costs associated with processing the Substitution request.

iii. All approved substitutions will be incorporated into the Contract Documents by plan revision.

2.2 FABRICATION

A. Shop-fabricate to comply with drawings.

B. Conform to requirements of ACI 315 where specific details are not shown or where drawings and specifications are not more demanding.

PART 3 - EXECUTION

3.1 PLACEMENT

A. General:

1. Place bars as noted.
2. All reinforcement shall be continuous. See drawings for lap splice schedule. Stagger splices where possible. Contact lap splices shall be securely wired together to maintain alignment.
3. Ensure placement will permit concrete protection in conformance with CRSI or to extent shown.
4. Support and fasten bars securely with spacers, chairs or ties to permit their being walked upon without displacement or movement both before and during placement of concrete. Wire-tie bar intersections.
5. Do not bend bars around openings or sleeves. Wherever conduits, piping, inserts, sleeves, etc. interfere with placing of reinforcement, obtain the Architect’s approval of placing before concreting.
6. Do not field bend bars unless expressly noted in the Contract Documents.

B. Welding:

1. Employ shielded metal-arc method and conform to AWS D1.4.
2. Ensure equipment supplies proper current and voltage and is adjustable to suit arrangement and thickness of items welded.

C. Prior to placing concrete, verify reinforcement has been bent, positioned, and secured in accordance with drawings; ensure removal of oil, grease, dirt, or other bond-weakening coatings; replace severely rust-pitted reinforcing bars.

D. Quality Assurance:

1. The Project Inspector will inspect placement of reinforcement and mechanical splices and notify Structural Engineer of any discrepancies in placement.
2. The Owner’s Testing Agency will inspect shop and field welding of reinforcing bars in accordance with CBC Section 1913A.

END OF SECTION 032000
SECTION 03 30 00
CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 DESCRIPTION

A. Section Includes: Provision of cast-in-place concrete unless specifically noted otherwise.

B. Related Sections:
   1. Section 031000 - Formwork.
   2. Section 032000 - Concrete Reinforcement.

1.2 REFERENCES

A. Requirements of GENERAL CONDITIONS and DIVISION NO. 1 apply to all Work in this Section.

B. Published specifications, standards, tests, or recommended methods of trade, industry, or governmental organizations apply to Work of this Section where cited by abbreviations noted below (latest editions apply).

   3. American Concrete Institute’s:
      a. “Standard Specifications for Tolerances for Concrete Construction and Materials” (ACI 117)
      b. “Specification for Structural Concrete for Buildings” (ACI 301).
      c. “Recommended Practice for Measuring, Mixing and Placing Concrete” (ACI 304).
      d. “Recommended Practice for Hot Weather Concreting” (ACI 305)
      e. “Recommended Practice for Cold Weather Concreting” (ACI 306)
      f. “Building Code Requirements for Structural Concrete” (ACI 318).


1.3 QUALITY ASSURANCE

A. The Contractor’s Testing Laboratory Qualifications: The Contractor’s Testing Laboratory shall be under direction of a Civil Engineer registered in the State of California, shall have operated successfully for four years prior to this work, and shall conform to requirements of ASTM E329.

B. Requirements of ACI 301 shall govern work, materials and equipment related to this Section; specifications herein set minimum results required, and references to procedures are intended to establish minimal guides.

Contra Costa Community College District
Diablo Valley College
AB Restroom Renovation
C. The Contractor shall be responsible for quality of concrete in place and shall bear burden of proof that concrete meets minimum requirements. Tolerances shall meet the requirements of ACI 117 except as modified in the Construction Documents.

D. Placing of concrete by means of pumping will be an acceptable method of placement providing that the Contractor can demonstrate that:
   1. Specified concrete strengths will be met.
   2. Equipment has a record of satisfactory performance under similar conditions and using a similar mix.
   3. Trial batches have been made.

1.4 SUBMITTALS

A. The Contractor’s Testing Laboratory’s certificate of compliance per ASTM E329.

B. The Contractor shall submit:
   1. Certified copies of mix designs for each concrete class specified including compressive strength test reports.
   2. Certification that materials meet the requirements specified.
   3. Samples only as requested by the Architect.
   4. Certification from vendor that samples originate from and are representative of each lot proposed for use.

C. The Owner’s Testing Agency will submit reports on tests and inspections performed to the Owner, the Architect, the Contractor, and the DSA.

D. Shop Drawings: Show construction and expansion and contraction joint locations and details.

E. Schedule of placing for the Architect’s review before starting work.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Ensure storage facilities are weather tight and dry.

B. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use.

C. Store bulk cement in bins capable of preventing exposure to moisture.

D. Use sacked cement in chronological order of delivery. Store each shipment so that it may be readily distinguishable from other shipments.

PART 2 - PRODUCTS

2.1 CONCRETE

A. Table 2-1: Concrete Properties
<table>
<thead>
<tr>
<th>Class</th>
<th>28-Day Strength (psi)</th>
<th>Aggregate Size (in)</th>
<th>Weight</th>
<th>Water / Cement</th>
<th>% Flyash</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Foundations/Grade Beams</td>
<td>4000</td>
<td>1</td>
<td>145</td>
<td>0.50</td>
<td>15-25</td>
<td>Water-Reducing admixture</td>
</tr>
<tr>
<td>Slab on Grade/Curbs</td>
<td>3000</td>
<td>1</td>
<td>145</td>
<td>0.50</td>
<td>15-25</td>
<td>Water-Reducing admixture</td>
</tr>
</tbody>
</table>

B. Strength refers to the compressive strength in psi after 28-days when tested in accordance with ASTM C39. All concrete shall develop compression strength specified in 28-days. To meet above requirements, mix shall be designed such that average compressive strength will exceed specified 28-day strength by an amount as specified by ACI 318.

C. Aggregate size refers to the maximum size in inches.

D. Weight refers to pounds per cubic foot, air dry.

E. Water/Cement Ratio is the maximum ratio of water to cementitious material by weight.

2.2 MATERIALS

A. General Requirements:
   1. Cement and aggregates shall have proven history of successful use with one another. Sources of cement and aggregate shall remain unchanged throughout work unless the Architect approves request for change made at least 10-days prior to anticipated date of casting.
   2. Ready-mixed concrete shall meet requirements of ASTM C94.
   3. Deviations in properties of materials tested by the Owner’s Testing Agency shall be cause for their rejection pending additional test results and redesign of mix by the Contractor’s Testing Laboratory.
   4. No frozen aggregates will be permitted.

B. Cements: ASTM C150, Type II. Use one brand of cement throughout project unless otherwise directed by the Architect.

C. Fly Ash: ASTM C618, Type F.

D. Aggregates:
   1. Coarse: ASTM C33. Coarse aggregate shall consist of a clean, hard, fine grained, sound crushed rock, or washed gravel or a combination of both. It shall be free from oil, organic matter or other deleterious substances and shall not contain more than two percent by weight of shale or cherty material. "Cleanness value shall not be less than 75 when tested per MM Test Method, 227 and conforming to CBC Section 1903A.6.
   2. Fines: ASTM C33. Sand equivalent shall be not less than 75 when tested as per ASTM D2419.
3. Light Weight Aggregates: ASTM C330; expanded shale type uniformly graded from 3/4-inch to No. 200 Mesh. Cleanliness value and sand equivalent not less than 75.

4. Provide aggregates from a single source for exposed concrete.

E. Water: ASTM C1602. Clean and potable, free from impurities detrimental to concrete.

F. Admixtures:

1. Water-Reducing Admixture: ASTM C494, Type A, non-lignini sulfonate. Same as Grace Construction Materials’ “WRDA with Hycol”; Master Builders “Pozzolith 322N”; Sika Corp.’s “Plastocrete 161”; or equal product substituted per Section 01630.


6. Other Admixtures: Only as approved by the Architect.

G. Non-Shrink Grout: Premixed high strength grout requiring only addition of water at the site. Same as Master Builder’s “Masterflow 928 Grout”; Burke’s “Non-Ferrous, Non-Shrink Grout,” or equal product substituted per Section 01630.

H. Curing Materials:

1. Waterproof Paper: ASTM C171, Type 1, regular. Same as Sisalkraft Division of St. Regis Paper Co.’s “Orange Label”; or equal product substituted per Section 01630.

2. Sheet Plastic: Polyethylene, four mils thick, fungus-resistant.


I. Concrete Sealer: Clear water repellent treatment, blend of six resins containing no silicones or stearates, no darkening or change of color. Same as Sonneborn-Contech’s “White Rox M-6-50-8”; Tamms Industries’ “Chemstop” or equal product substituted per Section 01630.

J. Epoxy Adhesive: Two component material suitable for anchoring rebar into dry or damp concrete. Same as Covert’s “CIA-Gel 7000,” Hilti’s “HIT HY-150,” Hilti’s “RE 500 SD,” Simpson Strong-Tie’s “SET” or equal product substituted per Section 01630.

2.3 MIXES

A. General Requirements:

1. The Contractor shall perform tests or assemble the necessary data indicating conformance with specifications.
2. For each mix submit data showing that proposed mix will attain the required strength in accordance with requirements of ACI 318 Section 5.3
3. If sufficient test results for ACI 318 Section 5.3.3.2 are not available, the contractor shall produce trial mixes in accordance with requirements of CBC Section 1905A.3.
4. The Contractor shall instruct Laboratory to base mix design on use of materials tested and approved by the Owner’s Testing Agency.
5. Mix design shall include compression strength test reports per ACI 318 Section 5.3.3.2
6. Mix shall be designed, tested, and adjusted if necessary in ample time before first concrete is scheduled to be placed. Laboratory data and strength test results for revised mix design shall be submitted to Architect prior to using in project.
7. Ensure mix designs will produce concrete to strengths specified and of uniform density without segregation.
8. If mix yield exceeds 1-cubic yard, modify mix design to no more than one cubic yard without changing cement content.
9. The Contractor’s mix designs shall be subject to review by the Architect and by the Owner’s Testing Agency.
10. Introduction of calcium chloride will not be permitted.
11. Unspecified admixtures will not be permitted unless the Architect reviews, the Contractor modifies mix designs as necessary, and modifications are accepted by the Owner’s Testing Agency.

B. Slab-on-Grade Mix requirements: Use of Water-Reducing admixture is required. High Range Water-Reducing admixture (super plasticizer) shall be used when required to maintain workability and pumpability.

C. Patching Mortar: Mix in proportions by volume of one part cement to two parts fine sand.

D. Non-Shrink Grout: Follow approved manufacturer’s printed instructions and recommendations.

2.4 MIXING

A. Batching Plant Conditions:

1. Batch plant shall be certified to comply with the requirements of the National Concrete Ready Mix Association.
2. Ensure equipment and plant will afford accurate weighing, minimize segregation and will efficiently handle all materials to satisfaction of the Architect and the Owner’s Testing Agency.
3. Replace at no additional expense equipment the Architect and the Owner’s Testing Agency deem inadequate or unsuitable.
4. Use approved moisture meter capable of determining moisture content of sand.
B. General Requirements:

1. Thoroughly clean concrete equipment before use for architectural concrete mixes to avoid contamination.
2. Mix cement, fine and coarse aggregates, admixtures and water to exact proportions of mix designs. Method of mixing shall comply with ACI 318 Section 5.8.
3. Measure fine and coarse aggregates separately according to approved method that provides accurate control and easy checking.
4. Adjust grading to improve workability; do not add water unless otherwise directed.
5. Maintain proportions, values, or factors of approved mixes throughout work.
6. Mix concrete in transit mixers five minutes immediately prior to discharge in addition to mixing as called for by ACI 304 and ASTM C94.

C. Admixtures: Use automatic metering dispenser to introduce admixture into mix. Dispenser shall be recommended and calibrated by admixture manufacturer.

2.5 SOURCE QUALITY CONTROL

A. The Owner’s Testing Agency will:

1. Review mix designs, certificates of compliance, and samples of materials the Contractor proposes to use.
2. Test and inspect materials, as necessary, in accordance with ACI 318 and CBC Sections 1903A, and 1913A for compliance with requirements.
3. Take samples as required from the Contractor’s designated sources.
4. Take one grab sample for each 100 tons of Portland cement except that, when used in bulk loading ready-mix plants where separate bins for pretested cement are not available, take grab samples for each shipment of cement placed in bin with not less than one sample being taken for each day’s pour and subsequently test such samples if required by the Architect who may be so advised by DSA.
5. Test both coarse and fine aggregate by use of solution of sodium or magnesium sulfate, or both whenever in the judgment of the Architect such tests are necessary to determine quality of material. Perform such tests in accordance with ASTM C88. Loss shall not exceed 6-percent of either fine or coarse aggregate. Aggregate failing to comply with this requirement may be used in the Work provided it contains less than 2-percent of shale and other deleterious particles and shows a loss in soundness test of not more than 10-percent when tested in the sodium sulphate solution. Test aggregates as required by ACI 318 Section 313 and CBC Section 1903A.6.
6. Test for sand equivalent of fine aggregate in accordance with California Test 217.
7. Test for cleanness value of coarse aggregate in accordance with California Test 227.
8. Inspect plant prior to any work to verify following:
   a. Plant is equipped with approved metering devices for determining moisture content of fine aggregate.
   b. Other plant quality controls are adequate.
9. Continuously inspect quality and quantity of materials used in transit mixed concrete, in batched aggregates and ready-mixed concrete at mixing plant or other location per CBC Section 1929A.4 where other materials are measured.
B. Waiver of Batch Plant Inspection:

1. Continuous batch plant inspection may be waived by the register design professional in responsible charge, subject to approval by the enforcement agency, under either of the following conditions:

   a. The concrete plant complies fully with the requirements of ASTM C 94, Sections 8 and 9, and has a current certificate from the National Ready Mixed Concrete Association or another agency acceptable to the enforcement agency. The certification shall indicate that the plan has automatic batching and recording capabilities.

   b. For single-story light framed buildings and isolated foundations supporting equipment only, where the specified compressive strength \( f'c \) of the concrete delivered to the jobsite is 3,500 psi (24.13 MPa) and where \( f'c \) used in design not greater than 3,000 psi (20.68 Mpa).

2. When continuous batch plant inspection is waived, the following requirement shall apply and shall be described in the construction documents:

   a. Qualified technician of the testing laboratory shall check the first batch at the start of the day.

   b. Licensed weightmaster to positively identify materials as to quantity and certify to each load by a batch ticket.

   c. Batch tickets, including actual material quantities and weights shall accompany the load and shall be transmitted to the inspector of record by a truck driver with load identified thereon. The load shall not be placed without a batch ticket identifying the mix. Copies of daily placement record shall be submitted to DSA.

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**PART 3 - EXECUTION**

3.1 EXAMINATION

A. Examine units of work to be cast and verify that:

1. Construction of formwork is complete.
2. Required reinforcement, inserts, and embedded items are in place.
3. Form ties at construction joints are tight.
4. Concrete-receiving places are free of debris.
5. Dampen subgrade or sand course for slabs-on-grade. Do not saturate.
6. Depths of depressed slab conditions are correct for delayed finish noted and for its proper bonding to concrete.
7. Conveying equipment is clean and properly operating.
8. The Architect has reviewed formwork and reinforcing steel and that preparations have been checked with the Project Inspector.
3.2 PREPARATION

A. Ensure availability of sufficient labor, equipment and materials to place concrete correctly in accordance with scheduled casting.

B. Protect finished surfaces adjacent to concrete-receiving places.

C. Clean transportation and handling equipment at frequent intervals and flush thoroughly with water before each day’s run. Do not discharge wash water into concrete form.

3.3 PLACING

A. The Inspector of Record, Architect, Structural Engineer, Testing Laboratory and DSA shall be notified at least 48 hours before placing concrete.

B. Place concrete in accordance with ACI 318 Chapter 5.

C. Place concrete in cycles as a continuous operation to permit proper and thorough integration and to complete scheduled placement. Place no concrete where sun, wind, heat, or facilities prevent proper finishing and curing.

D. Convey concrete as rapidly and directly as practicable to preserve quality and to prevent separation from rehandling and flowing; do not deposit concrete initially set. Complete placement of concrete within ninety (90) minutes after adding water unless otherwise noted. Retempering of concrete which has partially set will not be permitted.

E. Take precautions to avoid damage to under-slab moisture barrier and displacement of reinforcement and formwork.

F. Deposit concrete vertically in its final position. Avoid free falls in excess of six feet where reinforcement will cause segregation and in typical conditions unless the Architect approves otherwise.

G. Keep forms and reinforcement clean above pour line by removing clinging concrete with wire brush before casting next lift. Also remove leakage through forms.

H. Interruption in casting longer than 60-minutes shall be cause for discontinuing casting for remainder of day. In this event, cut back concrete and provide construction joints as the Architect directs; clean forms and reinforcement as necessary to receive concrete at a later time.

I. Hot Weather Concreting: Conform to ACI 305 and following requirements when mean daily temperature rises above 75 degrees Fahrenheit.

1. An upper temperature limit of concrete mixes shall be established by the Contractor for each class of concrete. Concrete temperature during placing shall not be so high as to cause difficulty from loss of slump, flash set, or cold joints, and shall not exceed 90°F. Other project climatic conditions detrimental to concrete quality such as relative humidity, wind velocity, and solar radiation shall also be considered.
2. Trial batches of concrete for each mix design shall be made at the limiting mix temperature selected. In lieu of trial batches, compression strength test reports (20 minimum) at the limiting temperature for each proposed mix shall be submitted to the Owner’s testing laboratory for review.

3. Practices to maintain concrete below maximum limiting temperature shall be in accordance with ACI 305. Concrete ingredients may be cooled before mixing, or flake ice or well-crushed ice of a size that will melt completely during mixing may be substituted for part of the mixing water.

4. Practices to avoid the potential problems of hot weather concreting shall be employed by the Contractor in accordance with ACI 305.

5. When the temperature of the reinforcing steel or steel deck forms is greater than 120°F, reinforcing and forms shall be sprayed with water just prior to placing the concrete.

J. Cold Weather Concreting:

1. No placement of concrete will be allowed at temperatures below 20 degrees Fahrenheit or if mean daily temperature for curing period is anticipated to be below 20 degrees Fahrenheit.

2. No concrete placement will be allowed on frozen subgrade.

3. Conform to ACI 306 and following requirements when mean daily temperature falls below 40 degrees Fahrenheit.

   a. Reinforcement, forms or ground to receive concrete shall be completely free from frost.
   b. Concrete at time of placement for footings shall have temperature no lower than 50 degrees Fahrenheit, for all other concrete this minimum temperature at time of placement shall be 60 degrees Fahrenheit. Maximum temperature shall be 90 degrees Fahrenheit.
   c. Concrete shall be maintained at temperature no lower than 50 degrees Fahrenheit for minimum 7-day period after placement by means of blanket insulation, heaters, or other methods as approved by the Architect.
   d. Use of calcium chloride or admixtures containing calcium chloride as accelerators will not be permitted.
   e. The Contractor shall keep a record of concrete surface temperature for first 7-days after each pour. This record shall be open to inspection by the Architect.

K. Consolidating:

1. Use vibrators for thorough consolidation of concrete.

2. Provide vibrators for each location during simultaneous placing to ensure timely consolidation around reinforcement, embedded items and into corners of forms; ensure availability of spare vibrators in case of failures. Vibrate through full depth of freshly placed concrete.

3. Do not place vibrators against reinforcement, attach to forms, or use to spread concrete.

4. Exposed Concrete: Vibrate with rubber type heads and, in addition, spade along forms with flat strap or plate.
L. Construction Joints:

1. Verify location and conformance with typical details; provide only where designated or approved by the Architect. Comply with ACI 318 Section 6.4. Construction joints require keys and additional reinforcement unless otherwise noted; consult architect for details.
2. All horizontal and vertical construction joints to be thoroughly sandblasted to clean and roughen entire surface to minimum 1/4-inch relief exposing clean coarse aggregate solidly embedded in mortar matrix.
3. Just prior to depositing concrete, the surface of the construction joint shall be thoroughly wetted.

M. Contraction (Control) Joints in Slabs-on-Grade:

1. Construct contraction joints in slabs-on-ground to form panels of patterns indicated on Shop Drawings. Use saw cuts 1/8” x 1/4 slab depth, unless otherwise indicated.
2. Time saw cutting to allow sufficient curing of concrete to prevent raveled or broken edges.
3. Contraction joints in unexposed floor slabs may be formed by saw cuts as soon as possible after slab finishing as may be safely done without dislodging aggregate.
4. If joint pattern not shown, provide joints not exceeding 15’ in either direction and located to conform to bay spacing wherever possible (at column centerlines, half bays, third-bays).

N. Walls and Other Formed Elements:

1. Space points of deposit to eliminate need for lateral flow. Placing procedures of concrete in forms permitting escape of mortar, or flow of concrete itself, will not be permitted.
2. Level top surface upon stopping work.
3. Take special care to fill each part of the forms by depositing concrete directly as near final position as possible, and to force concrete under and around reinforcement, embedded items, without displacement.
4. After concrete has taken its initial set, care shall be exercised to avoid jarring forms or placing any strain on ends of projecting reinforcement.
5. Where backfill is placed against a wall, it shall be adequately shored until it has attained design strength.

O. Penetrations Through Concrete:

1. Penetrations through structural concrete for conduit, piping or other items must be approved by the Architect.
2. Where such penetrations are approved, provide steel galvanized pipe sleeves as follows:
   a. Reinforcement must not be displaced. Provide minimum ¾” clearance between reinforcement and sleeve.
   b. Sleeves shall be Schedule 40, 60, 80, or 160 as follows based on pipe diameter “D” per Table 3-1.
   c. Spacing and edge distances shall conform to Table 3-1.
P. Table 3-1: Pipe Sleeves at Penetrations

<table>
<thead>
<tr>
<th>Pipe Diameter “D”</th>
<th>A53 Pipe Thickness</th>
<th>Minimum Center-to-Center Spacing</th>
<th>Minimum Edge Distance</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤ 2”</td>
<td>Schedule 40</td>
<td>6”</td>
<td>4”</td>
</tr>
<tr>
<td>&gt;2” ≤ 4”</td>
<td>Schedule 60</td>
<td>3D</td>
<td>6”</td>
</tr>
<tr>
<td>&gt;4” ≤ 8”</td>
<td>Schedule 80</td>
<td>3½ D</td>
<td>1½ D</td>
</tr>
<tr>
<td>&gt;8” ≤ 12”</td>
<td>Schedule 120</td>
<td>4D</td>
<td>2D</td>
</tr>
<tr>
<td>&gt; 12”</td>
<td>Not Permitted</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

3.4 CURING

A. General Requirements:

1. Take curing measures immediately after casting and for measures other than application of curing compound, extend for seven days. The Architect may recommend longer periods based upon prevailing temperature, wind and relative humidity. Comply with ACI 318 Section 5.11.
2. Avoid alternate wetting and drying and fluctuations of concrete temperature.
3. Protect fresh concrete from direct rays of sun, rain, freezing, drying winds, soiling, and damage.
4. Do not permit curing method to affect adversely finishes or treatments applied to finish concrete.

B. Curing Method, Typical: Obtain the Architect’s approval of alternate measures.

1. Keep forms and concrete surfaces moist during period forms are required to remain in place.
2. Apply curing compound per manufacturers’ recommendations, except at slabs-on-grade apply curing compound at 150% of manufacturer’s recommended application coverage rate.

3.5 CLEANING, PATCHING AND DEFECTIVE WORK

A. Where concrete is under strength, out of line, level or plumb, or shows objectionable cracks, honeycombing, rock pockets, voids, spalling, exposed reinforcement, signs of freezing or is otherwise defective, and, in the Architect’s judgment, these defects impair proper strength or appearance of the work, the Architect will require its removal and replacement at the Contractor’s expense.

B. Immediately after stripping and before concrete is thoroughly dry, patch minor defects, form-tie holes, honeycombed areas, etc., with patching mortar. Patch shall match finish of adjacent surface unless otherwise noted. Remove ledges and bulges.
C. Compact mortar into place and neatly file defective surfaces to produce level, true planes. After initial set, dress surfaces of patches mechanically or manually to obtain same texture as surrounding surfaces.

D. Rock Pockets:

1. Cut out to full solid surface and form key.
2. Thoroughly wet before casting mortar.
3. Where the Architect deems rock pocket too large for satisfactory mortar patching as described, cut out defective section to solid surface, key and pack solid with concrete to produce firm bond and match adjacent surface.

E. Cleaning:

1. Insure removal of bituminous materials, form release agents, bond breakers, curing compounds if permitted and other materials employed in work of concreting which would otherwise prevent proper application of sealants, liquid waterproofing, and other delayed finishes and treatments.
2. Where cleaning is required, take care not to damage surrounding surfaces or leave residue from cleaning agents.
3. Remove all exposed, loose fibers from stair treads to the satisfaction of the architect.

3.6 PROTECTION

A. Protect concrete from injurious action of the elements and defacement of any nature during construction operations.

B. Protect exposed corners of concrete from traffic or use which will damage them in any way.

C. Make provisions to keep all exposed concrete free from latence caused by spillage or leaking forms or other contaminants. Do not allow laitances to penetrate, stain, or harden on surfaces which have been textured.

3.7 FIELD QUALITY CONTROL

A. The Owner’s Testing Agency will:

1. Perform testing in accordance with ACI 318 and CBC Section 1705A.3, 1903A, and 1913A and Table 1705A.3.
2. Review concrete mix designs.
3. Inspect concrete and grout placement continuously.
4. Test concrete to control slumps according to ASTM C143.
5. Continuously monitor concrete temperature as it arrives on the site.
6. Test concrete for required compressive strength in accordance with CBC Section 1905A.1.2:

a. Make and cure four specimen cylinders according to ASTM C31 for not more than each 50 cubic yards, or 2000 square ft for of surface areas of slab or walls poured each day.
b. Retain one cylinder for 7-day test, two for the 28-day test and hold one cylinder for additional testing as required.

c. Number each cylinder 1A, 1B, 1C, 1D, 2A, 2B, 2C, 2D etc; date each set; and keep accurate record of pour each set represents.

d. Transport specimen cylinders from job to laboratory after cylinders have cured for 24-hours on site. Cylinders shall be covered and kept at air temperatures between 60 and 80 degrees Fahrenheit.

e. Test specimen cylinders at age 7-days and age 28-days for specified strength according to ASTM C39.

f. Base strength value on average of two cylinders taken for 28-day test.

7. Test and inspect materials, as necessary, in accordance with ACI 318, MM Test Method 227 (Coarse Aggregates) and MM Test Method 217 (Fine Aggregates), for compliance with requirements specified in this section.

B. The Contractor shall:

1. Submit ticket for each batch of concrete delivered to job site. Ticket shall bear the following information:

   a. Design mix number.
   b. Signature or initials of ready mix representative.
   c. Time of batching.
   d. Weight of cement, aggregates, water and admixtures in each batch with maximum aggregate size.
   e. Total volume of concrete in each batch.
   f. Notation to indicate equipment was checked for contaminants prior to batching.

2. Pay the Owner’s Testing Agency for taking core specimens of hardened structure and testing specimen according to ASTM C88 and C42 when laboratory tests of specimen cylinders show compressive strengths below specified minimum.

3. Submit Concrete Weighmaster affidavit per section 2.05 (B) 2.d.

3.8 FINISH OF FORMED SURFACES

A. Rough Form Finish: For formed concrete surfaces not exposed-to-view in the finish Work or by other construction. Concrete surface shall have texture imparted by form facing material used, with tie holes and defective areas repaired and patched and fins and other projections exceeding 1/4 inch in height rubbed down or chipped off.

B. Smooth Form Finish: For formed concrete surfaces exposed-to-view, or to be covered with a coating material applied directly to concrete, or a covering material applied directly to concrete, such as waterproofing, dampproofing, painting or other similar system. This is as-cast concrete surface obtained with selected form facing material, arranged orderly and symmetrically with a minimum of seams. Repair and patch defective areas with fins or other projections completely removed and smoothed.

C. Related Unformed Surfaces: At tops of walls, horizontal offsets and similar unformed surfaces occurring adjacent to formed surfaces, strike-off smooth and finish with a
texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces, unless otherwise indicated.

CONCRETE FINISHING SHALL BE SLIP RESISTANT.

3.9 SLAB FINISHES

A. Scratch Finish: Apply scratch finish to monolithic slab surfaces that are to receive concrete floor topping or mortar setting beds for tile, portland cement terrazzo, and other bonded applied cementitious finish flooring material, and as otherwise indicated.

1. After placing slabs, plane surface to tolerances for floor flatness FF of 20 and floor levelness FL of 15. Slope surfaces uniformly to drains where required. After leveling, roughen surface before final set, with stiff brushes, brooms or rakes.

B. Float Finish: Apply float finish to monolithic slab surfaces to receive trowel finish and other finishes as hereinafter specified, and slab surfaces which are to be covered with membrane or elastic waterproofing, membrane or elastic roofing, or sand-bed terrazzo, and as otherwise indicated.

1. After screeding, consolidating, and leveling concrete slabs, do not work surface until ready for floating. Begin floating when surface water has disappeared or when concrete has stiffened sufficiently to permit operation of power-driven floats, or both. Consolidate surface with power-driven floats, or by hand-floating if area is small or inaccessible to power units. Check and level surface plane to tolerances for flatness FF of 25 and levelness FL of 20. Cut down high spots and fill low spots. Uniformly slope surfaces to drains. Immediately after leveling, refloat surface to a uniform, smooth, granular texture.

C. Trowel Finish: Apply trowel finish to monolithic slab surfaces to be exposed-to-view, and slab surfaces to be covered with resilient flooring, carpet, ceramic or quarry tile, paint, or other thin film finish coating system.

1. After floating, begin first trowel finish operation using a power-driven trowel. Begin final troweling when surface produces a ringing sound as trowel is moved over surface. Consolidate concrete surface by final hand-troweling operation, free of trowel marks, uniform in texture and appearance. Check and level surface plane to tolerances flatness FF of 35 and levelness FL of 25. Grind smooth surface defects which would telegraph through applied floor covering system.

2. Floors to receive traffic topping shall have steel trowel finish.

D. Trowel and Fine Broom Finish: Where ceramic or quarry tile is to be installed with thin-set mortar, apply trowel finish as specified, then immediately follow with slightly scarifying surface by fine brooming.

E. Medium Broom Finish: Apply medium broom finish to exterior concrete platforms, steps and ramps, and elsewhere as indicated.

1. Immediately after float finishing, slightly roughen concrete surface by brooming with fiber bristle broom perpendicular to main traffic route. Coordinate required final finish with Architect before application.
3.10 CLEAN UP

A. Perform Work under this Section to keep affected portions of building site neat, clean, and orderly. Remove, immediately upon completion of Work under this Section, surplus materials, rubbish, and equipment associated with or used in performance. Be aware that failure to perform clean-up operations within 24 hours of notice by Architect will be considered adequate grounds for having work done by others at no added expense to the Owner.

END OF SECTION 033000
SECTION 04 20 00

CONCRETE MASONRY UNITS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Section Includes: Provision of concrete masonry work, including but not limited to, masonry units, mortar, grout, reinforcing steel, control joints, testing and inspection.

B. Related Sections:
   1. Section 032000 - Concrete Reinforcement
   2. Section 033000 - Cast-in-Place Concrete
   3. Section 051200 - Structural Steel

1.2 REFERENCES

A. Requirements of the GENERAL CONDITIONS and DIVISION NO. 1 apply to all Work in this Section.

B. Published specifications, standards, tests or recommended methods of trade, industry or governmental organizations apply to Work in this Section where cited by abbreviations noted below (latest editions apply).

   2. American Concrete Institute’s “Manual of Standard Practice for Detailing Reinforced Concrete Structures” (ACI 315).

1.3 QUALITY ASSURANCE

A. All masonry work shall comply with the standards and requirements of the above references. Where discrepancies exist between the references and the Contract Documents, the requirements of the Contract Documents shall govern.

B. Allowable Tolerances:

   1. Unit masonry shall be placed within 1/8-inch of dimensions noted.
   2. The maximum variation from plumb of walls shall be 1/8” in 20 feet.
   3. Joints shall have a uniform thickness of 3/8” unless otherwise noted. Joints shall not vary more than 1/16” in adjacent courses within two feet and shall not be less than 5/16” thick and not greater than 7/16” thick.

C. Reinforcing Steel:

   1. Reinforcing steel shall not be permitted to rust where there is danger of staining exposed surfaces of adjacent concrete.
   2. The Contractor shall replace rust-stained concrete and/or masonry at no additional expense to the owner or project.
D. Examination Criteria: All examinations, selections and approval shall be for the purpose of achieving a final installation of the unit masonry with the greatest possible uniformity of appearance and structural integrity based on the following criteria.

1. Testing and quality assurance measures outlined in this specification.
2. Color and texture shall match the approved mock-up for range, random variation and finish. The quality of construction shall match the approved mock-up.
3. Conformance to the contract documents and approved shop drawings within specified dimensions and tolerances.
4. Only one source for concrete masonry units shall be used throughout the work.
5. Other criteria as specified in this Section.
6. Non-conformance with any or all of the above criteria shall be grounds for removal and replacement of the work without expense to the Owner. The Architect shall determine if the work complies with the above criteria.

E. The Owner’s Testing Agency will:

1. Collect plant certificates from the Contractor for concrete masonry units, stating that all units have been properly cured before shipment and that they conform to all the requirements of these specifications. All masonry units shipped without certification will be rejected.
2. Field test masonry unit moisture content prior to block installation. See Section 3.07, Field Quality Assurance.

1.4 SUBMITTALS

A. Manufacturer’s literature: Submit manufacturer’s literature describing products, including mix designs, history of compression tests, and mixing requirements as they apply to each different masonry unit, accessory and other manufactured product to be used in the unit masonry construction. Literature shall include, but not be limited to, preformed rubber control joints and all additives.

B. Certificates:

1. Submit material certificates for the following signed by the manufacturer and the Contractor certifying that each material complies with requirements designated.
   a. Each material and grade of reinforcing bars. See Section 032001, Concrete Reinforcement.
   b. Each type and size of anchors, inserts, ties and accessories.
2. The Contractor shall submit a certificate of compliance with the standards designated.
3. Submit plant certificates for all concrete masonry units to the Owner’s Testing Agency and Architect, stating that all units have been properly cured before shipment and that they conform to all requirements of these specifications.

C. Mix Designs: Submit mix designs for mortar and grout, and history of compression tests. Submit manufacturer’s literature for grout admixtures.

D. Unit Samples: Submit sample concrete masonry units in each color and texture combination
specified.

E. Samples: Submit samples of all accessories embedded in masonry.

F. Mill Test: Submit mill test reports for all reinforcing steel.

G. Extreme Weather Procedures: Submit cold and hot-weather construction procedures evidencing compliance with requirements specified in ACI 530.1 and these specifications.

H. Shop Drawings: Coordination and shop drawings for all concrete masonry unit walls. Drawings shall consist of elevations and sections indicating materials and assembly, color surface finish, courses and reinforcing. Shop drawings shall meet the following requirements:

1. The shop drawings shall illustrate detailing, fabrication, bending and placement of unit masonry reinforcing bars. Comply with ACI 315 showing bar schedules, stirrup spacing, diagrams of bent bars, and arrangements of masonry reinforcement. The shop drawings shall also indicate the location of all conduits, plumbing and other items embedded in unit masonry walls and coordinate this work with the placement of the unity masonry reinforcement.

2. All shop drawings shall be drawn to scale.

I. Test Reports: Submit material test reports indicating and interpreting test results relative to compliance with the tests described in this Section and Section 3.07 Field Quality Assurance.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Deliver and store packaged material in original containers with seals unbroken and labels intact until time of use.

B. At the time of delivery to the site, masonry units shall conform to the linear shrinkage requirements of ASTM C90.

C. Unload and inspect each masonry unit carefully and store on raised platform protected from weather so as to meet ASTM C90 requirements. Reject and remove from the site all material not conforming to specification requirements. In addition to lack of conformance to manufacturers' specifications, masonry units shall be rejected if:

1. The color or texture of the concrete masonry units deviates from the range of colors and textures displayed on approved mock-up, as determined by the Architect.
2. Concrete masonry units that are chipped, crack or otherwise damaged.

D. Protect cementitious materials against exposure to moisture.

1. Use of cementitious or other materials that have become caked and hardened from absorption of moisture will not be permitted.

E. Prior to installation, unload concrete masonry units onto working pallets as described in Section 3.02, D.

1.6 JOB CONDITIONS

A. Environmental Conditions:
1. Do not place unit masonry when temperature is below 40 degrees Fahrenheit, unless the Architect approves and the Contractor provides means for preventing damage from freezing before and after placement.

B. Protection:

1. Protect surrounding work as required against damage from masonry work.
2. Clean satisfactorily and correct damage to surrounding work resulting from masonry work.
3. The contractor shall take all means and precautions necessary to protect masonry units from moisture absorption during shipping, storage on site, placement prior to grouting of wall, during wall construction until the masonry wall is completed and water repellant coating is applied.
PART 2 - PRODUCTS

2.1 MATERIALS

A. Hollow Load-Bearing Concrete Masonry Units: As manufactured by Basalite, Calstone or approved equal. Medium weight (115 pcf) open end type concrete block size 4 x 8 x 12-inches conforming to ASTM C90, (0.065 maximum allowable linear shrinkage). Minimum compressive strength of 3750 psi. Provide compressive strength indicated on drawings. The colors listed are Basalite. Submitted colors must match Basalite colors.

1. Class A - Precision Face; Color

B. Portland Cement: ASTM C150, Type II.

C. Aggregates:
   1. For Mortar: ASTM C144.
   2. For Grout: ASTM C404.

D. Hydrated Lime; ASTM C207, Type S

E. Quick Lime: ASTM C5.

F. Reinforcing Bars:
   1. Bars: New billet steel, ASTM A615, Grade 60.
   2. Tie Wires: ASTM A82.
   3. Comply with the requirements of Section 03 20 00, Concrete Reinforcement.

G. Water: Clean and potable, free from impurities detrimental to mortar and grout.

H. Control Joints: Preformed rubber in profiles required or shown. Same as Sonneborn-Contech’s “Masonry Control Joints”; Dur-O-Wal National Inc.’s “Rapid Control Joint”; or equal product substituted per Section 01 63 00.

I. Mortar Coloring: Mineral oxide type, match to block color.

J. Additives and Admixtures: Required in all grout to reduce early water loss to the masonry units and produce expansive action in the plastic grout to offset the initial shrinkage and promote bonding of grout to the interior masonry unit surfaces. Use Grout Aid by W.R. Grace or approved equal. Obtain approval of admixture by Architect, Structural Engineer and Owner’s Testing Agency.

2.2 FABRICATION

A. Concrete Masonry Units: Blocks shall have been air cured for not less than 28 days.

B. Reinforcement:
   1. Shop-fabricate to comply with Drawings.
   2. Conform with requirements of ACI 315 where specific details are not shown or where
Drawings and Specifications are not more demanding.

2.3 MIXES AND MIXING

A. Mortar:

1. Conform to ASTM C270, Type S.
   
a. Compressive Strength: Minimum 4,000 psi after 28 days.
b. Proportions by Volume: Shall be as shown in CBC Table 2103A.11
c. Mortar Properties: Shall be as noted in CBC Table 2105A.2.2.1.2

2. Mix in batch mechanical mixer permitting accurate control of water amounts. Place approximately half of the required water and sand into the mixer while turning. Add cement and remainder of the sand and water into mixer in that order and mix materials for at least three minutes with minimum of water to produce workable consistency. Site mixing of mortar shall not be permitted without review and acceptance of Contractor’s procedure by the Owner’s Testing Agency and the Structural Engineer.

3. Add lime and continue mixing as long as required to secure a uniform mass.

4. Total mixing time may not be less than 3 minutes or more than 10 minutes.

5. Use and place mortar in final position within 2½ hours after mixing.

   a. Mortar that have stiffened as a result of evaporation of water may be re-tempered with water as frequently as required to restore required consistency during this time period.

B. Grout: Site mixing of grout shall not be permitted without review and acceptance by the Structural Engineer.

1. Compressive Strength: Minimum 2,000 psi after 28 days.

2. Slump: 9- to 10-inches.

3. Proportions by Volume: Shall be per CBC Chapter 21A.

4. Use grout aid in all grout to reduce early water loss to the masonry units and produce an expansive action in the grout sufficient to offset initial shrinkage. Mix grout admixture in accordance with the manufacturer’s recommendations and requirements.

5. Grout to comply with requirement of CBC Chapter 21A for materials and mixing requirements.

6. Use sufficient water to make a workable mix that will flow into all joints of the masonry units with typical rates of absorption for ASTM C90. The slump of the grout should be approximately 9 to 10 inches depending on temperature and humidity conditions.

C. General Mixing Requirements:

1. Measure materials accurately.

2. Shovel measurements will not be permitted.

3. Use mechanical mixer of at least one-sack capacity.

4. Completely empty drum before charging succeeding batch of materials.

5. Exercise extreme care in measuring ingredients for partial batches.
2.4 SOURCE QUALITY CONTROL

A. The Owner’s Testing Agency will:

1. Collect mill test reports for reinforcements under Section 1.04.
2. Take samples of reinforcement and test per Section 03 20 00, 1.03 (D).
3. Sample and test concrete masonry units for compressive strength, unit weight, absorption and moisture content in accordance with ASTM C140.
   a. Compressive strength tests of units shall also comply with CBC 2105A.2.2.1.1.
4. Test for moisture content and drying shrinkage in accordance with ASTM C426.
5. Take and test Portland cement grab sample per Section 03 30 00, 2.05(A)4.

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine areas to receive masonry and verify the following:

1. Foundation surface is level to permit bed joint within range of 1/4- to 3/4-inch.
2. Edge is true to line to permit projection of masonry to less than 1/4-inch.
3. Projecting dowels are free from loose scale, dirt, concrete, or other bond-inhibiting substances and properly located.

B. Do not begin before unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean concrete surfaces to receive masonry.

B. Remove laitance or other foreign material lodged in surface by sandblasting or other means as required.

C. Ensure masonry units are clean and free from dust, dirt, or other foreign materials before laying.

D. Roughen concrete below walls to expose aggregate; remove loose particles and in hot weather dampen concrete surfaces before laying blocks. Contact surfaces of all foundations and floors that are to receive masonry work are to be mechanically roughened to 1/4” amplitude. Comply with CBC Section 1906A.4.

E. Ensure random color variations in the installation of CMU. Unload from three delivered pallets onto a “working” pallet to be used for construction. Alternate among pallets when unloading to ensure a mix of CMU on the working pallet.

3.3 REINFORCEMENT

A. Place bars where noted in accordance with ACI 315 and CBC 2103A.13.1 and do not disturb after start of masonry placement.

B. All horizontal reinforcement shall be laid in bond beam units.
C. Minimum clearance between bar and CMU is 1/2-inch and between parallel bars is 1-inch.

D. Horizontal and vertical reinforcing shall be held in position by wire positioners or spacing devices near ends and at intervals not to exceed 200 bar diameters, and as required to prevent displacement by construction loads or placement of grout beyond the tolerances.

3.4 PLACEMENT

A. General Requirements:

1. Comply with CBC Section 2104A.6.1.1.2. High-lift grouting is not permitted.
2. Ensure masonry units are sound, clean and free of cracking, chipping and broken edges at time of placement.
3. Accurately cut and fit units as required to accommodate other work using masonry saws.
4. Lay masonry units plumb, true to line, with level courses accurately placed.
5. Adjust unit to final position while mortar is soft and plastic.
6. Align vertical cells accurately.
7. Remove units disturbed after stiffening of mortar, clean joints, and relay unit with fresh mortar.
8. In hot weather, moisten contact surfaces of the masonry units to receive mortar immediately before laying to prevent excessive drying of mortar.
9. Do not lay up one tier of wall more than 16-inches ahead of other tier.
10. Where necessary to stop longitudinal run, rack back one-half block length in each course.
11. Do not attach construction supports to walls, except where permitted by the Architect.
12. Install anchors, bolts, and other embedded items accurately as work progresses and prior to grouting.
13. Masonry installer and reinforcing steel installer shall meet and coordinate placement of reinforcing steel prior to placement of concrete or grout.

B. Joints:

1. Fill joints to thickness noted: Ensure full coverage of face shells in both horizontal and vertical joints and on webs.
2. Tool joints as specified on the drawings and achieve solid, smooth, watertight, compacted joints.
3. Joints Exposed to Weather: Point with pointing tools making solid, smooth, watertight joint well bonded to masonry at edges.
4. Immediately fill holes made by line pin with mortar when pin is withdrawn.
5. Remove surplus mortar from joints.
C. Cold Weather Requirements:

1. When daily temperature is below 40 degrees F., ensure reinforcing, masonry units, etc., contacting mortar, and grout are free of frost.
2. Protect all mortar and grout from freezing for at least 48 hours after installation whenever temperature falls below 40 degrees F.
3. Maintain mortar and grout at temperature no lower than 50 degrees F., while being used and until installed.
4. In freezing or near freezing weather, provide equipment of adequate size for heating of mortar and grout.
5. Do not add water to mix at temperature greater than 140 degrees F.

D. Hot Weather Requirements:

1. Implement the requirements of approved Hot Weather construction procedures when ambient air temperature exceeds 100 degrees F or 90 degrees F with a wind velocity greater than 8 mph.

E. Protection:

1. Protect face materials against staining.
2. Remove misplaced grout or mortar immediately.
3. Protect sills, ledges, offsets, and similar items from mortar drippings or other damage during construction.

F. Concrete Masonry Units:

1. Bond: Running bond, unless specifically noted otherwise.
2. Joint Thickness: 3/8-inch, both vertically and horizontally.
3. Joint Treatment:
   a. Where exposed, all mortar joints shall be tooled joints.
   b. Where concealed, cut off mortar flush with face of work using trowel.
4. Use single open-ended or double open ended beam units, typical. Use proper units to provide for windows, doors, bond beams, lintels, pilasters, etc., in order to minimize cutting.
5. Do not wet units.
6. Align vertical cells to provide continuous, unobstructed opening for grouting.
7. Corners: Provide standard masonry bond by overlapping units.

3.5 GROUTING

A. General Requirements:

1. Use low-lift grouting procedure. High-lift grouting is not permitted. Do not pour grout until mortar has set and cured, 36 hours minimum. Grout walls as soon as possible after mortar has cured.
2. Grout voids between wythes and cells of concrete block.
3. Ensure grout flows into voids and completely surrounds reinforcing steel.
4. Stop grout approximately 1-1/2 inches below top of last course (1/2” at bond beams with
horizontal steel), except at top course, bring grout flush with top of block.
5. Grout from inside face of masonry wherever possible.
6. Where necessary to stop longitudinal run, provide suitable dam to retain grout in place.
7. Do not wet down grout spaces prior to grouting.

B. Low-Lift Grouting: Comply with CBC Section 2104A.5.1.1.1.
1. Pour grout to a maximum height of 4-feet, stopping 1-1/2-inches below top of unit except at bond beam units with horizontal steel the grout shall be stopped 1/2-inch below top of unit.
2. Delay 3 to 5 minutes allowing the excess of water to be absorbed by the masonry unit, then consolidate by vibrating.
3. Layup and grout next 4-feet of walls.

3.6 POINTING AND CLEANING

A. Point holes or defective mortar joints upon completion of work; where necessary, cut out and repoint defective joints.

B. At end of work day, fiber-brush new surfaces to remove mortar splotches, clean with mild detergent or enzymes, and rinse with clean water.

C. Do not use acid solution to remove green stain or efflorescence resulting from salts; follow recommendations of manufacturer for removal of such stains.

D. Upon completion of work, remove from site surplus materials, rubbish, and debris resulting from this work.

3.7 FIELD QUALITY ASSURANCE

A. Special Inspection: The Owner shall employ an approved, qualified masonry inspector to perform continuous masonry inspection per CBC 1701A. Special inspectors shall be prequalified by DSA. The masonry inspector shall be at the site during all masonry construction and perform the following duties:

1. Review plans and specifications and meet with the Contractor to discuss requirements before work commences.
2. Before masonry work commences, meet with the Contractor and the Architect in a joint meeting to review the requirements for surveillance and quality control of the masonry work.
3. Check brand and type of cement, lime (if used) and source of sand.
4. Inspect the foundation or slab to ascertain that it is clean and ready to receive units.
5. Check reinforcing steel dowels for straightness, proper alignment, spacing, size and length.
6. Observe manner in which units are laid up to ensure that joints are full of mortar and kept tight during work. Inspect cells to assure that fins will not interfere with grouting or foaming. Instruct masons to keep cells clean of mortar droppings and inspect to determine compliance.
7. Observe placing of grout continuously.
8. Perform or supervise performance of required sampling and field testing as specified.
9. Keep complete record of inspection of work. Report daily to the Owner's Representative the progress of the masonry inspection.
10. Submit verified reports to DSA.

B. Prism Test: The Owner’s Testing Agency will perform prism testing in accordance with CBC Section 2105A.2.2.2. Prior to construction, a set of 5 masonry prisms shall be built and tested using materials taken from those specified for this project. During construction test 3 prisms for each 5,000 sq. ft. of wall area and as additionally required by the Architect.

C. Mortar and Grout Testing: The Owner’s Testing Agency shall verify that mortar complies with the requirements of CBC Chapter 21A. Compressive strength tests shall be performed on grout, one test for each 5,000 square feet of wall area. Test mortar and grout in accordance with CBC 2105A.2.2.1.4.

END OF SECTION 04 20 00
SECTION 06 10 00
ROUGH CARPENTRY

PART 1 - GENERAL

1.1 DESCRIPTION

A. Section Includes: Provision of all lumber framing, rough hardware and blocking as indicated in the contract drawings.

1.2 REFERENCES

A. Requirements of GENERAL CONDITIONS and DIVISION NO. 1 apply to all Work in this Section.

B. The following published specifications, standards, tests, or recommended methods of trade, industry, or governmental organizations apply to Work in this Section (latest editions apply).


2. (APA) - American Plywood Association, "Guide to Plywood Grades."

3. (PS) - United States Product Standard, PS-1 and PS-2 “Construction and Industrial Plywood.”

4. (UL) - Underwriters’ Laboratories, Inc., “Fire Hazard Classification, FR-S.”

5. (WCLIB) - West Coast Lumber Inspection Bureau, “Standard Grading Rules No. 16.”

6. (WWPA) - Western Wood Products Association, “Grading Rules for Lumber.”

7. (AWPA) - American Wood Preservers Association Standards.

8. (AF&PA) - American Forest and Paper Association.


1.3 SUBMITTALS

A. Shop Drawings of all specially fabricated rough hardware.

B. Samples only as requested by the architect.
1.4 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Provide proper facilities for handling and storage of materials to prevent damage to edges, ends, and surfaces.

B. Keep materials dry. Where necessary, stack materials off ground on level flat forms, fully protected from weather.

1.5 JOB CONDITIONS

A. Environmental Requirements: Maintain uniform moisture content of lumber at not more than 19-percent during and after installation.

B. Sequencing, Scheduling: Coordinate details with other Work supporting, adjoining or fastening to rough carpentry Work.

PART 2 - PRODUCTS

2.1 MATERIAL

A. Rough Carpentry:

B. Sills on Concrete: Pressure treated Douglas Fir.

C. Lumber (Wood Framing): Meet requirements of following minimum grades.

<table>
<thead>
<tr>
<th>Item</th>
<th>Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Studs</td>
<td>D.F. No. 1</td>
</tr>
<tr>
<td>b. Plates</td>
<td>D.F. No. 1</td>
</tr>
<tr>
<td>c. Beams</td>
<td>D.F. No. 1</td>
</tr>
<tr>
<td>d. Joists</td>
<td>D.F. No. 1 or better</td>
</tr>
<tr>
<td>e. Posts</td>
<td>D.F. No. 1</td>
</tr>
<tr>
<td>f. Blocking</td>
<td>D.F. No. 2 or Standard or better</td>
</tr>
</tbody>
</table>

D. Plywood: Provide thickness, grade, and panel identification index shown on drawings. For plywood thickness 5/32 or greater provide a minimum of 5 ply.

E. Rough Hardware: All exterior hardware shall be hot-dipped galvanized.

1. Nails: Common wire, typical; hot-dipped galvanized at exposed conditions and pressure-treated lumber.

3. Expansion Bolts: Reverse cone, self-wedging, expansion type, Tightening of nut or increased tension on bolt shank shall act to force wedges outward to create positive increased resistance to withdrawal. Ramset/Read Head “Tru-Bolt,” Hilti Kwik-Bolt 3 or equal product substituted general conditions.

4. Metal Framing Connectors: Fabricate from hot-dipped galvanized steel (G90 coating). Connectors in contact with pressure treated lumber shall have G185 hot dipped galvanized coating per ASTM A653. Connectors shall be at least 16-gauge material, 1/8-inch plate materials where welded, unless otherwise shown or specified, punched for nailing. Nails and nailing shall conform to the manufacturer’s instructions, with a nail provided for each punched nail hole. Use maximum nail size listed by manufacturer. Manufactured by Simpson Company or equal product substituted general conditions.

5. Miscellaneous Hardware: Provide all common screws, bolts, fastenings, washers and nuts required to complete rough carpentry work.

6. Bolts and sill bolts in wood shall be ASTM A307 with standard cut threads; full diameter bolts (no rolled or “upset” threads permitted) per ANSI/ASME standard B18.2.1.

2.2 TREATMENTS

A. Fire-Retardant Treatment: Same as Koppers Co., Inc.’s “Non-Com” J.H. Baxter and Co.’s “Baco-Pyresote”; or equal product substituted general conditions.

B. Preservative Treatment: Furnish in accordance with AWPA. Preservatives with an ammonia base, including Ammoniacal Copper Zinc Arsenate (ACZA) are not permitted.

2.3 FABRICATION

A. Preparation:

1. Verify measurements at job site.

2. Verify details and dimensions of equipment and fixtures integral with finish carpentry for proper fit and accurate alignment.

3. Coordinate details with other work supporting, adjoining, or fastening to casework.

Lumber:

4. Air- or kiln-dry to maximum 19-percent moisture content at time of surfacing.

5. Furnish surfaced four sides, S4S, unless otherwise noted.

6. Size to conform with rules of governing standard. Sizes shown are nominal unless otherwise noted.
B. Wood Treatments:

1. Preservative Treatment:
   a. Treat lumber and plywood sheathing.
      i. In contact with concrete and masonry less than six feet above the ground.
      ii. Exposed to weather permanently.
      iii. Where specified in the Contract Documents.
   b. Lumber: Treat in accordance with AWPA C2
   c. Plywood: Treat in accordance with AWPA C9
   d. After Treatment and prior to shipping, air- or kiln-dry lumber to maximum 12-percent moisture content.

2.2 SOURCE QUALITY CONTROL

A. Lumber shall bear grade-trademark or be accompanied by certificate of compliance of appropriate grading agency.

B. Plywood shall bear APA grade-trademark.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas to receive rough carpentry Work and verify following:
   1. Completion of installation of building components to receive rough carpentry Work.
   2. That surfaces are satisfactory to receive Work.
   3. That spacing, direction, and details of supports are correct to accommodate installation of blocking, backing, stripping, furring and nailers.
   4. That all anchor bolts and holdown bolts are properly installed.

3.2 INSTALLATION

A. Cutting: Perform all cutting, boring, and similar Work required.

B. Studs, Joists, Beams, and Posts: Install all members true to line. No wood shingle shims are permitted. Place joists with crown up; maximum 1/4-inch crown permitted.
C. Nail joints in accordance with applicable requirements of the CBC Table 2304.9.1 unless otherwise shown or specified. Predrill where nails tend to split wood. Nails into pressure-treated lumber shall be hot-dipped galvanized.

D. Bolt holes to be 1/16-inch oversize. Threads shall not bear on wood. Use standard malleable iron washers against wood. Carriage bolts require washers under the nut only.

E. Provide blocking, grounds, nailers, stripping, and backing as shown and as required to secure other Work.

F. Maintain 1/8-inch gap between all plywood panel edges.

G. Do not utilize plywood sheets having a width smaller than 1-feet 0-inches.

H. Plywood flooring shall be field glued with adhesive meeting APA specification AFG-01 applied in accordance with the manufacturer's recommendations. Apply continuous line of glue on joists and in groove of tongue and groove panels.

I. Where wood is cut, sawed, planed, bored or marred after preservative or fire-retardant treatment, apply two heavy brush coats of same material used in treatment.

J. Nail heads shall be driven flush with plywood surface. Overdriven nails (nails which fracture the outer ply layer) shall be replaced one for one.

K. Screws (Wood or Lag): Screws shall be screwed and not driven into place. Screw holes for the unthreaded portion shall be predrilled to the same diameter and depth of shank. Holes for threaded portion shall be predrilled less than or equal to the diameter of the root of the thread. Provide standard cut washers under head of lag screws.

3.3 CLEANING AND ADJUSTING EXPOSED TIMBER

A. Remove damaged or otherwise disfigured portions and replace with new prior to the Owner's acceptance.

B. Wash finished Work in strict accordance with product manufacturer's directions and ensure that washed surfaces do not differ from clean unwashed surfaces. Any difference will be considered unsatisfactory work.

3.4 FIELD QUALITY CONTROL

A. The Owner's Testing Agency shall:

1. Inspect erected timber framing as required to establish conformity of work with Drawings.

2. Inspect all bolted connections.
3. Inspect roof diaphragm nailing for nail size, spacing and penetration at plywood panel edges, and special nailing at collector and drag members.

4. Inspect shear wall nailing for nail size, spacing and penetration at plywood panel edges, and nailing at holdown posts.

B. Machine Nailing: Use of machine nailing is subject to a satisfactory jobsite demonstration for each project and the approval of the Project Inspector, the Structural Engineer and DSA. The approval is subject to continued satisfactory performance. If the nail heads penetrate the outer ply more than would be normal for a hand-held hammer, or if minimum allowable edge distances are not maintained, the performance will be deemed unsatisfactory and machine nailing shall be discontinued.

END OF SECTION 06 10 00
SECTION 07 54 05

THERMOPLASTIC MEMBRANE ROOFING SYSTEM

PART 1 – GENERAL

1.1 SECTION INCLUDES

A. Single-ply roof system complying with California Title 24 (Cool Roofing) regulations as shown on the Drawings.

1.2 RELATED SECTIONS

A. Section 07 60 00 – Flashing and Sheet Metal
B. Section 07 90 00 – Sealants

1.3 SCOPE

A. Membrane and related items shall be classified by Underwriters Laboratories, Inc. as a Class A Sheathing Material for use in construction of Class A coverings and amendments. Wind: Factory (FM) 1-75.

1.4 APPLICATION

A. Duro-Last/Duro-Fleece (DLDF) membrane is composed of PVC film laminated to both sides of a weft insertion knitted scrim and laminated to fleece backing.

B. Install new single-ply, fully-adhered reinforced PVC roofing and PVC overlay systems, as shown on the Drawings.

C. Install new fully-adhered membrane flashings and associated components along walls, curbs, or as shown in the Drawings and as required to properly terminate the roof membrane.

D. Clean and restore all areas damaged, stained or otherwise affected by the Work.

E. Include Operation/Maintenance manual and PVC repair kit with instructional course as provided by the manufacturer for use by the Owner’s maintenance staff.

F. Attend a roof-related preconstruction meeting after the submittals were transmitted and prior to the start of Work. Required attendees are the Owner Representative, Engineer, Contractor, and Roof Manufacturer.
1.5 PHYSICAL PROPERTIES

A. The single-ply membrane shall allow installation at any time of the year and shall provide resistance to ultra-violet rays, superb tear and puncture strength, the ability to be impervious to most caustic chemicals and acids, and show no ill effects to heat or cold.

1.6 ROOFING CONTRACTOR'S QUALIFICATIONS

A. Contractor shall submit work history data showing successful warranted installation experience of the specified system, and of being authorized by the roofing system manufacturer to install the specified manufacturer’s materials.

B. The Contractor shall use adequate amounts of such qualified workmen to install the specified roofing system.

C. The Contractor shall have an experienced, pre-qualified, superintendent having experience installing the roof system specified, familiar with the requirements of this project, on the job at all times when roofing system work is in progress. Training for superintendent shall include certification of completion of manufacturer’s in-house training course and on-site training.

1.7 REQUIREMENTS OF THE MEMBRANE MANUFACTURER

A. Roofing system components shall conform to the current published specifications and details of the membrane manufacturer.

B. There shall be no deviation made from this specification without prior written approval of the membrane manufacturer and the Owner or Owner representative.

C. Any manufacturer proposing to supply material for this project shall within fourteen (14) days prior to bid date, provide financial information regarding their roofing company, i.e. a current D&B report. A manufacturer who has less than $50,000,000 in annual roofing material sales, a net worth of less than $3,000,000 or a history of late payments to creditors will not be permitted to submit their roofing material for use on this project. Manufacturer may be asked to submit an audited document listing the long-term warranty liability commitment of manufacturer.

D. Provide primary thermoplastic membrane factory prefabricated roofing system from a single manufacturer, which has successfully manufactured raw materials into specified products for not less than five (5) years. No secondary private labels will be accepted. Provide secondary materials, such as insulation, gypsum board, vapor barriers as recommended and approved by manufacturer of primary materials.

E. Products primary and secondary shall be manufactured in the United States of America by a company owned by citizens of the United States.
1.8 FIELD INSPECTION

A. The Owner reserves the right to retain, at the Owner’s expense, an independent inspection service to provide part-time or full-time inspection of the roofing system installation. The inspector shall have free access to the work area.

B. The Contractor shall arrange for the membrane manufacturer to provide inspection of the roofing system installation. Upon completion of the installation, an inspection shall be made by a Quality Assurance Specialist of the membrane manufacturer at no extra charge to the Owner or Contractor. The inspection is to confirm the roofing system is installed in accordance with the membrane manufacturer’s published specifications and details and Contract Documents.

1.9 DEFECTIVE WORK

A. Should the roofing system not be approved by the manufacturer’s technician, correcting the defective work shall be done by the Contractor until the roofing system satisfactorily meets all the specifications and manufacturer’s requirements. Corrective work shall be done with no additional expense to the Owner.

1.10 WARRANTIES

A. The Contractor shall warrant the roof application with respect to workmanship and proper application for two (2) years from the date of acceptance by the membrane manufacturer. Should any leaks covered under the warranty occur during this period, corrective action shall be taken by the Contractor to repair the roof to the satisfaction of the Owner and the manufacturer. All corrective work shall be done at no cost to the Owner.

B. The warranty shall be full roofing system repair and/or replacement fifteen (15) year warranty covering materials and labor. The warranty shall be a no-dollar limit type and provide for completion of repairs, replacement of membrane or total replacement of the roofing system at the then current material and labor prices throughout the life of the warranty. Warranty shall contain no exclusions for ponded water, biological growth, incidental or consequential damages.

C. Warranty shall be issued by the original manufacturer of the roofing membrane. No private label membranes will be accepted.

D. No future work shall be done on the roof, including but without limitations, openings made for flues, vents, drains, sign braces, or other equipment fastened to or set on the roof, without prior notification of the Contractor or membrane manufacturer. Contractor or membrane manufacturer shall be given the opportunity to make the necessary roofing application recommendations, and require such recommendations to be complied with. Failure to observe this condition can render the warranty null and void.
E. Corrective measures on leaks shall be undertaken within seventy-two (72) hours after Owner notification has been received by the Contractor or the roofing manufacturer from the Owner.

1.11 SUBMITTALS

A. The contractor shall submit the following:

1. Written confirmation from membrane manufacturer of approved applicator status and that the Contractor is qualified for the specified warranty.

2. Manufacturer literature and MSDS sheets for the items listed in Part 2.

3. Submit 6 in. long samples of the following items for approval prior to ordering:
   a) Pre-manufactured pipe flashing
   b) Termination bar
   c) Sample of membrane
   d) Mechanical fasteners and metal distribution plates
   e) Lap splice sample (factory and field)
   f) Roofing insulation

4. Shop drawings including outline of the roof and roof size, perimeter and penetration details, special details and section layout, location of factory dielectric and field welds, accessory and material list.

5. Pullout Tests: Perform pullout tests and submit engineering results of manufacturer’s random location pull tests. Manufacturer shall obtain at least two (2) pull resistance tests from indicated locations of sections of decking, where integrity is in question. Submit pull test results with drawing indicating the locations of the tests. Engineering results shall demonstrate the manufacturer’s reasons for selection of anchorage, frequency and the seaming patterns.

6. Membrane Data: Prior to receipt of bids, Contractor shall submit all forms and other required data to roofing system manufacturer for pre-approvals. Advise building Owner or Owner Representative in writing of any recommendations made or revisions required by manufacturer to particular job conditions. In the absence of any comments, the Owner and/or his representative shall assume the manufacturer’s most recently published specifications shall be followed.

7. Provide Operations/Maintenance manual and repair procedures to the Owner and/or Owner’s representative.

B. INSULATION

1. The Contractor shall verify dimensions and existing roof penetration locations to
ensure proper layout and tapered insulation quantities. Submit a tapered insulation layout drawing (full size: 24 inch x 36 inch) from the insulation manufacturer. The drawing should include an outline of the roof area and locations of drains and major roof penetrations (i.e., smoke hatches and fan units). Provide a profile of tapered sections; indicate minimum and maximum thicknesses at perimeters, for the proposed insulation system.

2. Submit certification from each insulation manufacturer stating the roof membrane manufacturer for the specified warranty accepts the submitted products.

1.12 PRODUCT DELIVERY, STORAGE AND HANDLING PROCEDURES

A. Deliver materials in original unopened packaging.

B. Containers labeled with manufacturer’s name, brand name, and identification of various items.

C. Store materials in a dry area and protect from inclement weather. Damaged materials shall be replaced at contractor’s expense.

D. Do not allow roofing membrane to come in contact or be exposed to any materials that would be detrimental to or cause degradation of the roofing membrane.

1.13 JOB CONDITIONS

A. Environmental Conditions

1. In making field heat welds, make sure all welding surfaces are clean and free of moisture or foreign items.

2. Weather Precautions: Proceed with roofing work when existing and forecasted weather conditions permit work performance in compliance with manufacturer’s recommendations.

3. Roofing system shall not be applied when the surrounding air, surface temperature, relative humidity or wind velocity is not within the range acceptable under the manufacturer’s recommendations.

B. Protection

1. Prior to starting work, protect all work in an approved manner including all paving and faces of building walls. Provide special protection of the face of the building wall adjacent to hoist.

2. Complete the whole roofing section or any portion of the roof in a single day to avoid exposure to rain, dew, or moisture of any kind. If rain threatens during the day or in an emergency, protect the unfinished exposed roofing components.
and provide temporary water cut-offs around exposed edges and incomplete flashing areas.

3. All hoisting equipment shall bear on solid pad blocking. If on the roof surface, pad shall be large enough to evenly distribute the load to avoid crushing insulation and roof system. Pad shall consist of two separate layers of material to eliminate vibration and movement to directly affect the roofing membrane. Pad shall be of sufficient size to accommodate work tools and weights used around hoisting operations.

4. Repairs: Clean or repair surfaces damaged or soiled by operations under this contract to the satisfaction of the Owner or Owner’s representative without additional cost to the Owner. These would include, but not be limited to, windows, doors, floors, walls, stairs, elevators, steps, walks, curbs, lawn areas, or other roofs.

PART 2 – MATERIALS

2.1 ROOF MEMBRANE

A. A special formulated, permanent, thermoplastic alloy, bonded to a high tenacity, low shrinkage weft inserted polyester fabric with resistance to ultraviolet rays, microorganisms and impervious to most caustic chemicals.

B. Membrane shall be factory dielectrically welded, prefabricated sheets up to 2,500 square feet or as determined by job condition.

C. The new roofing shall be a prefabricated fully adhered installation of single-ply reinforced co-polymer alloy (CPA) membrane. Product: 60 mil thick fleece-back membrane by Duro-Last Corporation or approved equal. Manufacturer’s physical specifications and minimum performance criteria shall be in accordance with the following table.

<table>
<thead>
<tr>
<th>Physical Property</th>
<th>Test Method Used</th>
<th>Specification Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum Thickness</td>
<td>ASTM D-751</td>
<td>0.060 inch (60 mils) Nominal (with fleece)</td>
</tr>
<tr>
<td>Tear Strength,</td>
<td>ASTM D-751 – Procedure B</td>
<td>50 x 200 lbf.</td>
</tr>
<tr>
<td>Breaking Strength</td>
<td>ASTM D-751 – Grab Method</td>
<td>554 x 408 lbf.</td>
</tr>
<tr>
<td>Elongation at Break</td>
<td>ASTM D-751 – Grab Method</td>
<td>34%</td>
</tr>
<tr>
<td>Low Temperature Bend</td>
<td>ASTM D-2136</td>
<td>no cracks, -40 degrees F</td>
</tr>
<tr>
<td>Static Puncture</td>
<td>ASTM D 5602</td>
<td>≥ 33 lbf.</td>
</tr>
<tr>
<td>Water Absorption</td>
<td>ASTM D 570 166 hrs. @ 158°F</td>
<td>2.3%</td>
</tr>
<tr>
<td>Linear Dimensional Change</td>
<td>ASTM D1204 – 6 hrs. @176°F</td>
<td>-0.10 %</td>
</tr>
<tr>
<td>Accelerated Weathering</td>
<td>ASTM G 154 (Formerly G53)</td>
<td>No cracking, checking, crazing, or erosion at 5000 hours of exposure.</td>
</tr>
<tr>
<td>Factory Mutual Research</td>
<td>ASTM E-108; FM 4450 &amp; FM 4470</td>
<td>Rated 1-75</td>
</tr>
<tr>
<td>-------------------------</td>
<td>-------------------------------</td>
<td>-----------</td>
</tr>
<tr>
<td>Underwriter’s Laboratory</td>
<td>UL-790</td>
<td>Class A, B and C approved</td>
</tr>
<tr>
<td>Scrim: Weft Inserted Polyester</td>
<td>-</td>
<td>18 x 9, 1000 denier</td>
</tr>
</tbody>
</table>

D. Membrane Adhesive: Duro-Last WB II or approved equal (for only Duro-Last membrane at walls).

E. Fleece Membrane Adhesive: Duro-Fleece CR-20 or approved equal (for only Duro-Fleece membrane at roof deck and at walls).

F. Underseal Adhesive: Duro-Last SB 240 or approved equal – trowable mastic.

G. Perimeter Flashing Adhesive: Duro-Caulk Advanced.

H. Slip Sheet: Atlas FR-50 or approved equal

I. Manufacturer

1. Manufacturers requesting approval must submit acceptable information certifying that they are the direct manufacturer from raw material into specified membrane, factory prefabricate the membrane into roofing panels if any, and meet the performance and financial criteria required.

2. Fire resistance of CPA roofing system shall meet UL Class A. All packaging of membrane and insulation shall bear UL Class A label.

3. Membrane color shall be white.

2.2 MATERIALS

A. Membrane-Related Materials

1. All membrane components, including pipe and curb flashings, shall be factory prefabricated from the same fabric reinforced material used for the deck membrane.

2. Termination Sealant: Compatible with materials to which membrane is to be bonded, conforming to Federal Specifications TT-598 and TT-S-00230C as furnished by the membrane manufacturer.


4. Water Cut-Off Mastic: Compatible with materials with which it is used and furnished by the membrane manufacturer.
5. Fasteners: Compatible with roof deck as furnished by the membrane manufacturer. Fasteners shall be furnished by the membrane manufacturer and be Duro-Coated Duro-Last HD #14 and must pass 30 cycles in the Keesternich Cabinet, DIN #50018-2 Liter. The FM approved fastener is inserted through the hole in the distribution plate and properly secured to the roof deck.

6. Terminations/Edge Details: Shall be manufactured from rigid exterior vinyl with slotted holes for securement and furnished by membrane manufacturer. All other terminations/edge details must be approved and warranted by the membrane manufacturer.

7. Termination Bars: Duro-Last or approved equal.

8. Pourable Sealer: Duro-Last Pitch Pocket Filler or approved equal.

2.3 COVERBOARD & INSULATION

A. Cover Board: Board shall be a minimum of 1/4 inch thick by 4 feet by 8 feet. Dens-Deck Prime roof board by Georgia Pacific or approved equal – at roof decks. 1/2 inch thick 4 feet by 8 feet Dens-Deck roof board – at walls.

B. Tapered and Flat Stock Insulation: A rigid isocyanurate board with factory-applied fiberglass bituminous felts on both sides. Conforming to HH-I-530A (Type II, unfaced) and C1289-02, Type II, Class 1, Grade 2 with an average density of 2.0 lbs. per cubic foot. Manufacturer: DuroLast, Duro-Guard Polyisocyanurate ISO II or an approved equal flat and tapered panels. The board size: 4 foot by 8 foot, ¼ in. per foot slope for tapered insulation.

2.4 MISCELLANEOUS

A. Roofing Nails: Stainless Steel “Stronghold” type: (for use on parapet walls, wood nailers).

B. Pipe Clamps: Stainless steel draw band clamps.

C. Fasteners and Accessories

1. Fasteners for securement of each layer of gypsum fire barrier board under pvc roof system through the isocyanurate insulation (where applicable) and into the wood deck shall be fluorocarbon-coated, No. 14 self-drilling, self-tapping screws, long enough to penetrate the receiving substrate 1-¼ inches minimum and 1-½ inches maximum. Fasteners shall be in conformance with FM 4470 specifications.
2. Provide screws with stress distribution plates by Duro-Last, minimum 0.024 inch thick, 3 inch square plate.

D. Nailers & Blocking

1. Blocking/Lumber: Grade #2 Douglas Fir with 19% moisture content max conforming to standard 15 grading and dressing rules of the West Coast Lumber Inspection Bureau, or other species of wood of equal strength. All lumber shall be grade marked at the mill and pressure treated by a method approved by the roofing membrane manufacturer: “Wolmanized” or “Osmose K-33” is acceptable.

2. Nailer Fasteners: Nailers shall be securely anchored to the deck to resist the minimum force required in the recent edition of Loss Prevention Data Sheet I-49, “Perimeter Flashing,” Factory Mutual Systems, for FM 1-75, fasteners spacing must be 4 inches o.c. maximaum. 16 d common nails must be minimum size fasteners.

3. PVC(Vinyl)-Clad Metal Flashing: GSM flashing coated on one side by membrane manufacturer with weldable, PVC-clad surface or pre-manufactured with factory/shop welded piece of membrane pre-welded to surface by membrane manufacturer.

4. Other Accessories: Shall be furnished and approved by the membrane manufacturer.

PART 3 – EXECUTION

3.1 SUBSTRATE INSPECTION AND PREPARATION

A. Inspect all surfaces to receive roofing for condition that will adversely affect execution, performance.

B. All roof surfaces and all sloped surfaces to gutters and outlets shall be checked and approved by the roofing contractor prior to the start of the roofing work.

C. Install roofing material only under satisfactory conditions as specified by the membrane manufacturer.

D. Scheduling: Schedule the roofing work in areas and sections in such a manner as to keep the new and existing insulation, roofing materials, and building dry and watertight during new roofing work.

E. Damage sustained to the facility or contents as a result of the scheduling of roofing work shall be the Contractor’s responsibility.
F. Preparation shall comply with the membrane manufacturer’s recommendations.

G. Mechanically secure separation material units to roofing deck independent of membrane attachment and cover immediately with membrane. Butt units tightly together, limiting joint separation to 1/8 inch, maximum. Meet attachment pattern requirements of the membrane manufacturer.

H. Prior to insulation installation, remove all dirt, debris and dust from deck surfaces with a vacuum. Insulation systems shall be installed on properly installed, clean, dry surfaces. Should surface moisture such as dew exist, the Contractor shall provide the necessary equipment to dry the surface prior to application. Do not dry with open flames.

I. Inspect insulation boards for defects, including but not limited to: broken corners, improperly adhered skins, excessive moisture content, dimensional irregularities, or other defects which may adversely effect the replacement roof system. Mark defective insulation boards and remove them from site.

J. Cut insulation to the minimum dimension of 12 inches; the minimum surface area shall be 2 square feet.

K. Do not deliver to site or install any material or system that has not been approved. Materials installed without approval may be required to be removed. All containers must bear the label and material classification of the manufacturer. Partially used containers and unlabeled containers may not be incorporated into the work.

L. Comply with the manufacturer’s written instructions and these specifications. In case of discrepancies, the greater quantity and/or better quality of work, as determined by the Owner, will be provided by the contractor at no additional cost.

M. Flashings shall be installed concurrently with the roof membrane to assure watertight terminations.

N. Do not cut any material with a solvent or diluant unless approve by the owner in writing.

O. Keep covers tightly sealed on all canned and evaporative products to prevent premature curing.

P. Report any damaged or unsuitable deck sections immediately to the Owner’s representative prior to covering and replacing.

Q. The contractor shall ensure that all applicable safety requirements are strictly followed. This includes OSHA, CALOSHA and other applicable requirements regarding work with construction equipment for workers and building occupants.

R. Welded seams shall be checked after cooling for continuity with a dull, flat head screwdriver or
other suitable object. Daily, on-site evaluation of welded seams shall be made by the Contractor at locations as directed by the Owner's representative or membrane materials representative. Two inch wide cross-section cuts shall be taken through completed seams. Correct weld displays failure from shearing of the membrane prior to separation of the weld. Each test cut cross-section area shall be patched by the Contractor at no extra charge to the Owner.

S. Membrane specified to be fully adhered to insulation and various other horizontal and vertical substrates must be adhered completely without voids, bridging of membrane or unattached membrane.

3.2 GENERAL REQUIREMENTS

A. Precautions

1. Do not lay out or expose insulation that cannot be covered by membrane on the same day.

2. In making field heat welds, make sure edges are clean and free of tar, mastic or other foreign items.

3. Do not expose membrane and accessories to a constant temperature in excess of 120 degrees Fahrenheit.

4. Sealants and adhesives should be applied according to the manufacturer's specifications and all containers shall be disposed of properly.

5. Start securing the membrane at the highest point and work towards the drains.

6. Storing, wheeling, or trucking directly on roof insulation or membrane surface is not recommended. Smooth, clean plywood or plank walkways, runways and platforms shall be provided as necessary.

B. Comply with local, state, and federal regulations regarding the removal and disposal of roofing materials.

C. Roofing shall not be applied when ambient temperature is less than 40°F or more than 100°F. Materials which have a temperature other than the recommended application temperature by the manufacturer shall not be installed.

D. Surfaces to receive membrane or flashings shall be thoroughly dry. Should surface moisture such as dew exist, the Contractor shall provide the necessary equipment to dry the surface prior to application. No open flames will be allowed.

E. Completed roof areas shall not be trafficked. Work shall be coordinated to prevent this
situation by working toward the roof edges and access ways. Should access to completed roof areas be necessary, the Contractor shall provide (membrane covered) plywood protection for the trafficked areas.

F. Temporary waterstops shall be installed at the end of each day’s work, and shall be removed before proceeding with the next day’s work. Waterstops shall be compatible with all materials and shall not emit dangerous or incompatible fumes.

G. The Contractor is cautioned that thermoplastic membranes are incompatible with oil-based and asphaltic-based cement. Creosote and penta-based materials are also incompatible. The Contractor should consult the manufacturer with respect to material compatibility and shall provide protection against contamination of PVC membrane and flashings.

H. The Contractor shall provide necessary temporary protection and barriers to segregate the work area and to prevent damages to adjacent areas.

I. Prior to and during application, dirt, debris and dust shall be removed from surfaces either by vacuuming, sweeping or similar methods.

J. Liquid materials such as solvents and adhesives shall be stored and used away from open flames, sparks and excessive heat.

K. The Contractor shall be a licensed and approved applicator recommended by the manufacturer of the roof system specified. The Contractor shall notify the manufacturer prior to initiating the construction. It is the responsibility of the Contractor to arrange for the membrane manufacturer’s technical representative to be on site when construction commences and a minimum of once per week until construction is completed. The Owner and Owner’s Representative should be notified of scheduled visits so that they may attend.

L. The building will be open to normal use during the time of construction. The Contractor shall take all precautions to create as little disruption as possible during the course of the work.

M. The Contractor shall provide and equip as many work crews as is necessary to complete the project within the Contract period and according to the Contract Specifications without sacrificing quality.

N. The Contractor shall closely follow adhesive application rates when adhering membranes and flashings. The contents within adhesive containers shall be thoroughly mixed prior to application. Submit adhesive container tags to the Owner’s Representative on a daily basis.

3.3 INSULATION INSTALLATION

A. Tapered Insulation (Roof Replacement Only)

→ 1. Insulation shall be installed mechanically attached to the deck per drawings.
Comply with FM I-75 rating and have minimum ⅛ in. per foot slope.

2. Insulation shall have a maximum dimension of 4 feet by 8 feet

3. The insulation shall be staggered 50% from row to row.

4. Butt each insulation board firmly to the adjacent board. Do not jam insulation boards or allow cracks between insulation boards.

5. Cut boards to allow a maximum ¾ in. gap away from vertical surfaces.

6. Mechanical attachment may be done through roof cover board.

B. Crickets (Roof Replacement and Roof Overlay)

1. Install cover board over tapered isocyanurate insulation. Crickets shall be constructed to ensure a minimum slope of 1/2 in. per foot along the valley towards the drainage point.

2. Butt each insulation board firmly to the adjacent board. Do not jam insulation boards or allow cracks between insulation boards.

3. Cut boards to allow a maximum ¾ in. gap away from vertical surfaces.

3.4 COVERBOARD INSTALLATION (Roof Replacement and Roof Overlay)

A. Cover Board Installation

→ 1. Cover board shall be installed mechanically attached and through insulation and/or existing roofing to the structural deck.

2. Cover boards shall have a maximum dimension of 4 feet by 8 feet.

3. The cover boards shall be staggered 50% from row to row.

4. Butt each cover board firmly to the adjacent board. Do not jam cover boards or allow cracks between cover boards.

5. Cut boards to allow a maximum ¾ in. gap away from vertical surfaces.

3.5 MEMBRANE INSTALLATION

A. Layout

1. Select the proper factory marked rolled sheet of roofing membrane for an outside corner or high point.
2. Orient the roofing membrane so the membrane long seams are running perpendicular to the direction of roof slope.

3. When laying out, pull the membrane tight.

B. Roof Sections

The intent of this Specification Section is to provide the Owner with a fully adhered membrane, 100% bonded to the substrate.

1. Ensure all bituminous substances and contaminants of the original system are removed or covered with slip sheet mechanically fasted to existing substrate at walls/curbs and adhered at roof deck. Clean flashings, etc., of all bitumen residue.

2. Install membrane system in accordance with the recommendations and requirements of the membrane materials manufacturer, as amended in these Specifications.

3. Duro-Fleece CR-20 membrane adhesive shall be used as the contact adhesive for the roof membrane.

4. Solvent-based adhesive, specially formulated for vertical surfaces, shall be used as the contact adhesive for flashings installed.

5. Inspect surface of roof cover boards prior to installation of roof membrane. Surfaces shall be clean and smooth with no excessive surface roughness. Contaminated surfaces or unsound surfaces shall be cleaned and voids shall be filled.

6. Over the properly installed and prepared gypsum fiberglass mat fire barrier board substrate, the adhesive shall be sprayed onto substrate only at a rate as recommended by the membrane manufacturer. Apply the adhesive in an even coating with no globs, puddles, or similar irregularities. Allow the adhesive to dry slightly but not completely.

7. The membrane shall be carefully unrolled into the wet adhesive. The adhesive shall be spread and the membrane rolled out until the entire roll has been set into adhesive. The membrane shall be pressed firmly in place with a weighted foam covered lawn roller by frequent rolls in two directions. Lap the adjacent sheets a minimum of 3 inches. **Note that adhesive shall not be applied in seam areas.**

C. Field Welding

1. Weld adjacent sheets in accordance with the manufacturer’s written instructions. Both sides and end lap joints shall be hot-air welded. Hand welded laps shall be 4 inches wide minimum; machine welded laps shall be 3 inches wide minimum. Sheets must be welded immediately after installation.
2. Use welding equipment provided by the membrane materials manufacturer. All technicians shall successfully complete a course of instruction provided by the roof membrane manufacturer’s representatives prior to welding. All weld surfaces must be clean and dry. **No adhesive or other contaminant shall be present within the lap areas.**

3. Hand welded seams shall be completed in three (3) stages. Warm up equipment for at least one (1) minute prior to welding.

   a. Tack weld the lap every 3 feet to hold seam in place.

   b. Weld the back edge of the lap with a thin, continuous weld to prevent loss of the hot air during the final weld.

   c. Insert the hot air nozzle into the lap, keeping the welding equipment at a 45º angle to the side lap. Once the material starts to flow, apply the hand roller at a right angle to the welding gun and press lightly. For straight laps, use the 1-1/2 inch wide nozzle. Correct weld speed will complete approximately 20 inches per minute. The hot air weld equipment shall have temperature adjustments to provide this proper speed and weld.

4. Alternately, an automatic lap welding machine may be used. Follow the manufacturer’s strict requirements, instructions and local codes for electric supply, grounding and over current protection. The automatic weld machines power requirement is 218 to 230 volts at 30 amps. The availability of this voltage shall be verified at the work site on the roof before using the automatic welding machine. The use of portable generators is recommended. Prior to utilizing the automatic weld machine on the roof, detailed instructions and operating procedure shall be obtained from the membrane manufacturer’s technical representatives.

5. Terminate the membrane at perimeters and penetrations once welding of adjacent sheet seams is completed. Membrane shall be terminated with the manufacturer’s recommended metal termination bar fastened at 6 inches (maximum) on center.

6. Flashings shall be installed concurrently with the roof membrane in order to achieve a watertight condition as the work progresses. When a situation arises where a break in the day’s work occurs in the central area of a roof, a temporary waterstop shall be constructed to provide a 100% watertight seal utilizing a raised temporary waterstop. Sweep back and totally clean a 6 inch edge along the existing roof and set a 2 inch x 4 inch stud atop the prepared area in roof cement. Carry the new membrane up and over 2 inch x 4 inch waterstop. Seal the edge of the membrane in a continuous heavy application of water cut-off mastic. Weight the membrane down in the sealant with a 2 inch x 10 inch wood member with ballast on top. Ballast should be approximately 20 pounds per linear foot. When restarting work, remove all sealant, membrane, insulation fillers, etc. from the work area. Do not reuse any of the temporary cut-off material in the new work. Cut off contaminated membrane
and dispose of immediately. If inclement weather occurs while a temporary waterstop is in place, the Contractor shall provide the labor necessary to monitor the situation to maintain a watertight condition.

7. Inspect all field welds with a probe. Re-weld loose laps at the end of each workday.

D. Perimeter Nailing and Around All Types of Penetations Fastening

1. The membrane shall be mechanically fastened at all roof perimeters, parapets, curbs, walls, penetrations, in accordance with the Contract Documents and roofing manufacturer’s specifications and details, but not less than 1 fastener per every 12 inches of length.

E. Cut-Outs

1. Make cut-outs in roofing membrane for protrusions through the roof. Some situations might require that the deck membrane be slit to the section edge for fitting around protrusions.

2. Fasten around cut-outs with approved fasteners (see Section 2.02 Materials), 12 inches on center or a minimum of one per side.

F. Membrane Flashings

1. All flashings shall be installed concurrently with the roof membrane as the job progresses. No temporary membrane flashings shall be allowed without the prior written approval of the Owner. Approval shall only be given for specific locations on specific dates.

2. Follow the manufacturer’s requirements and these Specifications. Ensure that shop drawings and material submittals have been approved.

3. Fully adhere polyester slip sheet at specified locations as detailed. Ensure that felt isolates bituminous products (new and existing) from new PVC flashings.

4. Wall flashings shall be fully adhered to the plywood/wood substrates or roof Dens-Deck boards, where occurs on walls using a solvent-based adhesive. Cut the Membrane in six (6) foot long sections. Apply adhesive at walls to both substrate and membrane at rates per membrane manufacturer 50-60 square feet. Do not apply adhesive in lap areas. Allow the adhesive to become tacky when touched with a dry finger on both surfaces. The product on the membrane cannot be permitted to dry completely. The coated membrane shall be rolled onto the coated substrate being careful to avoid wrinkles. Adjacent sheets shall be overlapped 3-inches. Bring the top of the membrane up and over the parapet wall or wood blocking and secure with annular ring nails as shown in the contract drawings. The
wall flashing membrane shall extend 4 inches onto the roof membrane.

5. Membrane flashings shall be hot-air welded at their seams and at their connections with the adhered roof membrane or membrane clad metal flashings.

6. Vent pipes shall be flashed to the top of the pipe. Asphalt contaminated vent pipes which cannot be thoroughly cleaned shall be wrapped with aluminum tape prior to the installation of membrane flashing. Field or shop fabricated pipe caps of the PVC membrane shall be installed as shown in the detail drawings. Provide stainless steel pipe clamp (drawband) terminations at all locations.

7. Membrane termination shall be flashed in with reinforced membrane. Termination bars shall be utilized as detailed in the contract drawings. Set termination bars in a bed of sealant with fasteners spaced at 3 inches on center.

8. All perimeter edge termination details must include sealant.

3.6 SPECIAL REQUIREMENTS

A. Do not apply adhesive in lap areas.

B. The applicator shall keep track of the amount of adhesive used to confirm required by manufacturer adhesive rate.

3.7 CLEAN-UP

A. Upon completion of the membrane installation, the Contractor shall remove all foreign matter, rubbish and scrap material from the roof.

B. The membrane surface shall be cleaned using cleaners recommended by the membrane manufacturer.

3.8 INSPECTION & WARRANTY

A. Inspection: The Contractor shall submit all required drawings, details, and completed questionnaires to the roofing manufacturer before obtaining the specified warranty. After the authorized Manufacturer has inspected the roof for determining acceptability for warranty issuance, deficiencies on the final inspection report shall be corrected by the Contractor and made ready for reinspection within five (5) working days.

B. Warranty: Upon receipt of required materials, certifying inspection, and acceptance of the roofing system by the roofing manufacturer, the warranty shall be duly executed and issued to the Owner.

3.9 REPAIRS

A. Future repairs or additions to the roofing system shall be made using the heat welding
process.

B. Contractor shall provide repair procedures to the Owner and/or Owner's representative.

3.10 CONSTRUCTION DAMAGE

A. Upon completion of work, repair or replace as required, building materials damaged as a result of the roofing operations. Match existing materials and construction as determined by the Owner.

END OF SECTION
SECTION 07 60 00
FLASHING AND SHEET METAL

PART 1 - GENERAL

1.1 SECTION INCLUDES
   A. Sheet metal flashings shown on the Drawings

1.2 RELATED WORK
   A. Section 07 54 00 — Thermoplastic Membrane Roofing System
   B. Section 07 90 00 — Sealants

1.3 REFERENCES
   A. ASTM A153 — Zinc Coating Hot-Dip Galvanized
   C. MIL-S-6872B — General Specifications for Soldering Process
   D. AWS D1.1 — Structural Welding Code

1.4 SUBMITTALS
   A. Submit three (3), 6 inch by 6 inch samples, of each type and thickness of sheet metal to be used in the construction.
   B. Submit three (3), samples of gutter assembly and flashings to be used in the construction.
   C. Submit shop drawings with dimensions of all sheet metal details.
   D. Submit mill certification.
   E. Submit manufacturer literature for all accessory items in Part 2 of this Section.

1.5 STORAGE
   A. Stack performed material to prevent twisting, bending, or abrasion, and provide ventilation.
   B. Prevent contact with materials during storage, which may cause discoloration, staining or damage.
PART 2 - PRODUCTS

2.1  SHEET MATERIALS

A.  Sheet Metal

1.  22 gauge galvanized steel: ASTM A123 and A525.

B.  Steel bars

1.  ASTM A36.

C.  Vinyl Coated Drip Edge: 24 gauge galvalume with PVC coating by Duro-Last.

2.2  FINISHES

A.  Not applicable.

2.3  ACCESSORIES

A.  Fasteners

1.  Sheet Metal-to-Wood Blocking: No. 12, 1-1/2 inch minimum long Stubbs stainless steel nails, annular-thread shank.

2.  Sheet Metal-to-Sheet Metal: No. 10, 1 inch long stainless steel sheet metal screws with metal capped neoprene washers.


4.  Unistrut: 3/8 inch diameter lag bolts, 3 inch long minimum.

B.  Solder

1.  50% tin and 50% lead.

2.  Flux: ASTM B32

C.  Sealant and Backer Rod

1.  Refer to Section 07 90 00 – Sealants.

D.  Miscellaneous


2.  Cold galvanized compound: Zinc-rich, spray-applied compound.

4. Hatch: O'Keefe, Bilco, or approved equal. Size to accommodate existing opening.

2.4 FABRICATION SCHEDULE

A. All sheet metal to be 22 gauge galvanized steel unless noted below.

2.5 FABRICATION

A. Form sections true to shape, accurate in size, square and free from distortion or defects.
B. Form pieces to maximum length of 8 feet.
C. Mechanically fasten and solder watertight joints, splices and transitions which are not designed for expansion/contraction.
   1. Fasten metal for strength and watertightness by solid riveting, welding or forming double lock seams.
   2. Sealing for water tightness by soldering: after soldering, immediately remove all traces of acid or flux with appropriate neutralizer, followed by repeated washing and scrubbing.
   3. Sealant-filled joints may not be substituted for solder joints: Use sealant as indicated on the Drawings.
D. Do not fabricate any sheet metal components without approved shop drawings and fabrication samples.

PART 3 - EXECUTION

3.1 INSPECTION

A. Field measure site conditions prior to fabricating Work Notify Architect/Engineer immediately of any inconsistency between existing conditions and the drawings.
B. Beginning of installation means acceptance of existing conditions.

3.2 PREPARATION

A. Allow substrates to dry thoroughly. Do not proceed with flashing application if moisture content of exposed wood supporting metal flashing is above 19%.
B. Clean debris from all substrates.

3.3 INSTALLATION

A. General
1. Proceed with sheet metal installation in conjunction with roofing and flashing in each area.

2. Do not dilute primers, coatings, or sealants.

3. Keep containers closed except when removing materials from them.

4. Field fabricate sheet metal following the same criteria set forth in Paragraph 2.05 – FABRICATION.

5. Except as otherwise specifically shown on the Drawings or approved shop drawings, conform to the drawing details included in the SMACNA manual.

6. Comply with Military Specification MIL-S-68728 entitled, "General Specifications for Soldering Process" when forming soldered joints. Use conduction soldering methods. Areas to be joined shall be cleaned of all oil, grease, pencil marks, paint, dirt or other foreign substances. Remove all burrs using files, grinding stones or other methods. Hold parts in place using clamps, jigs and supports or by self-fixturing. If parts are tack-soldered to hold them in place, the area of tack-soldering shall be reworked into the final soldering. Parts cannot be allowed to move during the soldering process.

7. All corners, transition and termination pieces shall be mechanically fastened and soldered to provide strength and a weatherproof connection.

8. Apply sealant over the head when using pop rivets for fastening

9. All sheet metal edges shall be hemmed 1/4 inch minimum.

10. Roof deck flanges shall be 4 inches wide minimum.

11. Roof flanges shall be nailed 3 inches on center staggered.

12. Flash all roof flanges (top and bottom) in accordance with this Specification.

13. Flux shall be applied to all surfaces that will receive solder. Flux-cored solder shall not be used. Flux shall be fluid when heated and be effective in removing oxides and other impurities from the joint. Flux should be readily displaced by the molten solder.

14. Areas to be joined shall be heated above the liquious temperature of the solder. To deliver maximum heat, the copper bit of the soldering iron shall be applied at the right angle so that the flat side of the iron's bit provides maximum contact area. Solder shall be applied to the joint and not the bit of the iron. Allow solder to flow in place to provide a minimum 1 inch final width of solder over the joint. Joint shall not be disturbed until it has been allowed to completely cool. After soldering, completely remove all flux and acid by washing and scrubbing with a neutralizing agent.
B. Hook Strips/Cleats

1. Hook strips/cleats shall be formed with a 3 inch face and a 3/4 inch kick, bent out at a 60° angle to the face (or 30° to the wall).

2. Secure continuous hook strips/cleats to wood nailers with nails spaced at 6 inches on center.

3. Provide 1/8 inch gap at butt joints between hook strip/cleat sections.

C. Securement Clips

1. Securement clips shall be 6 inches long, 2 inches wide, and hemmed along each side of the long dimension.

2. Secure these clips to substrate with specified fasteners. Use a minimum of two (2) fasteners per clip and use 2 clips minimum. Space clips 32” o.c. maximum.

3. Bend clips a minimum of 1 inch over bottom drip edge of counterflashing and crimp tightly.

D. Counterflashing

1. Install counterflashing in accordance with approved shop drawings and manufacturer’s product data to comply with specified performance requirements. Reglet and counter flashing components shall be true to line, without buckling, creasing, warp or bind in finished surfaces.

2. Coordinate counterflashing at roof surfaces with roofing work to provide weather tight condition at roof terminations.

3. Isolate dissimilar materials to prevent electrolysis. Separate bituminous coating.

4. Secure counterflashing using continuous cleats, clips and fasteners in accordance with product data and as indicated.

E. Skirt Flashing

1. Skirt flashings shall be formed with a 4 inch face and a ¼ inch kick, bent out a 60° angle to the face (or 30° to the wall).

2. Secure skirt flashings to the existing counterflashings with stainless steel rivets at all areas where existing counterflashings are being reused. Clean existing counterflashing and apply sealant over rivet heads.

F. Gravel Stop and Edge Metal
1. Secure continuous hook strips with the specified fasteners as previously noted.

2. Form gravel stop/edge metal cover plates to the dimensions indicated.

3. Provide 6 inch wide cover plates, set in full bed of sealant over all 1/8-inch gaps at butt joints in sheet metal sections. Hem edges of cover plates to fit snugly against fascias. Stagger butt joints between the hook strips and the fascias. At PVC coated edge metal, apply sealant at vertical edges of the back of two adjoining pieces, typical.

G. Sleeve Flashing and Storm Hoods

1. Storm hood and sleeve flashing shall be formed with locked and soldered seams. Sleeves shall have integral deck flanges with hemmed edges to the configurations shown on the Drawings. Storm hood shall counterflushing sleeves flashing 3 inches, minimum.

2. Secure sleeve flashings to wood blocking and flash into roof system.

3. Storm hood shall be secured to exhaust pipe with stainless steel band clamp. Set storm hood in full bed of sealant.

H. Mechanical Unit Cover Fasteners

1. Secure existing light mechanical unit covers to wood curbs with #10 stainless steel wood screws with integral metal-capped neoprene washers. Install screws at 12 inches on center, maximum, with a minimum of two screws per side of curb.

2. Secure mechanical unit to curb using 1/4 inch lag bolts installed through EPDM gasketed metal cap washer. Set EPDM gasket in bed of polyurethane sealant.

I. Vent, Duct, and Fan Flashings

1. Contractor shall provide samples or shop drawing for new vent, duct, and pan flashing with sheet metal covers. Do not fabricate prior to approval of samples and shop drawings.

2. Flashings shall be fabricated to be vandal resistant with solid welds and have slope toward free edges, on all four sides.

END OF SECTION
SECTION 07 65 00

SELF ADHERED FLASHING MEMBRANE

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:

1. Self-adhering sheet flashing (flexible flashing) and sealant for concealed flashings as indicated, along window, door and louver opening perimeters; under cement plaster trim accessory joints; over concealed sheet metal flashing flanges and cement plaster termination trim accessories, at all inside and outside corners over building paper; ridge and rake edges; as required to make the building weather-tight and not specified in other sections.

B. Related work:

1. Section 07 60 00 – Sheet metal flashing
2. Section 08 11 00 – Metal Doors & Frames
3. Section 08 51 13 – Aluminum Windows
4. Section 09 20 00 – Lath & Paster

1.02 SUBMITTALS

A. Procedure: In accordance with Division 1 Section 01340 - Submittals

B. Data: Copies of manufacturer data for each product.

C. Shop drawings: Show interface between flashings and other membranes, different surfaces, and any special conditions or other pertinent data.

D. Samples: 12 in. square samples of flashing and 12 in. long samples of sealant.

1.03 PRE-INSTALLATION CONFERENCE

A. Division 1 Section 01200 – Project Meetings: Pre-installation conference.

B. Convene one week prior to commencing work of this section.
PART 2 PRODUCTS

2.01 MANUFACTURERS/MATERIALS

A. Self-adhering (peel and stick) flexible modified bitumen flashings by the following:

1. Ice & Water Shield by W.R. Grace & Company, or equal

PHYSICAL PROPERTIES FOR GRACE ICE & WATER SHIELD COLD APPLIED, SELF-ADHERING MEMBRANES:

<table>
<thead>
<tr>
<th>PROPERTY</th>
<th>TEST METHOD</th>
<th>TYPICAL VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Color</td>
<td>Gray-Black</td>
<td></td>
</tr>
<tr>
<td>Cured Film Thickness</td>
<td>ASTM D 3767 Method A</td>
<td>1.02 mm (40-mil.)</td>
</tr>
<tr>
<td>Material Weight Installed</td>
<td>ASTM D 461</td>
<td>0.3 lb/ft²</td>
</tr>
<tr>
<td>Low Temperature Flexibility At –29F(-20C)</td>
<td>ASTM D 1970</td>
<td>Unaffected</td>
</tr>
<tr>
<td>Elongation,</td>
<td>ASTM D 412</td>
<td>250%</td>
</tr>
<tr>
<td>Adhesion to Plywood</td>
<td>ASTM D 903 *</td>
<td>525 N/m (3 lb/in. width)</td>
</tr>
</tbody>
</table>

B. Primer and sealant: As recommended by the flashing manufacturer.

PART 3 EXECUTION

3.01 INSPECTION

A. Verify conditions and measurements affecting the work of this Section at site. Make sure that detrimental conditions are corrected before proceeding with installation.

3.02 INSTALLATION

A. Install flashings in compliance with the manufacturer’s printed instructions, and the following.

B. Press and form material tightly against the substrate. Insure complete adhesion by using a roller or by hand; pressure is essential to eliminate wrinkles and bubbles.

3.03 FIELD QUALITY CONTROL

A. Before the paper backing and metal lath are installed, inspect the flashings and roll again where not in firm contact with the substrate. Make sure that all joints are weathertight.

END OF SECTION
SECTION 07 90 00
SEALANTS & CAULKING

PART 1 - GENERAL

1.01 WORK INCLUDED

A. Furnish and install all sealant and caulk as shown, as specified and as required for complete and proper installation.

B. Related work described elsewhere: Refer to the various sections for particular sealant locations and requirements, including materials and methods different from those specified in this Section.

1.02 SUBMITTALS

A. Product Data: Manufacturer’s specification, recommendations, and application equipment and procedures, installation instructions including cleaning of joint surfaces, for each type of material required.

1. Certification that joint sealant materials are compatible with adjacent materials.

B. Samples:

1. Samples for color selection of exposed sealant.

2. 12” samples of sealant applied between one (1) type of material used on project.

3. 12” sample of backer rod.

1.03 QUALITY ASSURANCE

A. Comply with manufacturer’s printed instructions, except where more stringent requirements are indicated.

B. Before purchase of each required material, confirm its compatibility with each other material it will be applied to in joint system as well as itself during and after curing.

C. Qualifications of Applicators: Installation shall be by workmen skilled and trained in the techniques of sealants and caulk and who are completely familiar with the published recommendations of the manufacturers of sealants and caulk being used.

D. Rejection of Installed Work: Faulty installation of sealants or caulk shall be removed and redone to the approval of the Architect at no additional cost to the Owner.
E. Manufacturer's Representative: Technically qualified and approved by product manufacturer.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in original, tightly sealed containers or unopened packages with manufacturer's name, labels, and product identification.

B. Store materials out of weather in original containers or unopened packages as recommended by manufacturer.

1.05 ENVIRONMENTAL CONDITIONS

A. Environmental Requirements: Do not apply materials under extreme temperature conditions when joint openings are at maximum or minimum width and during wet weather when surfaces are not dry.

1.06 SCHEDULING

A. General: Coordinate Work with the work of Sections affected by sealants to assure Work is performed in proper sequence and in manner to cause no delay. Where applicable, furnish proper setting templates and layouts affecting Work of other Section.

1.07 GUARANTEE

A. All sealant and caulking work shall be guaranteed from material defects and workmanship for a period of five (5) years against leaks, adhesion, cohesion, resistance to weather, migration, glow, stain and other forms of deterioration and defects. Should these occur, material shall be removed and replaced at no cost to the Owner, including any other material or work damaged by the leaks.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Colors:

2. Exposed Material: Manufacturer's standard colors, as selected by Architect.

B. Sealant for general use: PRC #5000-S, Pecora GC-9 one part polysulfide, Vulkem #116 one-part polyurethane sealant, or equal meeting requirements of Fed. Specifications TT-S-00230c. Color shall match finished adjacent surfaces and are to be approved by the Architect. Consistencies as required for application by gun or knife, as necessary.
C. Silicone Sealant: Use at concrete, masonry, and glazing applications. Tremco, Dow Corning, or equal.

D. Polyurethane Sealant: Sonneborn Sonolastic NP1, Sikaflex 2cNS, or equal.


F. Acoustical Sealant:

2.02 MISCELLANEOUS MATERIALS

A. Compressible Sealer: Neoprene shapes and sizes as shown and required. Provide tapes with pressure sensitive adhesive one side.

B. Joint Primer/Sealer: Provide type of joint primer/sealer recommended by sealant manufacturer for joint surfaces to be primed or sealed.

C. Sealant Backer Rod: Applied Extrusion Technologies' Sof Rod, or equal; flexible, permanent, durable, non-gassing, non-absorptive material as recommended for compatibility with sealant by sealant manufacturer.

D. Cleaning Solvent: Non-corrosive type recommended by manufacturer; compatible with joint forming materials.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify that surfaces are ready to receive work and field measurements are as shown on Drawings and recommended by manufacturer.

B. Verify that surfaces in contact with sealant are free of form release agents and other coatings applied during fabrication.

C. Begin installation only when conditions are satisfactory.

3.02 INSTALLATION

A. Clean joint surfaces immediately before installation of sealant.
   1. Remove dirt, insecure coating, moisture, and other substances which would interfere with bond of sealant.
   2. Use cleaning solvent to clean joint surfaces.
3. Wipe joints free of solvent, using clean, dry white cotton cloths or white, lintless paper.

B. Prime or seal joint surfaces.
   1. Do not allow primer/sealer to spill or migrate to adjoining surfaces.

C. Employ only proven installation techniques, which will ensure that sealants will be deposited in uniform, continuous ribbons without gaps or air packets, with complete "wetting" of joint bond surfaces equally on opposite sides.
   1. Except as otherwise indicated, fill sealant rabbet to a slightly concave surface, slightly below adjoining surfaces.
   2. Where horizontal joints are between a horizontal surface and a vertical surface, fill joint to form a slight cove, so that joint will not trap moisture and dirt.

D. Use one (1) piece backer rod filler about one-third (1/3) to one-half (1/2) wider than the width of joint so sufficient pressure is exerted by filler to provide substantial resistance to displacement.

E. Install joint backer rod for backup to control limits for receiving sealant. Depth shall be as recommended by sealant manufacturer. Use blunt tools. Remove and replace all broken or punctured backer rods.

F. If joint is too shallow for use of backer rod, apply bond breaker to back of joint as recommended by sealant manufacturer. If bond breaker is used, apply it carefully to avoid prevention of sealant bond to sides of joints.

G. Use guns where possible to insure penetration and density. Finish joint densely and completely filled, producing a smooth surface.

H. Manufacturer's directions shall be followed for installation of sealants or caulking during extreme weather conditions. Do no installation during freezing weather or temperature limits set by manufacturer, or against wet or damp materials.

I. Install fire resistant sealant systems in strict conformance to manufacturer's printed instructions, complete with required joint backing.

3.03 SOUND ISOLATION

A. Sound-insulated walls indicated on the Drawings shall be sealed airtight with acoustical sealant specified.

B. Penetrations Through Non-Fire-Rated Partitions and Floors:
   1. Penetrations or openings as a result of conduits, ducts, pipes, and around electrical junction boxes in sound-insulated walls shall be sealed airtight.
   2. Holes smaller than 1" but too large to seal with sealant shall be first packed with mineral wool fiber and then sealed airtight.
   3. Holes larger than 1" shall be first packed with glass fiber, then sealed over with 1/16" thick lead sheet, and then sealed airtight.
3.04 CLEANING AND CURING

A. Clean adjoining surfaces to eliminate evidence of spillage; do not mar surfaces.

B. Cure sealants in compliance with manufacturer's instructions and recommendations to obtain high early-bond strength, internal cohesive strength, and surface durability.

END OF SECTION
SECTION 08 11 00
METAL DOORS & FRAMES

PART 1 - GENERAL

1.01 WORK INCLUDED

A. Provide hollow metal doors, steel door frames

B. Related Sections:
   1. Section 08 71 00 – Door Hardware
   2. Section 09 91 00 – Painting

1.02 SUBMITTALS

A. Shop Drawings: Show door and frame type, material description and gauges, exact profile, elevations, fire-resistive rating and complete details, including reinforcing, anchors, and connections.

   1. Use same reference numbers for details and openings as those indicated on Drawings.

B. Manufacturer and product data.

C. Certificates: Submit certificates for specified doors and frames indicating compliance with fabrication and minimum labeling requirements. Certificates shall be signed by Contractor and authorized representative of hollow metal manufacturing company.

1.03 QUALITY ASSURANCE

A. Standard steel door frames shall comply with the Steel Door Institute (SDI) "Recommended Specifications for Standard Steel Doors and Frames" (ANSI/SDI 100) and other requirements as specified herein.

B. Labeled doors and frames

   1. All doors and frames for rated openings (Classes A, B, C, D, or E) shall be of the construction and design having specific Underwriters' Laboratories approval according to current procedures for three (3) hour, one and one half (1½) hour, three-quarter (¾) hour, or twenty (20) minute fire rating.

   2. Identify each fire-rated door and frame with permanent, metal labels from approved testing agency indicating applicable fire rating.

   3. Construct and install assemblies to comply with National Fire Protection Association (NFPA) Standard No. 80 and as specified herein.

1.04 DELIVERY, STORAGE, AND HANDLING

Contra Costa Community College District
Diablo Valley College
AB Restroom Renovation
A. Deliver, store, and handle steel doors and frames in manner to prevent damage or deterioration.

B. Provide packaging such as cardboard or other containers, separators, banding, spreaders, and paper wrappings to protect items during transit and Project site storage.

C. Follow special storage and handling requirements of manufacturer.

D. Mark each door and frame, on a surface which will be hidden after installation, with designation of opening for which it is furnished. Mark opening designation also on exterior packaging for each door and frame.

1.05 WARRANTY

Warrant materials and workmanship for the lifetime of the original installation.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Manufacturer: Must be a member in good standing of the Steel Door Institute, Curries, Steelcraft, or equal.

B. Hot-Rolled Steel Sheets and Strip: Commercial carbon steel, pickled and oiled, complying with ASTM A568 and A569.

C. Cold-Rolled Steel Sheets: Commercial-quality carbon steel complying with ASTM A366 and ASTM A568.

D. Shop-Applied Paint: Rust-inhibitive primer, either air dried or baked on, suitable as a base for specified finish paints complying with ANSI, A224.1 - 1990.

E. Hardware: Specified in Section 08710.

F. Doors: Fourteen (14) gauge stretch clear - beveled hot-dipped, galvanized steel.

G. Frames: Fourteen (14) gauge, hot-dipped, galvanized sheet steel. Steel for fire-resistive frames according to Underwriters' Laboratories, Inc. requirements for labeled frames of the ratings shown on the drawings.

   1. Frames shall be seamless welded construction.

H. Frame Anchors: As per manufacturer's sixteen (16) gauge x 1¼" wide steel angle frames welded to frame typical, except anchors for fire-resistive frames to be required for Underwriters' Laboratories, Inc. labeling.

I. Vision Panel Frames:

   1. Manufacturer: Anemostat, or product of comparable quality and utility.
2. Style: Slim line steel frame, square.
   a. Non-Rated Doors: Eighteen (18) gauge cold rolled steel, with corners and intersections mitered, welded, and ground smooth; shop primed with manufacturer's standard primer.
   b. Fire-Rated Doors: In addition to requirements specified above, frames shall be provided in accordance with applicable labeling requirements for door rating shown, and shall bear appropriate label.

2.02 FABRICATION - GENERAL

A. Fabri cate metal doors and frames to required profiles and sizes by forming and welding with exposed edges straight and sharp.

B. Fit and fabricate accurately with corner hairline joints and all surfaces free from warp, wave, buckle, and other defects.

C. Welding:
   1. In accordance with AWS standards for high-grade hollow metal work.
   2. Grind all exposed beads and faces smooth.

D. Exposed Fasteners: Unless otherwise indicated, provide countersunk, flat Phillips, or Jackson heads for exposed screws and bolts.

E. Finish Hardware Preparation:
   1. Prepare metal doors and frames to receive mortise and concealed hardware, including cutouts, reinforcing, drilling, and tapping in accordance with final Finish Hardware Schedule and templates provided by hardware suppliers.
      a. Preparation shall be in accordance with SDI-107.
   2. Provide minimum gauge hardware reinforcing in accordance with Table IV of ANSI/SDI-100.
   3. Reinforce metal doors and frames to receive surface-applied hardware.
      a. Drilling and taping for surface-applied finish hardware shall be done at Project site by hardware installer.
   4. Locate finish hardware as shown on final shop drawings or, if not shown, in accordance with "Recommended Location for Builder's Hardware" published by the National Builders' Hardware Association.

F. Shop Finishing and Painting:

2. Fill joints with mineral filler, and finish surfaces smooth and flush.

3. After fabrication, thoroughly clean surfaces of mill scale, rust, oil, grease, dirt, and other foreign matter, and chemically treat with phosphate compound to assure maximum paint adhesion.

4. Apply one (1) coat of rust inhibitive primer, baked at three hundred degrees (300°) for thirty (30) minutes.

5. Coat inside of frame profile with bituminous coating to a thickness of 1/16".

2.03 METAL FRAME CONSTRUCTION

A. General construction shall be welded units, corners mitered and fitted. All welds shall be full depth of all frame and ground smooth. Provide not less than three (3) anchors per side suitable for wall conditions, or provide special anchors when detailed specifically on the Drawings. Include floor angles or clips, welded to frame for concealed fastening to floor. Provide additional anchors for large frames as required to prevent twisting or other movement from door operations.

B. Reinforcement shall be furnished for all mortise type hardware, drilled and tapped at factory. Hinge reinforcing shall be seven (7) gauge minimum. Butt and lockset reinforcing shall be ten (10) gauge minimum and surface applied hardware reinforcing shall be twelve (12) gauge minimum.

C. Door closer reinforcement shall be 3/16" thick steel plate welded to frame with six (6) (minimum) 1" long fillet welds. Drill and tap for door closer screws.

2.04 METAL DOOR CONSTRUCTION

A. The two face sheets shall be formed from stretcher-levelled cold rolled steel not less than fourteen (14) U.S. gauge and shall be rigidly connected and reinforced inside by fourteen (14) gauge steel “C” channels, spaced 8” on center, full height of door and all around door edges. Fabricate with welds at all ends and at 3” on center.

B. Sound deadening material shall be mineral composition, incombustible, moisture resistant, chemically inert and shall fill all voids between stiffeners and face sheets.

C. Suitable provision shall be made to receive glass panels and/or louvers of size shown on drawings.

D. Glass moldings shall be welded units and shall be watertight at exterior locations.

E. Tops of doors to be flush and be made watertight at exterior locations.

F. Door edges to be welded and to be free of seams or cracks. Bevel lock edge 1/8" in 2". Minimum door thickness 1½".
G. Faces of doors to be flat with no joints, weld marks or bumps.

H. Doors shall be neatly mortise and reinforced for all mortise type hardware and shall be drilled and tapped at the factory. Do not cut through door edge at hinge mortise. For surface applied items such as closers, push and pull plates, kickplates, escutcheons, stops, etc., doors shall be reinforced but drilling and tapping shall be done in the field by the door erection contractor.

I. Minimum reinforcing as follows: Surface hardware .0747" steel, hinge reinforcing .180" steel, lock reinforcing .127" steel-for cylindrical locks .0747" steel box type reinforcing unit.

J. Close top and bottom edges with fourteen (14) gauge minimum continuous channel extending full width of door and continuously sealed welded to both faces. Exterior door tops shall be flush and closed to moisture, bottoms with weep holes for elimination of condensation. Fill interior spaces between stiffeners with inorganic, non-combustible insulation.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine substrate and conditions under which steel door frames are to be installed and notify the Architect, in writing, of any conditions detrimental to proper and timely completion of the work.

B. Do not proceed with the work until unsatisfactory conditions have been corrected.

3.02 INSTALLATION OF FRAMES

A. Install frames in accordance with SDI-105, "Recommended Erection Instructions for Steel Frames."

B. Exercise care in setting of frames to maintain scheduled dimensions, hold head level, and maintain jambs plumb and square.

C. Coordinate installation of sheet metal head flashing above exterior side of all frames, where detailed.

D. Secure anchorages and connections to adjacent construction.

1. Anchors shall be furnished to suit wall conditions and floor angles or clips welded to frame for fastening to floor. Install a minimum of three (3) anchors on each side of jamb.

E. Whenever possible, leave frame spreader bars intact until frames are set perfectly square and plumb and anchors are securely attached.

F. Allow for expansion movement as required.

G. Install fire-rated frames in accordance with NFPA Standard No. 80.
H. Grout ends at jambs and thresholds at exterior frames into blockouts in floor slabs with concrete.

3.03 INSTALLATION OF DOORS

A. All doors shall be expertly hung and installed in proper frames as scheduled and shall fit snug against all stops. Fit accurately and hang free from hinges bind with uniform clearance of 1/16" at heads and jambs.

B. General: Install complete with all hardware. Fit doors to provide uniform 1/16" to 1/8" clearance at jambs and head. 1/4" to finish floor at bottom where there is no threshold or carpet. 1/4" at bottom to top of carpet or threshold.

C. Weatherstripped Doors: Install and trim complete with gaskets, strips, and bottoms in accordance with details and specifications.

D. Do not erect members which are observed to be warped, bowed, deformed, or otherwise damaged or defaced to such extent as to impair strength or appearance.
   1. Remove and replace members which have been damaged in process or erection.

E. Adjust and lubricate operable parts as required for correct function.

F. Install fire rated doors in accordance with NFPA Standard No. 80.

3.04 PRIME COAT TOUCH-UP

A. Immediately after erection, items with prime coat which has been damaged shall be sanded smooth and touched up with same prime as applied at shop.

B. Remove rust before above-specified touch-up is applied.

C. Touch-up shall not be obvious.

3.05 ADJUSTMENT

A. Replace or rehang doors which are hinge bound or do not swing or operate freely.

3.06 PROTECTION

A. Protect installed work against damage from other construction work.

3.07 CLEANING

A. Remove from the site all debris resulting from the work of this section.

END OF SECTION
SECTION 08 31 00
ACCESS DOORS & PANELS

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes fire resistive rated and non-rated access doors and panels with frames.

1. Provide for access to controls, valves, traps, dampers, cleanouts, attics and similar items requiring operation behind inaccessible finished surfaces.

2. Coordinate exact locations with various trades to assure proper placement of access doors and panels.

B. Related Sections:

1. Section 09 91 00 - Painting
2. Division 23 – Heating, Ventilation & Air Conditioning

1.02 REFERENCES

A. ASTM International:

B. Intertek Testing Services (Warnock Hersey Listed):
1. WH - Certification Listings.

C. National Fire Protection Association:

D. Underwriters Laboratories Inc.:
1. UL - Building Materials Directory.

1.03 SUBMITTALS

A. Section 01 30 00 - Submittals: Submittal procedures.

B. Shop Drawings: Indicate exact position of access door units.

C. Product Data: Submit literature indicating sizes, types, finishes, hardware, scheduled locations, fire resistance listings, and details of adjoining Work.

E. Manufacturer's Installation Instructions: Submit installation requirements and rough-in dimensions.
1.04 CLOSEOUT SUBMITTALS

A. Section 01 70 00 – Contract Closeout.

B. Project Record Documents: Record actual locations of access units.

1.05 QUALITY ASSURANCE

A. Fire Resistance Ratings: Where indicated as fire rated provide assemblies from manufacturers listed in UL Directory or Intertek Testing Services (Warmock Hersey Listed) Directory.

B. Fire Rated Horizontal Access Doors: Rating 1 hour or as indicated on Drawings.
   1. Tested Rating: Determined in accordance with ASTM E119.

C. Attach label from agency approved by authority having jurisdiction to identify each fire rated access door.

1.06 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified with minimum three years documented experience.

1.07 COORDINATION

A. Coordinate Work under provisions of Division 1 - Project Coordination.

B. Coordinate Work with work requiring controls, valves, traps, dampers, cleanouts, and similar items requiring operation being located behind finished surfaces.

PART 2 - PRODUCTS

2.01 ACCESS DOORS AND PANELS

A. Manufacturers:

1. Bauco Access Panel Solutions
2. J. L. Industries.
3. Nystrom Products Co.
5. Substitutions: under the provisions of Section 01 63 00.

B. Concealed Access Panels: As indicated on the drawings.
C. Flush Framed Access Doors: Frames and nominal 1 inch wide exposed flanges of 16 gauge steel and door panels of 14 gauge steel.

D. Fire Rated Access Doors: Frames and nominal 1 inch wide exposed flanges of minimum 16 gauge steel and door panels of 20 gauge steel. Provide self closing and latching doors with keyed lock.

E. All interior wall access panels to be stainless steel, and lockable.

2.02 FABRICATION

A. Fabricate units of continuous welded construction; weld, fill, and grind joints to assure flush and square unit.

B. Wall and Ceiling Access Door and Panel Hardware:
   1. Hinge: Standard continuous or concealed spring pin type, 175 degree steel hinges.
   2. Lock: Self-latching lock. Screw driver slot for quarter turn cam lock.

C. Size Variations: Obtain acceptance of manufacturer's standard size units which vary slightly from sizes shown or scheduled.

2.03 SHOP FINISHING

A. Base Metal Protection: Galvanized, hot dipped Prime coat units with alkyd baked on primer.

B. Finish: Two coats baked enamel, color as selected.

C. All interior ceiling-mounted access panels to be 24" x 24" inch size unless otherwise noted, screwdriver slot lock, and either factory-finished baked enamel white or primed and painted in the field white to match the adjacent ceiling finishes.

D. All exterior wall-mounted access panels at the roof level must be 24" wide x 36" wide, lockable with handle, continuous hinge, and weather-tight seals, 16 gauge galvanized sheet metal - prime and paint to match.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Division 01 - General Requirements: Coordination and project conditions.

B. Verify rough openings for access doors and panels are correctly sized and located.

3.02 INSTALLATION

A. Secure frames rigidly in place, plumb and level in opening, with plane of door and panel face aligned with adjacent finished surfaces.
1. Set concealed frame type units flush with adjacent finished surfaces.
2. Coordinate and set concealed frame type units between full tiles and between grout joints.
3. Secure tile with epoxy adhesive to panel. Grout to match adjacent tiled wall.

B. Position unit to provide convenient access to concealed work requiring access.

C. Install fire rated units in accordance with NFPA 80 and requirements for fire listing.

D. All access panels to be mounted tight to wall/ceiling finishes and sealed.

E. All exterior wall access panels to have painted GSM head flashing with hemmed drip edge.

END OF SECTION
SECTION 08 71 00

DOOR HARDWARE

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions of Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes items known commercially as finish or door hardware that are required for swing, sliding, and folding doors, except special types of unique hardware specified in the same sections as the doors and door frames on which they are installed.

B. This Section includes the following, but is not necessarily limited to:

1. Door Hardware, including electric hardware.
2. Low-energy door operators plus sensors and actuators.
3. Thresholds, gasketing and weather-stripping.
4. Door silencers or mutes.

C. Related Sections: The following sections are noted as containing requirements that relate to this Section, but may not be limited to this listing.

1. Division 8: Section - Steel Doors and Frames.
2. Division 8: Section - Wood Doors.

1.03 REFERENCES (USE DATE OF STANDARD IN EFFECT AS OF BID DATE.)

A. 2013 California Building Code, CCR, Title 24.

B. BHMA – Builders’ Hardware Manufacturers Association

C. DHI – Door and Hardware Institute


1. NFPA 80 - Fire Doors and Other Opening Protectives
2. NFPA 105 - Smoke and Draft Control Door Assemblies

E. UL - Underwriters Laboratories.

1. UL 10C - Fire Tests of Door Assemblies
2. UL 305 - Panic Hardware

F. WHI - Wamock Hersey Incorporated

G. SDI - Steel Door Institute
1.04 SUBMITTALS & SUBSTITUTIONS

A. General: Submit in accordance with Conditions of the Contract and Division 1 Specification sections.

B. Submit product data (catalog cuts) including manufacturers' technical product information for each item of door hardware, installation instructions, maintenance of operating parts and finish, and other information necessary to show compliance with requirements.

C. Submit six (6) copies of schedule organized vertically into “Hardware Sets” with index of doors and headings, indicating complete designations of every item required for each door or opening. Include following information:

1. Include a Cover Sheet with:
   a. Job Name, location, telephone number.
   b. Architects name, location and telephone number.
   c. Contractors name, location, telephone number and job number.
   d. Suppliers name, location, telephone number and job number.
   e. Hardware consultant's name, location and telephone number.

2. Job Index information included:
   a. Numerical door number index including; door number, hardware heading number and page number.
   b. Complete keying information (referred to DHI hand-book "Keying Systems and Nomenclature"). Provision should be made in the schedule to provide keying information when available; if it is not available at the time the preliminary schedule is submitted.
   c. Manufacturers’ names and abbreviations for all materials.
   d. Explanation of abbreviations, symbols, and codes used in the schedule.
   e. Mounting locations for hardware.
   f. Clarification statements or questions.
   g. Catalog cuts and manufacturer’s technical data and instructions.

3. Vertical schedule format sample:

<table>
<thead>
<tr>
<th>Heading Number 1 (Hardware group or set number – HW -1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) 1 Single Door #1 - Exterior from Corridor 101</td>
</tr>
<tr>
<td>(d) 3' 0&quot;x7' 0&quot; x 1-3/4&quot; x (e) 20 Minute (f) WD x HM</td>
</tr>
<tr>
<td>(g) 1 (h) (i) ea</td>
</tr>
<tr>
<td>2 6AA 1 ea</td>
</tr>
</tbody>
</table>

(a) - Single or pair with opening number and location. (b) - Degree of opening (c) - Hand of door(s) (d) - Door and frame dimensions and door thickness. (e) - Label requirements if any. (f) - Door by frame material. (g) - (Optional) Hardware item line #. (h) - Keyset Symbol. (i) - Quantity. (j) - Product description. (k) - Product Number. (l) - Fastenings and other pertinent information. (m) - Hardware finish codes per ANSI A156.18. (n) - Manufacture abbreviation.

D. Make substitution requests in accordance with Division 1. Substitution requests must be made prior to bid date. Include product data and indicate benefit to the project. Furnish samples of any proposed substitution.
E. Keying Schedule: Submit separate detailed schedule indicating clearly how the Owner's final instructions on keying of locks has been fulfilled.

F. Templates for doors, frames, and other work specified to be factory prepared for the installation of door hardware. Check shop drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.

G. Furnish as-built/as-installed schedule with close-out documents, including keying schedule and transcript, wiring/riser diagrams, manufacturers' installation and adjustment and maintenance information.

H. Fire Door Assembly Testing: Submit a written record of each fire door assembly to the Owner to be made available to the Authority Having Jurisdiction (AHJ) for future building inspections.

1.05 QUALITY ASSURANCE

A. Obtain each type of hardware (latch and lock sets, hinges, closers, exit devices, etc.) from a single manufacturer.

B. Supplier Qualifications: A recognized architectural door hardware supplier, with warehousing facilities in the project's vicinity, that has a record of successful in-service performance for supplying door hardware similar in quantity, type, and quality to that indicated for this project and that employs an experienced architectural hardware consultant (AHC) who is available to Owner, Architect, and Contractor, at reasonable times during the course of the Work, for consultation.

1. Responsible for detailing, scheduling and ordering of finish hardware.
2. Meet with Owner to finalize keying requirements and to obtain final instructions in writing.
3. Stock parts for products supplied and are capable of repairing and replacing hardware items found defective within warranty periods.

C. Hardware Installer: Company specializing in the installation of commercial door hardware with five years documented experience.

D. Fire-Rated Openings: Provide door hardware for fire-rated openings that complies with NFPA Standard No. 80 and requirements of authorities having jurisdiction. Provide only items of door hardware that are listed and tested by UL or Warnock Hersey for given type/size opening and degree of label. Provide proper latching hardware, door closers, approved-bearing hinges and seals whether listed in the Hardware Schedule or not.

1. Where emergency exit devices are required on fire-rated doors, (with supplementary marking on doors' UL labels indicating "Fire Door to be Equipped with Fire Exit Hardware") provide UL label on exit devices indicating "Fire Exit Hardware".

E. Exit Doors: Operable from inside with single motion without the use of a key or special knowledge or effort.

1.06 DELIVERY, STORAGE AND HANDLING

A. Coordinate delivery of packaged hardware items to the appropriate locations (shop or field) for installation.
B. Hardware items shall be individually packaged in manufacturers' original containers, complete with proper fasteners. Clearly mark packages on outside to indicate contents and locations in hardware schedule and in work.

C. Provide locked storage area for hardware, protect from moisture, sunlight, paint, chemicals, etc.

D. Contractor to inventory door hardware jointly with representatives of hardware supplier and hardware installer until each all are satisfied that count is correct.

1.07 WARRANTY

A. Provide warranties of respective manufacturers’ regular terms of sale from day of final acceptance as follows:

1. Locksets: Three (3) years.
2. Closers: Thirty (30).
3. Exit devices: Three (3) years.
4. All other hardware: Two (2) years.

1.08 MAINTENANCE

A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner’s continued adjustment, maintenance, and removal and replacement of door hardware.

1.09 PRE-INSTALLATION CONFERENCE

A. Convene a pre-installation conference at least one week prior to beginning work of this section.

B. Attendance: Architect, Construction Manager, Contractor, Hardware Supplier, Installer, Key District Personnel, and Project Inspector.

C. Agenda: Review hardware schedule, products, installation procedures and coordination required with related work. Review District's keying standards.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

<table>
<thead>
<tr>
<th>Item</th>
<th>Manufacturer</th>
<th>Acceptable Substitutes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hinges</td>
<td>Ives</td>
<td>Hager, Stanley, McKinney</td>
</tr>
<tr>
<td>Locks, Latches</td>
<td>Schlage</td>
<td>Or Approved Equal</td>
</tr>
<tr>
<td>Cylinders</td>
<td>Corbin-Russwin</td>
<td>District Standard</td>
</tr>
<tr>
<td>Exit Devices</td>
<td>Von Duprin</td>
<td>Or Approved Equal</td>
</tr>
<tr>
<td>Closers</td>
<td>LCN</td>
<td>Or Approved Equal</td>
</tr>
</tbody>
</table>

AB RESTROOMS
DVC
Door Hardware
Section 08 71 00 - 4
2.02 MATERIALS

A. Hinges: Exterior out-swinging door butts shall be non-ferrous material and shall have stainless steel hinge pins. All doors to have non-rising pins.

1. Hinges shall be sized in accordance with the following:
   a. Height:
      1) Doors up to 42" wide: 4-1/2" inches.
      2) Doors 43" to 48" wide: 5 inches.
   b. Width: Sufficient to clear frame and trim when door swings 180 degrees.
   c. Number of Hinges: Furnish 3 hinges per leaf to 7'-5" in height. Add one for each additional 2 feet in height.

2. Furnish non-removable pins (NRP) at all exterior out-swing doors and interior key lock doors with reverse bevels.

B. Heavy Duty Cylindrical Locks and Latches: Schlage "ND" Series as scheduled with "Rhodes" design, fastened with through-bolts and threaded chassis hubs.

1. Locksets to comply with ANSI A156.2, Series 4000, Grade 1; tested to exceed 3,000,000 cycles. Locksets shall meet ANSI A117.1, Accessible Code.
2. Chassis: One piece modular assembly and multi-functional allowing function interchange without disassembly of lockset.
3. Spindle shall be deep-draw manufactured not stamped. Spindle and spring cage to be one-piece integrated assembly.
4. Anti-rotation plate to be interlocking to the lock chassis. Lock design utilizing bit-tabs are not acceptable.
5. Lever Trim: Accessible design, bi-directional, independent assemblies.
6. Locks shall be of such construction that when locked, the door may be opened from within by using lever and without the use of a key or special knowledge.
7. Thru-bolts to secure anti-rotation plate without sheer line. Fully threaded thru-bolts are not acceptable.
8. Spring cage to have double compression springs. Manufacturers utilizing torsion springs are not acceptable.
9. Latchbolt to be steel with minimum ½" throw deadlatch on keyed and exterior functions; ¾" throw anti-friction latchbolt on pairs of doors.
10. Strikes: ANSI curved lip, 1-1/4" x 4-7/8", with 1" deep dust box (K510-066). Lips shall be of sufficient length to clear trim and protect clothing.
C. Exit devices: Von Duprin as scheduled.

1. Provide certificate by independent testing laboratory that device has completed over 1,000,000 cycles and can still meet ANSI/BHMA A156.3 - 2001 standards.
2. All internal parts shall be of cold-rolled steel with zinc dichromate coating.
3. Mechanism case shall have an average thickness of .140".
4. Compression spring engineering.
5. Non-handed basic device design with center case interchangeable with all functions.
6. All devices shall have quiet return fluid dampeners.
7. All latchbolts shall be deadlocking with ¾" throw and have a self-lubricating coating to reduce friction and wear.
8. Device shall bear UL label for fire and or panic as may be required.
9. All surface strikes shall be roller type and utilize a plate underneath to prevent movement.
10. All Exit Devices to be sex-bolted to the doors.
11. Panic Hardware shall comply with CBC Section 11B.404.2.7 and shall be mounted between 34" and 44" above the finished floor surface.
   a. Provide exit devices UL certified to meet maximum 5 pound requirements according to the California Building Code section 11B-309.4, and UL listed for Panic Exterior Fire Exit Hardware.

D. Closers: LCN as scheduled. Place closers inside building, stairs, room, etc.

1. Door closer cylinders shall be of high strength cast iron construction with double heat treated pinion shaft to provide low wear operating capabilities of internal parts throughout the life of the installation. All door closers shall be tested to ANSI/BHMA A156.4 test requirements by a BHMA certified testing laboratory. A written certification showing successful completion of a minimum of 10,000,000 cycles must be provided.
2. All door closers shall be fully hydraulic and have full rack and pinion action with a shaft diameter of a minimum of 11/16 inch and piston diameter of 1 inch to ensure longevity and durability under all closer applications.
3. All parallel arm closers shall incorporate one piece solid forged steel arms with bronze bushings. 1-9/16" steel stud shoulder bolts, shall be incorporated in regular arms, hold-open arms, arms with hold open and stop built in. All other closers to have forged steel main arms for strength, durability, and aesthetics for versatility of trim accommodation, high strength and long life.
4. All parallel arm closers so detailed shall provide advanced backcheck for doors subject to severe abuse or extreme wind conditions. This advanced backcheck shall be located to begin cushioning the opening swing of the door at approximately 45 degrees. The intensity of the backcheck shall be fully adjustable by tamper resistant non-critical screw valve.
5. Closers shall be installed to permit doors to swing 180 degrees.
6. All closers shall utilize a stable fluid withstanding temperature range of 120 degrees F. to -30 degrees F. without requiring seasonal adjustment of closer speed to properly close the door.
7. Provide the manufactures drop plates, brackets and spacers as required at narrow head rails and special frame conditions. NO wood plates or spacers will be allowed.
8. Maximum effort to operate closers shall not exceed 5 lbs., such pull or push effort being applied at right angles to hinged doors. Compensating devices or automatic door operators may be utilized to meet the above standards. When fire doors are required, the maximum effort to operate the closer may be increased but shall not exceed 15 lbs. when specifically approved by fire marshal. All closers shall be adjusted to operate with the minimum amount of opening force and still close and latch the door. These forces do not apply to the force required to retract latch bolts or disengage other devices that hold the door in a closed position. Per 11B-404.2.8.1, door shall take at least 5 seconds to
move from an open position of 90 degrees to a position of 12 degrees from the latch jamb.

E. Flush Bolts & Dust Proof Strikes: Automatic Flush Bolts shall be of the low operating force design. Utilize the top bolt only model for interior doors where applicable and as permitted by testing procedures.

1. Manual flush bolts only permitted on storage or mechanical openings as scheduled.
2. Provide dust proof strikes at openings using bottom bolts.

F. Door Stops:

1. Unless otherwise noted in Hardware Sets, provide floor type with appropriate fasteners. Where wall type cannot be used, provide floor type. If neither can be used, provide overhead type.
2. Do not install floor stops more than four (4) inches from the face of the wall or partition (CBC Section 11B-307).
3. Overhead stops shall be made of stainless steel and non-plastic mechanisms and finished metal end caps. Field-changeable hold-open, friction and stop-only functions.

G. Protection Plates: Fabricate either kick, armor, or mop plates with four beveled edges. Provide kick plates 10" high and 2" LDW. Sizes of armor and mop plates shall be listed in the Hardware Schedule. Furnish with machine or wood screws of bronze or stainless to match other hardware.

H. Thresholds: As Scheduled and per details.

1. Thresholds shall not exceed 1/2" in height, with a beveled surface of 1:2 maximum slope.
2. Set thresholds in a full bed of butyl-rubber or polyisobutylene mastic sealant complying with requirements in Division 7 "Thermal and Moisture Protection".
3. Use ¼" fasteners, red-head flat-head sleeve anchors (SS/FHSL).
4. Thresholds shall comply with CBC Section 11B-404.2.5.

I. Seals: Provide silicone gasket at all rated and exterior doors.

1. Fire-rated Doors, Resilient Seals: UL10C Classified complies with NFPA 80 & NFPA 252. Coordinate with selected door manufacturers’ and selected frame manufacturers’ requirements.
2. Fire-rated Doors, Intumescent Seals: Furnished by selected door manufacturer. Furnish fire-labeled opening assembly complete and in full compliance with UL10C Classified complies with NFPA 80 & NFPA 252. Where required, intumescent seals vary in requirement by door type and door manufacture -- careful coordination required.

J. Door Shoes & Door Top Caps: Provide door shoes at all exterior wood doors and top caps at all exterior out-swing doors.

K. Silencers: Furnish silencers for interior hollow metal frames, 3 for single doors, 2 for pairs of doors. Omit where sound or light seals occurs, or for fire-resistive-rated door assemblies.

2.03 KEYING

A. Furnish a masterkey system as directed by the owner or architect. Furnish Corbin Russwin interchangeable cores for use with Schlage ND Series locks as specified.
B. A detailed keying schedule is to be prepared by the owner and/or architect. Each keyed cylinder on every keyed lock is to be listed separately showing the door #, key group (in BHMA terminology), cylinder type, finish and location on the door.

C. Furnish all cylinder cores as Corbin Russwin to match the existing District key system.

2.04 FINISHES

A. Generally to be satin chrome US26D (626 on bronze and 652 on steel) unless otherwise noted.

B. Furnish push plates, pull plates and kick or armor plates in satin stainless steel US32D (630) unless otherwise noted.

C. Door closers shall be powder-coated to match other hardware, unless otherwise noted.

D. Aluminum items to be finished anodized aluminum except thresholds which can be furnished as standard mill finish.

2.05 FASTENERS

A. Screws for strikes, face plates and similar items shall be flat head, countersunk type, provide machine screws for metal and standard wood screws for wood.

B. Screws for butt hinges shall be flathead, countersunk, full-thread type.

C. Fastening of closer bases or closer shoes to doors shall be by means of sex bolts and spray painted to match closer finish.

D. Provide expansion anchors for attaching hardware items to concrete or masonry.

E. All exposed fasteners shall have a phillips head.

F. Finish of exposed screws to match surface finish of hardware or other adjacent work.

G. All Exit Devices and Lock Protectors shall be fastened to the door by the means of sex bolts or through bolts.

PART 3 - EXECUTION

3.01 INSPECTION

A. Verify that doors and frames are square and plumb and ready to receive work and dimensions are as instructed by the manufacturer.

B. Beginning of installation means acceptance of existing conditions.

C. Fire-Rated Door Assembly Inspection: Upon completion of the installation, all fire door assemblies shall be inspected to confirm proper operation of the closing device and latching device and that only the manufacturer’s furnished fasteners are used for installation and that it meets all criteria of a fire door assembly per NFPA 80 (Standard for Fire Doors and Other Opening Protective) 2013 Edition. A written record shall be maintained and transmitted to the Owner to be made available to the Authority Having Jurisdiction (AHJ). The inspection of the swinging fire doors shall be performed by a certified FDI (Fire Door Assembly Inspector) with knowledge and understanding of the operating components of the type of door being
subjected to the inspection. The record shall list each fire door assembly throughout the project and include each door number, an itemized list of hardware set components at each door opening, and each door location in the facility.

3.02 INSTALLATION

A. Install hardware in accordance with manufacturer’s instructions and requirements of DHI.

B. Use the templates provided by hardware item manufacturer.

C. Mounting heights for hardware shall be as recommended by the Door and Hardware Institute. Operating hardware will to be located between 34” and 44” AFF.

D. Set units level, plumb and true to line and location. Adjust and reinforce the attachment substrate as necessary for proper installation and operation.

E. Drill and countersink units that are not factory-prepared for anchorage fasteners. Space fasteners and anchors in accordance with industry standards.

F. Set thresholds for exterior doors in full bed of butyl-rubber sealant.

G. If hand of door is changed during construction, make necessary changes in hardware at no additional cost.

3.03 ADJUST AND CLEAN

A. Adjust and check each operating item of hardware and each door, to ensure proper operation or function of every unit. Replace units which cannot be adjusted to operate freely and smoothly as intended for the application made.

B. Clean adjacent surface soiled by hardware installation.

C. Final Adjustment: Wherever hardware installation is made more than one month prior to acceptance or occupancy, return to that work area and make final check and adjustment of all hardware items in such space or area. Clean operating items as necessary to restore proper function and finish of hardware and doors. Adjust door control devices to compensate for final operation of heating and ventilating equipment.

D. Instruct Owner’s Personnel in proper adjustment and maintenance of hardware finishes, during the final adjustment of hardware.

E. Continued Maintenance Service: Approximately six months after the completion of the project, the Contractor accompanied by the Architectural Hardware Consultant, shall return to the project and re-adjust every item of hardware to restore proper functions of doors and hardware. Consult with and instruct Owner’s personnel in recommended additions to the maintenance procedures. 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.

3.04 HARDWARE LOCATIONS

A. Conform to CCR, Title 24, Part 2; and ADAAG; and the drawings for access-compliant positioning requirements for the disabled.

3.05 FIELD QUALITY CONTROL
A. Contractor is responsible for providing the services of an Architectural Hardware Consultant (AHC) or a proprietary product technician to inspect installation and certify that hardware and its installation have been furnished and installed in accordance with manufacturers' instructions and as specified herein.

3.06 SCHEDULE

A. The items listed in the following schedule shall conform to the requirements of the foregoing specifications.

B. While the hardware schedule is intended to cover all doors, and other movable parts of the building, and establish type and standard of quality, the contractor is responsible for examining the Plans and Specifications and furnishing proper hardware for all openings whether listed or not. If there are any omissions in hardware groups in regard to regular doors they shall be called to the attention of the Architect prior to bid opening for instruction; otherwise, list will be considered Complete. No extras will be allowed for omissions.

C. The Door Schedule on the Drawings indicates which hardware set is used with each door.

**Manufacturers Symbols**

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Manufacturer</th>
<th>Hardware Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IVE</td>
<td>Ives</td>
<td>Hinges, Kick Plates, Door Stops &amp; Silencers</td>
</tr>
<tr>
<td>LCN</td>
<td>LCN</td>
<td>Door Closers</td>
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<tr>
<td>C-R</td>
<td>Corbin-Russwin</td>
<td>Locks, Latches &amp; Cylinders</td>
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<tr>
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<td>Select Products</td>
<td>Continuous Hinges</td>
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<tr>
<td>VON</td>
<td>Von Duprin</td>
<td>Exit Devices</td>
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<tr>
<td>ZER</td>
<td>Zero International</td>
<td>Thresholds, Gasketing &amp; Weather-stripping</td>
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**HARDWARE SET: 01**

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<tr>
<th>Quantity</th>
<th>Item</th>
<th>Part Number</th>
<th>Location</th>
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<tbody>
<tr>
<td>3</td>
<td>Ea Hinge</td>
<td>5BB1 4.5 x 4.5 NRP</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Ea Privacy Set</td>
<td>CL3320 NZD</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Ea I.C. Core</td>
<td>8000-6 57C1 KEYWAY</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Ea Surface Closer</td>
<td>4011</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Ea Kick Plate</td>
<td>8400 10&quot; x 2&quot; LDW B4E</td>
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</tr>
<tr>
<td>1</td>
<td>Ea Wall Stop</td>
<td>WS407CCV</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Set Gasketing</td>
<td>188S</td>
<td>BLK</td>
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<tr>
<td>1</td>
<td>Ea Door Bottom</td>
<td>154A</td>
<td>AL</td>
</tr>
<tr>
<td>1</td>
<td>Ea Threshold</td>
<td>PER DETAIL</td>
<td>AL</td>
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</table>

**HARDWARE SET: 02**

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<tbody>
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<td>Ea Classroom Lock</td>
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<td>1</td>
<td>Ea I.C. Core</td>
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<tr>
<td>1</td>
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</tr>
<tr>
<td>1</td>
<td>Ea Kick Plate</td>
<td>8400 10&quot; x 2&quot; LDW B4E</td>
<td></td>
</tr>
<tr>
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<td>Ea Wall Stop &amp; Holder</td>
<td>WS45</td>
<td></td>
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<tr>
<td>1</td>
<td>Ea Threshold</td>
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<td>AL</td>
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<tr>
<td>3</td>
<td>Ea Silencer</td>
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</table>
SECTION 09 22 26

NON-STRUCTURAL METAL FRAMING

PART 1 GENERAL

1.1 SECTION INCLUDES

1.2 Metal suspension system for the support of gypsum drywall in ceiling, a soffit installation for interior and exterior finishes.

1.3 RELATED SECTIONS
   A. Section 09 29 00 Gypsum Board
   B. Division 23 Heating Ventilating and Air Conditioning (HVAC)
   C. Division 26 Electrical

1.4 REFERENCES

   a. *ASTM A 1008 Standard specification for the Steel, Sheet, Cold Rolled Carbon, Structural, High Strength Low-Alloy and High Strength Low Alloy with Improved Formability
   c. ASTM C 635 Standard Specification for Metal Suspension Systems
   d. ASTM C 645-09 - Standard Specification for Nonstructural Steel Framing Members
   e. ASTM C 754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products
   f. ASTM C841 Standard Specification for Installation of Interior Lathing and Furring
   g. ASTM C842 Standard Specification for Application of Interior Gypsum Plaster
   h. ASTM C 847 - Standard Specification for Metal Lath
   i. ASTM C926 Standard Specification for Application of Portland Cement-Based Plaster
   j. ASTM C 1063 - Standard Specification for Installation of Lathing and Furring to Receive Interior and Exterior Portland Cement-Based Plaster (Plaster and Stucco Accessories)
   l. International Building Code
   m. ESR-1289: International Code Council Evaluation Service Report
   n. Miami Dade County, Florida Wind Uplift Compliant

   *American Society for Testing and Materials
1.5 SUBMITTALS
A. Product Data: Submit manufacturer's technical data for each type of Metal Framing system required.

B. Samples: Metal Framing System, including main runner and 4 foot cross tees.

C. Shop Drawings: Layout and details of Metal Framing System. Show locations of items which are to be coordinated with, or supported by the metal suspension system.

1.6 QUALITY ASSURANCE
A. Installer Qualifications: Installer experienced in performing work of this section who has specialized in installation of work similar to that required for this project.

B. Pre-installation Meetings: Conduct pre-installation meeting to verify project requirements, substrate conditions, and manufacturer's installation instructions.

C. Fire Resistance Characteristics: For fire-resistance-rated assemblies that incorporate Metal framing systems provide materials and construction identical to those tested in fire resistance assembly as indicated in the construction documents and or architectural plans in accordance with ASTM E119.

1.7 DELIVERY, STORAGE, AND HANDLING

1.8 Protect and store products in manufacturer's unopened packaging until ready for installation.

1.9 PROJECT CONDITIONS
A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.
PART 2 PRODUCTS

2.1 MANUFACTURERS
1. Acceptable Manufacturer: Armstrong World Industries Lancaster PA

1. Suspensions System Components

2. Armstrong Drywall Suspension Systems all main beams and cross tees shall be commercial quality hot-dipped galvanized steel

   a. Main Beams: manufactured main beam—1-1/2" knurled face with ScrewStop™ reverse hem by 1-11/16 inches high by 144 inches long with factory punched cross tee routs and hanger wire holes and SuperLock™ main beam clip for a strong secure connection and fast accurate alignment. Heavy-duty performance per ASTM C635.

      i. Main Beams
          1. HD8906 – 12’

   b. Cross Tee: manufactured cross tee – 1-1/2" knurled face with ScrewStop™ reverse hem by 1-1/2 inches high by (50), (48), (36), (26), (24), (14) inches long with factory punched cross tee routs and hanger wire holes and XL stake on clip for a strong secure connection.

      i. Cross tee
          1. XL8965 - 6’
          2. XL8945P - 4’
          3. XL8926 - 2’

   c. Wall Molding: manufactured knurled face angle molding. Locking Angle molding pre-engineered locking tabs punched 8" on center - 1-1/4 inch by 1-1/4 inch by 144 inches in length.

      i. Wall Angle items
          1. KAM10 – Knurled Angle – 1-1/4” X 120”
          2. KAM12 – 1-1/4” X 144”
          3. KAM151020E – 1-1/2” X 120” – 22 Gauge
          4. KAM151020 – 1-1/2” X 120” – 20 Gauge
          5. KAM21025 – 1-1/2” X 120” – 25 Gauge
          6. KAM21020EQ – 1-1/2” X 120” – 22 Gauge
          7. KAM21020 – 1-1/2” X 120” – 20 Gauge

   d. Channel Molding: manufactured Unhemmed Channel Molding nominal 3/4 inch by 1-9/16 inch by 1-1/4 inch by 120 inches in length.

      i. Channel Molding items: 7838 – 120” & 7858 – 144”
e. Axiom One Piece Drywall Bottom Trim: available 2.5”, 4” and 6”

f. Hanger wire: a Class 1 zinc coating, soft temper, pre-stretched, with a yield stress load of at least time three times the design load, but not less than 12-gauge.

g. Accessories:

i. **Drywall Angle Clips (DWAC)** 30, 45, 60 and 90 degree are used to create positive and secure angles for drywall and ceiling installations on either main beams or cross tees.

ii. **Main Beam Adapter Clip (MBAC)** Attaches to the web of acoustical suspension system allows for larger screwing surface metal thickness meets ASTM requirements.

iii. **DWS8LT** Transition clip for 5/8” drywall with locking tabs facilitates transition from drywall to acoustical ceiling one sided hold down clip eliminates the need for drywall bead.

**PART 3 EXECUTION**

**3.1 EXAMINATION**

A. Prior to installation, inspect previous work of all other trades. Verify that all work is complete and accurate to the point where this installation may properly proceed in strict accordance with framing shop drawings.

B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

C. Installation: In accordance with all approved plans, details, and manufacturer’s installation guidelines located in the Armstrong Drywall Grid System Hanging and Framing Flat Ceilings CS-3539.

(1) Install seismic components if required by the building code. Seismic components to be specified on the architectural plans by the project engineer or design team.

**END OF SECTION**
DIVISION: 09 00 00—FINISHES  
SECTION: 09 22 26—SUSPENSION SYSTEMS

REPORT HOLDER:

WORTHINGTON ARMSTRONG VENTURE (WAVE)

101 LINDENWOOD DRIVE, SUITE 350  
MALVERN, PENNSYLVANIA 19355

EVALUATION SUBJECT:

FIRE-RESISTANCE-RATED AND NONFIRE-RESISTANCE-RATED  
SUSPENDED CEILING SYSTEMS

"2014 Recipient of Prestigious Western States Seismic Policy Council (WSSPC) Award in Excellence"

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DIVISION: 09 00 00—FINISHES  
Section: 09 22 26—Suspension Systems

REPORT HOLDER:
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101 LINDENWOOD DRIVE, SUITE 350  
MALVERN, PENNSYLVANIA 19355  
(610) 722-1218  
www.armstrong.com  
jilkelly@armstrong.com

EVALUATION SUBJECT:
FIRE-RESISTANCE-RATED AND NONFIRE-RESISTANCE-RATED SUSPENDED CEILING SYSTEMS

ADDITIONAL LISTEE:
ARMSTRONG WORLD INDUSTRIES  
POST OFFICE BOX 3001  
LANCASTER, PENNSYLVANIA 17604

1.0 EVALUATION SCOPE

Compliance with the following code:

- 2013 Abu Dhabi International Building Code (ADIBC)®

*The ADIBC is based on the 2009 IBC. 2009 IBC code sections referenced in this report are the same sections in the ADIBC.

Properties evaluated:

- Exterior and interior finish
- Fire-resistance
- Structural

2.0 USES

The suspended ceiling systems described in this report are suspended or direct-hung, concealed framing, ceiling assemblies used in fire-resistance-rated and nonfire-resistance-rated construction for both exterior and interior applications.

3.0 DESCRIPTION

3.1 General:

The 8900 series ceiling system is designed for screw-attached wood panels (complying with DOC PS 1 or PS 2) of nonfire-resistance-rated or screw-attached gypsum wall board (complying with ASTM C36 or ASTM C1396) ceiling panels of fire-resistance-rated, interior roof and/or floor-ceiling assemblies.

The XL 7936 series ceiling system is designed for interior or exterior nonfire-resistance-rated roof-ceiling and/or floor-ceiling assemblies. For exterior ceilings without weather-exposed surfaces, as defined in IBC Section 2502, the system is designed for screw-attached gypsum sheathing (complying with ASTM C79 or ASTM C1396). For exterior weather-exposed surfaces, the system is designed for screw-attached metal lath (complying with ASTM C847) with three coats of cement (Type I or II portland cement complying with ASTM C150) plaster finish.

3.2 Components:

3.2.1 Main Runners: Main runners used in both the 8900 series ceiling systems and XL 7936 series ceiling systems are the 8900 (Drywall Stucco and Plaster System) series main runners. All main runners are classified as heavy-duty in accordance with ASTM C635. The main runners have an inverted T-shape and double web. The double web section is rotary-stitched together with a knurled lower flange for screw penetration, and is reverse-folded over for screw retention along the entire length of the bottom flange. The runners are cold-formed from ASTM A653, CS Type B steel, and have a hot dipped, galvanized G-40 coating for interior ceilings or a G-90 coating for exterior ceilings. Table 1 and Figure 1 specify the dimensions, lengths and allowable transverse loads.

The HD 8906, HD8906IC and HD890610 main runners for fire-resistance-rated systems have an added end-coupling for temperature expansion relief, and additional routs for added cross-runner spacing to accommodate field assembly of NEMA Type F lighting in nonfire-rated installations.

The SP-135 main runners for stucco systems are nonfire-resistance-rated systems. SP-135 main runner rout spacing is designed for cross-runner spacing of 13 1/2 inches (343 mm) on center to accommodate stucco lathing.

The main runner has lengths and routing that allow the ceiling framing system to be assembled in the field without field-cutting or screw fastening.

3.2.2 Cross Runners: Cross runners include the XL 7936 (Stucco System) series and the 8900 (Drywall Stucco and Plaster System) series.

The XL 7936 (Stucco System) cross runners have an inverted T-shaped double web. The cross runners are
cold-formed from 0.018-inch-thick (No. 26 MSG) steel that conforms to ASTM A653, CS Type B, and have a hot-dipped galvanized G-40 coating for interior ceilings or a G-90 coating for exterior ceiling. The double web section is rotary-stitched together with a knurled lower flange for screw penetration, and a reverse-folded over for screw retention along the entire length of the bottom flange.

The 8900 (Drywall Stucco and Plaster System) series cross runners have an inverted T-shape and a double web. The cross runners are cold-formed from 0.018-inch-thick (No. 26 MSG) and 0.018-inch-thick steel that conforms to ASTM A653, CS Type B, and have a hot-dipped galvanized G-40 coating for interior ceilings or a G-90 coating for exterior ceilings. The double web section is rotary-stitched together with a knurled lower flange for screw penetration, and a reverse-folded hem for screw retention along the entire length of the bottom flange. Table 2 and Figure 1 specify dimensions, lengths, and allowable transverse loads.

The XL 8947, XL 8947P, XL 8925 and XL 7918 cross runners are used to accommodate NEMA Type F lighting fixtures. These cross runners have factory-knurled reverse hems at the lower flange to receive screws.

The 8900 (Drywall Stucco and Plaster System) series includes cross runners for both fire-resistance-rated and nonfire-resistance-rated drywall ceiling assemblies. XL 8965, XL 8947, XL 8947P, XL 8945, XL 8945P, XL 8341, XL 8925, XL 8926 and XL 7918 cross tees are used in fire-resistance-rated drywall assemblies, while XL 8947, XL 8947P, XL 8926, XL 8925 and XL 7918 cross tees are used in nonfire-resistance-rated assemblies. The cross tees have additional routs to accommodate a full flange opening for NEMA Type F lighting fixtures. The additional routs allow field assembly of the gypsum board ceiling framing without cutting or fastening.

3.2.3 Hanger Wire: Hanger wire for suspended ceilings other than plaster, and any fixtures, must comply with IBC Section 2506.2.1. Hanger wires for plaster ceiling framing systems must comply with ASTM C1063 for use under the IBC. For exterior applications, corrosion-resistant hanger wires, fasteners and accessories must be used.

3.2.4 Accessories: Each system has accessory items that include support angles and corner caps. Steel for accessory items complies with ASTM A568 designation 1008 or 1010, and has a G40, or G90 galvanization coating designation in accordance with ASTM A653.

3.3 The 8900 (Drywall System) Series Two-hour Fire-resistance-rated Suspended Ceiling System:
The 8900 series concealed grid system is part of a two-hour, fire-resistance-rated roof-ceiling or floor-ceiling assembly. The rating applies to restrained and unrestrained assemblies as described in IBC Section 703.2. Figure 2 shows assembly details. General requirements in IBC Section 711 must be observed.

4.0 INSTALLATION
4.1 General:
The suspended ceiling system must be installed in accordance with this report and the manufacturer's published installation instructions. Except for installations with plaster ceilings, the suspended ceiling system must be installed in accordance with 2012 and 2009 IBC Section 808.1.1.1 (2006 IBC Section 803.9.1.1) for systems exceeding 4 psf and less than 10 psf, as applicable. The minimum tension and compression capacity of framing member connections is 180 pounds (800 N). For plaster ceilings, the suspended ceiling system must be installed in accordance with IBC Sections 2510 and 2512.

4.2 Main Runners:
Main runners must be installed and leveled to within 1/4 inch in 10 feet (6.4 mm in 3048 mm), with the supporting wire taut. Vertical support hanger wire must be installed within 6 inches (152 mm) of the main runner fire expansion relief. The design loads for main runners must be less than or equal to the capacities allowed in Table 1 of this report. Supports for the main runners that consist of vertical hangers, perimeter hangers, and lateral force bracing must be installed in accordance with the applicable code.

4.3 Cross Runners:
Main runners, or other cross runners, must support cross runners to within 1/32 inch (0.80 mm) of the required center-to-center spacing. This tolerance must be noncumulative beyond 12 feet (3658 mm). Intersecting runners must be installed to form a right angle to the supporting members.

The maximum design loads for cross runners must be less than or equal to the capacities allowed in Table 1 of this report. A cross runner that supports another cross member must have a minimum uniformly distributed load capacity of 12 pounds per linear foot (175 N/m).

4.4 Seismic Design:
4.4.1 Seismic Design Requirements under the 2012 IBC: Suspended ceilings constructed of lath and plaster or gypsum boards, screw or nail attached to suspended members that are laterally braced to the structure above, are exempt from the provisions found in Section 13.5.6 of ASCE 7-10 as referenced in IBC Section 1613, and must be designed and installed to support the lateral loads determined in accordance with Section 13.3 of ASCE 7-10.

4.4.2 Seismic Design Requirements under the 2009 and 2006 IBC: Seismic design and installation details of the ceiling system must be in accordance with Section 13.5.6 of ASCE 7-05 as referenced in IBC Section 1613. Suspended Ceilings constructed of lath and plaster or gypsum boards, screw or nail attached to suspended members that support a ceiling on one level extending from wall to wall, are exempt the lateral load design requirements of CISC 3-4.

4.5 Partitions:
The partitions must be laterally supported as required by Section 13.5.8 of ASCE 7 as referenced in IBC Section 1613.

4.6 Gypsum Wallboard Attachment:
Gypsum wallboard must be installed and fastened to the ceiling framing system in accordance with IBC Section 2508.

4.7 Plaster Attachment:
Metal plaster bases must be installed in accordance with ASTM C1063. To attach the lath, minimum 1-inch-long, No. 8, Type S, oval head screws per ASTM C1002 must be used. These screws must secure the metal lath to the runners and perimeter members at 6 inches (305 mm) on center in accordance with IBC Section 2510.

4.8 Special Inspection:
Suspended ceilings in Seismic Design Categories D, E or F must be subjected to periodic special inspection during anchorage of suspended ceilings in accordance with the requirements of IBC Section 2506.2.1 and Section
5.0 CONDITIONS OF USE

The suspended ceiling systems described in this report comply with, or are suitable alternatives to what is specified in, those codes listed in Section 1.0 of this report, subject to the following conditions:

5.1 The ceiling suspension main and cross runners are fabricated and installed in accordance with this report and the manufacturer's published installation instructions. In the event of a conflict between the manufacturer's installation instructions and this report, this report governs.

5.2 Design loads and spans of main and cross runners must comply with Tables 1 and 2 of this report.

5.3 Suspended ceiling systems must be designed to resist the lateral loads determined in accordance with Section 13.3 of ASCE 7-10 for recognition under the 2012 IBC (and in accordance with ASCE 7-05, Section 13.5.6, for recognition under the 2009 and 2006 IBC). The documents must be prepared by a registered design professional where required by statutes of the jurisdiction in which the project is to be constructed.

5.4 For Seismic Design Categories C, D, E or F, a quality assurance plan complying with ASCE 7, Section 11A, must be submitted to the code official.

5.5 Periodic special inspections must be provided in accordance with Section 4.8 of this report and ASCE 7-10 (for 2012 IBC) and ASCE 7-05 (for 2009 and 2006 IBC), Section 11A.1.3.9, Item 2 of ASCE 7, Section 13.5.6.2.2, and Item h of ASCE 7-05. A statement of special inspection must be provided as required in 2012 IBC Section 1704.3 (2009 and 2006 IBC Section 1705.3, Item 4.3).

5.6 The ceiling framing systems must not be used to provide lateral support for walls or partitions, except as provided for in ASCE 7, Section 13.5.8.1.

5.7 The ceiling systems must be braced to resist seismic forces as determined from Section 1613 of the IBC.

5.8 The supporting construction of the ceiling system has not been evaluated and is outside the scope of this evaluation report. The code official must approve the roof or floor construction supporting the suspended ceiling system.

5.9 The ceiling systems are limited to ceilings not considered accessible in accordance with Item 28 of 2012 IBC Table 1607.1 (Item 32 of 2009 and 2006 IBC Table 1607.1).

5.10 For exterior ceiling installations, the ceiling systems must be designed for wind loads.

5.11 Light fixtures must be positively attached to the suspended ceiling system with connectors having a minimum capacity, in any direction, of 100 percent of the lighting fixture weight. Lighting fixtures may also be attached to the grid with clips complying with the ICC-ES Acceptance Criteria for Attachment Devices for Recessed Light Fixtures (Luminaires) in Suspended Ceiling Systems (AC184).

6.0 EVIDENCE SUBMITTED

6.1 Data in accordance with ICC-ES Acceptance Criteria for Suspended Ceiling Framing Systems (AC368), dated February 2012.

6.2 Reports of fire-resistance tests in accordance with ASTM E119 (UL 263).

7.0 IDENTIFICATION

Cartons of all products are identified with the name and address of Armstrong World Industries, Inc., the evaluation report number (ESR-1289) and the word "WAVE."
### TABLE 1—DIMENSIONS AND ALLOWABLE LOADS FOR MAIN RUNNERS

<table>
<thead>
<tr>
<th>CATALOG NUMBER</th>
<th>TYPE</th>
<th>LENGTH (inches)</th>
<th>BASE-METAL THICKNESS (inch)</th>
<th>MAXIMUM SPAN (feet)</th>
<th>ALLOWABLE LOADS</th>
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<td>120</td>
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<td>135</td>
<td>0.018</td>
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</table>

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 psf = 14.59 N/m, 1 lbf = 4.448 N.

1Runner web is stitched.

### TABLE 2—DIMENSIONS AND ALLOWABLE LOADS FOR CROSS RUNNERS

<table>
<thead>
<tr>
<th>CATALOG NUMBER</th>
<th>TYPE</th>
<th>LENGTH (inches)</th>
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For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 psf = 14.59 N/m, 1 lbf = 4.448 N.
FIGURE 1
FIGURE 2—SERIES 8900 TWO-HOUR-FIRE-RESISTANCE-RATED ASSEMBLY

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 psf = 4.88 kg/m², 1 gallon = 3.8 L, 1 sq. ft. = 0.0929 m², 1 psi = 6.89 kPa, 1 lbm = 0.45 kg, 1 sq. in. = 645.16 mm².

1. Roof Covering: Roof covering consisting of hot-mopped or cold-application materials compatible with insulation(s) described in Item 2 that provide Class A, B or C coverings.

2. Roof Insulation—Mineral and Fiber Boards: The boards must comply with ASTM C612, Type IA or IB. Nominal 1-inch-thick minimum, 24-inch-by-48-inch or larger. To be applied in six layers as follows:
   A. May be loosely laid on top of gypsum sheathing (Item 4).
   B. May be fastened to steel roof deck (through gypsum sheathing) with mechanical fasteners (Item 7).
   C. May be bonded to gypsum sheathing with adhesive.
   D. Individual layers of mineral and fiber boards above the mechanical fasteners, if used, may be bonded to the bottom layer and to each other with adhesive or hot asphalt.

   First layer to be installed perpendicular to gypsum sheathing direction, with end joints staggered 2 feet in adjacent rows. Each layer of boards must be offset, in both directions, from layer below a minimum of 12 inches in order to lap all joints.

3. Sheathing Material (Optional): Vinyl film or paper scrim vapor barrier, applied with adhesive to the gypsum sheathing. Adjacent sheets overlapped 2 inches.

4. Gypsum Sheathing: Water-resistant core gypsum sheathing complying with ASTM C79. Supplied in sheets nominally 2 by 4 feet to 4 by 12 feet, by nominal 1/4 inch thick. Minimum weight is 2.0 psf. Applied perpendicular to the steel roof deck direction, with or without adhesive or mechanical fasteners through the insulation. End joints to occur over crests of steel roof deck, with end joints staggered 1 foot or more in adjacent rows.

5. Steel Roof Deck: Minimum 1/8-inch-deep, nominal 36-inch-wide fluted units, minimum 0.029-inch-thick (No. 22 gage) galvanized steel. Welded to supports with 1/2-inch puddle welds, through welding washers. Side lap joints of adjacent units are welded or secured together with No. 8 by 1/4-inch-long, self-drilling, self-tapping steel screws midway between steel joists.

6. Adhesive (Optional): Applied to the crest of the steel roof deck in 1/2-inch-wide ribbons at a rate of 0.4 gallon per 100 square feet (approximately 6 inches on center). Applied in 1/2-inch-wide ribbons at 0.4 gallon per 100 square feet between the vapor barrier and the gypsum sheathing, and between the sheathing and the first layer of roof insulation.

7. Mechanical Fasteners (Optional): (Not shown) Insulation clips with discs may be used to secure roof insulation to the steel roof deck (through gypsum sheathing). Clips are 3/16 inches long, having a shank diameter of 0.203 inch. Clips designed so that their tips "lock" against the underside of the steel roof deck. Steel discs are 2/3 inches in diameter, and 0.030 inch thick. Fastener spacing is per manufacturer's specifications.

8. Hot Asphalt or Coal Tar Pitch (Optional): (Not shown) May be applied between layers of roof insulation when applied at a rate not exceeding 25 lbs. /100 sq. ft.

9. Steel Joists: Type 8H3 or 10K1, minimum size; spaced 48 inches on center, welded to end supports. NOTE: Design load must stress 8H3 joists to maximum bending stress of 22,000 psi.

10. Bridging: Minimum 1/2-inch-diameter steel rods are welded to top and bottom chords of each joist.
11. Cold-rolled Channels: Minimum 0.060-inch-thick (No. 16 gage) cold-rolled steel channels, 1/2 inches deep with 5/8-inch flanges. Two channels are tied together back-to-back with 16 SWG galvanized steel wire and are then wired to top of joist lower chord with minimum 16 SWG galvanized steel wire, spaced as required to provide attachment provision for ceiling hanger wires between steel joists.

12. Hanger Wire: Number 12 SWG galvanized steel wire, twist-tied to bottom chord of joists or cold-rolled steel channels. Hanger wires are spaced 48 inches on center along main runners (at every other main runner/cross tee intersection). Hanger wires also to occur at all four corners of light fixtures, at midspan of cross tees adjacent to light fixtures and air-duct outlets, and adjacent to each main runner splice.

13. Air Duct: Number 22 MSG (minimum) galvanized steel. Total area of duct opening not to exceed 225 square inches per 100 square feet of ceiling area. Total area of individual duct openings is not to exceed 225 square inches. Maximum opening dimension is 18 inches. Inside and outside faces of duct throat must be protected with 1/8-inch-thick ceramic fiber paper, laminated to the metal. Duct supported by 1/2-inch-deep, No. 16 MSG cold-rolled steel channels spaced not over 48 inches on center, suspended by No. 12 SWG galvanized steel wire.

14. Damper: Number 16 MSG minimum galvanized steel, sized to overlap duct opening 2 inches, minimum. Protected on both sides with 1/16-inch-thick ceramic fiber paper, laminated to the metal and held open with a fusible link.

15. Fixtures, Recessed Light: Fluorescent-lamp-type steel housing, 2-by-4-foot size. Fixtures must be spaced so their total area does not exceed 24 square feet per each 100 square feet of ceiling area, and wired in conformance with the National Electrical Code.

16. Fixture Protection—Gypsum Wallboard: Same as Item 18. Cut to form a five-sided enclosure, trapezoidal in cross section, at least 1/4 inches higher than the light fixture housing. The fixture protection consists of a 23 1/4-inch-by-49-inch top piece, two 47 1/4-inch-long side pieces and two 23 1/4-inch-long end pieces. The top edge of each fixture protection side piece may be notched 1 inch deep by 10 inches long near its midpoint.

17. Steel Framing Members—Armstrong World Industries, Inc.: Type 8900 Drywall stucco and plaster system main runners are nominally 12 feet long, and are spaced 48 inches on center. Ends of main runners at walls to rest on wall angle, without attachment, with 7/8- to 1/4-inch end clearance. Primary cross tees (1 1/4 inches wide across flange) or cross channels, nominally 4 feet long, are installed perpendicular to main runners and spaced 24 inches on center. Additional primary cross tees or cross channels are required at each wallboard end joint, 8 inches from, and on each side of, the wallboard end joint, and 8 inches from each side of light fixtures. Secondary cross tees (1 1/4 inches wide across flange), nominally 4 feet long, are installed at sides of light fixtures.

18. Wallboard, Gypsum: Five-eighths-inch-thick, Type X, 4-foot-wide gypsum wallboard is installed with the long dimension perpendicular to cross tees, with side joints centered underneath main runners. Wallboard is fastened to each cross tee with 1-inch-long Type S screws, located 1/4 inch from end joints and 1/4 inch from side joints, and spaced 12 inches on center. End joints of adjacent wallboard sheets must be staggered not less than 4 feet on center. Wallboard is fastened to leg of wall angle with wallboard screws spaced 12 inches on center.

19. Metal Trim Molding: Number 25 MSG galvanized steel, measuring 5/8 inch deep, with 1/4- and 1-inch-long legs. Placed over and against wallboard edges around light fixtures, with the 1-inch leg facing down and fastened to the cross tees and main runners with 1 1/4-inch-long screws. Spacing of screws approximately 8 inches on center along 4-foot side, and 10 inches on center along 2-foot side, of light fixtures.

20. Screw, Wallboard: Number 6, Type S, 1- and 1 1/4-inch-long, self-drilling and self-tapping screws.


22. Wall Angle: (Not shown) Number 24 MSG painted steel with 1 1/4-inch legs. Nailed to walls around perimeter of ceiling to support steel framing member ends and to permit screw attachment of the gypsum wallboard.
PART 1 - GENERAL

1.01 WORK INCLUDED

A. Provide gypsum board construction at walls and ceilings as shown, as specified and as needed for a complete and proper installation.

1.02 SUBMITTALS

A. Manufacturer's information for materials, installation and application.

B. Samples: Of components and accessories, upon request.

1.03 QUALITY ASSURANCE

A. Regulatory Requirements

   1. Fire-Resistance Ratings:

      a. Comply with fire-resistance ratings as indicated and required by governing authorities and codes.
      b. Provide materials, accessories, and application procedures which have been listed by a nationally recognized testing agency or tested according to ASTM E119 for type of construction shown.

B. Design Requirements:

   1. Installation Tolerances:

      a. Gypsum board surfaces to be painted shall have no measurable variation in any 2'-0" direction and a maximum variation of 1/4" in 10'-0" when a straightedge is laid on the surface in any direction.
      b. Shim work as required to comply with specified tolerances.

1.04 REFERENCE STANDARDS

A. American Society for Testing and Materials (ASTM):


B. Gypsum Association (GA):

   1. GA216, Recommended Specifications for the Application and Finishing of Gypsum Board.
   2. GA-214-M-97 Recommended levels of Gypsum Board Finish.
1.05 DELIVERY, STORAGE, AND HANDLING

A. Store materials inside under cover and stack flat.

B. Stack gypsum board so that long lengths are not over short lengths.

C. Gypsum board shall not be stored or stacked on floors in excess of forty pounds (40 lbs.) per square foot equivalent loading.

1.06 ENVIRONMENTAL CONDITIONS

A. Environmental Requirements:

1. Temperature: During cold weather, in areas receiving gypsum board installation, maintain temperature range between fifty-five degrees (55°) and seventy degrees (70°) F for twenty four (24) hours before, during, and after gypsum board and joint treatment application.

2. Ventilation:

   a. Provide ventilation during and following adhesives and joint-treatment applications.
   
   b. Use temporary air circulators in enclosed areas lacking natural ventilation.
   
   c. Under slow drying conditions allow additional drying time between coats of joint treatment.
   
   d. Protect installed materials from drafts during hot, dry weather.

B. Protection: Protect adjacent surfaces against damage and stains.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. United States Gypsum Co., USG Corp.

B. Georgia-Pacific Corp.

C. National Gypsum Co.

D. Substitutions: Refer to Section 01630.
2.02 MATERIALS

A. Gypsum Board: Comply with ASTM C840; maximum permissible lengths; ends square cut, tapered edges on boards to be finished.

1. Typical: ASTM C1396, Type X, fire rated gypsum board, impact resistant unless otherwise indicated.

2. 1/4” gypsum board where indicated.

3. First Layer at Double Layer Applications: ASTM C1396 or ASTM C442, Type X, fire rated gypsum backing board.

4. Tile and FRP Substrate: GP ‘Denshield’ Tileguard, or equal. 5/8” thick. Grade/ rating as required by wall assembly. **WR Gypsum board is not acceptable.**

B. Gypsum Board Accessories: Comply with ASTM C840.

1. Provide protective coated steel corner beads and edge trim; type designed to be concealed in finished construction by tape and joint compound.

2. Corner Beads: Manufacturer’s standard metal beads.

3. Vent Screeds: Types as indicated.


5. Reinforcing Tape, Joint Compound, Adhesive, Water, Fasteners: Types recommended by system manufacturer and conforming to ASTM C475.
   a. Typical Joint Compound: Chemical hardening type for bedding and filling, ready-mixed or powder vinyl type for topping.

   a. Back control joints with 4 mil thick polyethylene air seal.

7. Reveals: Extruded aluminum special trim pieces in manufacturer's standard or custom shapes to conform to configurations and dimensions indicated.
   a. Manufactures:
      1) Fry Reglet Corp./Drywall Moldings.
      2) MM Systems Corp./Drywall Moldings.
      3) Gordon Inc./Final Forms l Drywall Trims.
      4) Substitutions: Refer to Section 01630.

8. Metal suspension systems:
   a. USG DGL Drywall Suspension System.
   b. National Gypsum Company
   c. Or equal.
9. Screws: Type W Bugle head screws for wood studs or Type S Bugle head screws for metal studs, meeting ASTM 1002 or C954. Length as required according to all applicable codes and standard installation procedures. Nails will not be considered an acceptable alternate.

C. Acoustical Accessories:

1. Resilient Channels: Provide resilient channels where indicated and where required to provide required sound transmission classifications.
   a. Fasteners and Anchorages: As recommended by gypsum board system manufacturer for maximum STC and NRC ratings.

2. Acoustical Insulation: Preformed mineral fiber, ASTM C665, Type I; friction fit type without integral vapor barrier; as required to meet STC ratings indicated, or of thickness indicated.

3. Acoustical Sealant: ASTM C919, type recommended for use in conjunction with gypsum board.
   a. Type: Paintable, non-shrinking and non-cracking where exposed, nondrying, nonskinning, nonstaining, and nonbleeding where concealed.

4. Electrical Box Pads: Provide at outlet, switch and telephone boxes in walls with acoustical insulation.
   a. Manufacturers for Non-Fire Rated Partitions:
      1) Harry A. Lowry & Associates (800.772.2521)/Lowry’s Electrical Box Pads.
      2) Tremco Sheet Caulking (650.572.1656).
      3) Fire rated partition material manufacturers.
      4) Substitutions: Refer to Section 01630.

   b. Manufacturers for Fire Rated Partitions:
      1) Hevi-Duty Nelson (800.331.7325)/Fire Rated FSP Firestop Putty Pads.
      2) Specified Technologies, Inc. (800.992.1180)/Fire Putty Pads.
      3) Substitutions: Refer to Section 01630 – Product options and Substitutions.

D. Textures:

1. Classroom and corridor walls and soffits: light orange peel.

2. Storage, utility, janitor: light knock-down.
PART 3 - EXECUTION

3.01 EXAMINATION

A. Check framing for accurate spacing and alignment.

B. Verify that spacing of installed framing does not exceed maximum allowable for thickness of gypsum board to be used.

C. Do not proceed with installation of gypsum board until deficiencies are corrected and surfaces to receive gypsum board are acceptable.

D. Protrusions of framing, twisted framing members, or unaligned members shall be repaired before installation of gypsum board is started.

E. Clean partition cavities prior to installation of gypsum board.

3.02 APPLICATION OF GYPSUM BOARD

A. General: Work shall comply with applicable requirements of specified reference standards, except where more stringent requirements are specified; by local codes; or by manufacturer or gypsum board.

1. Neatly fit and stagger end joints.

2. Make joints occur on different studs at opposite sides of partition.

3. Cut and fit neatly around outlets and switches.

4. Installation techniques shall result in plumb and straight surfaces with no waves or buckles, free of unevenness at joints.

5. Brush cut edges and penetrations of water-resistant gypsum board with water resistant tile adhesive.

6. Nailing is not permitted for either walls or ceilings in any location. No exceptions will be made.

B. Ceilings:

1. Apply with long dimension at right angles to horizontal supports. Screw to all bearings at 8" o.c. perimeter and 12" o.c. field.

2. Provide solid bearing at end joints.

3. All joints loosely butted; No screws less than 3/8" from edges and ends at boards.
C. Partitions:

1. General: Apply with long dimensions at vertical to supports and with all abutting edges over supports. Screw to each bearing at 8’’ o.c. perimeter and 12’’ o.c. field.
   a. Apply full lengths between floor and ceiling.
   b. Start application at corner of room or space.
   c. Stagger joints to occur on different framing members on opposite sides of partitions.
   d. Do not place butt ends against tapered edges.
   e. Cut, fit neatly around all outlets, switches, and other penetrating items.
   f. Install gypsum board within ¼” of penetrating ducts, pipes, conduit, outlet boxes, and other penetrating items.

D. Fastening:

1. Attach gypsum board with fasteners as specified according to manufacturer’s latest specifications.
2. Space fasteners in accordance with more stringent of GA-216 recommendations or UL standards.
3. Drive screws with power screwdriver recommended by gypsum board manufacturer.
4. Do not hammer-drive screws.
5. Do not break through paper surface of gypsum board.
6. Set fastener heads slightly below surface of gypsum board.
7. Stagger fasteners opposite each other on adjacent ends or edges.
8. Omit fasteners at edges where metal edge trim will be installed.

E. Double-Layer Application:

1. Apply base layer vertically, offsetting vertical joints at least one (1) stud space between layers.
2. Fasten to supports in accordance with more stringent of manufacturer’s instructions, GA-216 recommendations or UL standards.
3. Precut and fit face layer by laminating to base layer with adhesive.
4. Provide temporary support for face layer, by fasteners or shoring, until adhesive is dry.
   a. Provide alternate permanent support by attaching face layer to base layer with screws in accordance with manufacturer's instructions.

F. Metal Trim and Moldings:
   1. Apply trim at exterior corners and at interior corners where gypsum board intersects metal or other dissimilar materials.
   2. Install in longest lengths practicable.
   3. Run trim and moldings straight and square with planes.
   4. Edges: Apply applicable shape metal edge trim at exposed edges of gypsum board and where otherwise shown.
      a. Gypsum Board Abutting Other Materials: Install edge trim with 1/4” clearance to allow for caulking.
   5. External Corners: Apply metal corner beads at external corners and where otherwise shown in single lengths.

G. Perimeters, penetration, and openings in sound-rated partitions shall be installed and sealed in accordance with requirements specified in Section 07 90 00 – Sealants & Caulking

3.04 TAPING AND FINISHING

A. Provide level #4 finish per GA-214-M-97 for all exposed areas

B. Apply finishing compound and tape in accordance with manufacturer's directions.
   1. Do not apply tape and joint compound over joints containing acoustical sealant until the sealant has completely cured.

C. Center tape over joints and embed in uniform layer of joint compound of sufficient width and depth to provide form and complete bond.
   1. Apply skim coat while embedding tape.
   2. At water-resistant gypsum board, fill fastener heads, penetrations, and joints with water-resistant compound.

D. Treat angles with reinforcing tape folded to conform to adjacent surfaces and straight, true angles.

E. Provide minimum twenty four (24) hours drying time between applications of compounds.

F. Apply coat of finishing compound over joint compound and tape.
1. Spread evenly and feather out beyond edge of board.

2. After first finishing coat is thoroughly dry, cover with second coat with edges feathered out slightly beyond the preceding coat.

3. Apply third coat if required to visually conceal gypsum board joints.

G. Give dimples at fastener heads and marred spots on surface of gypsum board one coat joint compound and two coats finishing compound, applied in same manner as for joints specified above.

H. Conceal flanges of metal reinforcement with minimum two coats compound.
   1. Extend compound 8" to 10" each side of metal nosing.

I. After each application of joint or finishing compound has dried, lightly sand joints.
   1. Leave gypsum board and treated areas uniformly smooth and ready for painting or other decoration.

J. Where gypsum board is covered with a wainscot or wall covering, apply one (1) coat of topping compound over joint compound, sand smooth and prime.

K. Where acoustical tile is glued to gypsum board apply one coat topping compound over joint compound, sand smooth and prime.

3.06 PROTECTION OF FINISHED WORK

A. Provide proper procedures for protection of completed units from damage or deterioration until final acceptance of the Project.

3.07 DIVISION OF THE STATE ARCHITECT

A. Interpetive Regulation (IR25-3) Drywall Ceiling Suspension

B. Materials: Materials are to comply with applicable UBC Standards. Gypsum board is either ½ inch or 5/8 inch in thickness.

C. Design: For lateral load, refer to CBC, Section 1632A. The weight of the suspended ceiling shall not be less than four (4) pounds per square foot for design purposes.

D. Details of Construction.
   1. General: Gypboard ceilings should not support building components other than air conditioning/heating grills or light fixtures. All such components shall be supported either directly from main runners, or by supplemental framing which is supported by main runners. No vertical loads other than gypsum board dead load shall be applied to cross-furring.

    2. Vertical Support System: There are many possible variations of hanger and main runner
sizes and spacings listed in the CBC, Table No. 25A-A, and all of the combinations are acceptable. However, the main runners that are most frequently used are 1-1/2 inch cold rolled channels, 0.475 lbs/ft. This is acceptable provided the following requirements are met:

a. Vertical hanger wires are #9 gage and galvanized soft-annealed steel.

b. Cross-furring may be 7/8 inch, 25 gage galvanized hat sections at 24 inches o.c. maximum.

c. If main runners are spaced at 4'-0" o.c., hanger wires shall be spaced at 3'-0" o.c. maximum.

d. If main runners are spaced at 3'-6" o.c., hanger wires shall be spaced at 3'-6" o.c. maximum.

e. If main runners are spaced at 3'-0" o.c, hanger wires shall be spaced at 4'-0" o.c. maximum.

f. To use a main runner spacing of 4'-0 o.c. with a hanger spacing of 4'-0" o.c., main runners must be 1-1/2 inch hot rolled channels weighing 1.12 lbs/ft. Also, #8 gage galvanized hanger wires would be required.

3. The following requirements apply to all wire hangers/runner combinations:

a. Hangers should be saddle-tied around main runners to develop the full strength of the hangers.

b. Cross-furring should be saddle-tied to the main runners with one strand of #16 gage, or two strands of #18 gage tie wire.

c. Main runners should be spliced by lapping and interlocking flanges 12 inches minimum and tying near each end with double loops of #16 gage wire.

d. Cross-furring should be spliced by lapping and interlocking the pieces eight (8) inches minimum and tying near each end with double loops of #16 gage wire.

4. Fasten hangers wire with not less than three (3) tight turns. Fasten bracing wires with four (4) tight turns. Make all tight turns within a distance of 1-1/2 inches. Hanger or bracing wire anchors to the structure should be installed in such a manner that the direction of the anchor aligns as closely as possible with the direction of the wire.

Note: Wire turns made by machine where both strands have been deformed or bent in wrapping can waive the 1-1/12 inch requirement, but the number of turns should be maintained, and be as tight as possible.

Separate all ceiling hanger and bracing wires at least six (6) inches from all unbraced ducts, pipes, conduit, etc.

When drilled-in concrete anchors or shot-in anchors are used in reinforced
concrete for hanger wires, 1 out of 10 must be field tested for 200 lbs. in tension. When drilled-in concrete anchors are used for bracing wires, 1 out of 2 must be field tested for 440 lbs. in tension. Shot-in anchors in concrete are not permitted for bracing wires. If any shot-in or drilled-in anchor fails, see Section 1923A.3.5, Title 24.

Note: Drilled in or shot-in anchors require special DSA approval when used in prestressed concrete.

Provide trapeze or other supplementary support members at obstructions to typical hanger spacing. Provide additional hangers, struts or braces as required at all ceiling breaks, soffits, or discontinuous areas. Hanger wires that are more than 1 in 6 out of plumb are to have counter-sloping wires.

E. Support and anchorage of light fixtures and mechanical services.

1. All recessed or drop-in light fixtures, as well as ceiling mounted mechanical air terminals and services, shall be supported directly by main runners or by supplemental framing which is supported by main runners and positively attached with screws or other approved connectors.

2. Surface mounted fixtures shall be attached to a main runner with a positive clamping device made of material with a minimum of 14 gauge. Rotational spring clamps do not comply.

F. Lateral System.

1. Wire Brace System: Provide bracing assemblies, per Figure 1 of IR 25-2, as determined by calculations, with the following limitations:

   a. For school buildings, place bracing assemblies at a spacing not more than 12 ft. by 12 ft. on center.

   b. For Essential Services Buildings, place bracing assemblies not more than 8 ft. by 12 ft. on center.

   c. Provide bracing assemblies at not more than six (6) feet from each perimeter wall and at the edge of vertical ceiling offsets.

   d. The slope of bracing wires shall not exceed 45 degrees from the plane of the ceiling and shall be taut. Splices in bracing wires are not to be permitted without special DSA approval.

   e. Ceiling grids members may be attached to not more than two (2) adjacent walls. Ceiling grid members shall be at least ½ inch free of other walls. If walls run diagonally to ceiling grid runners, one end of main and cross runners should be free, and a minimum of ½ inch clear of wall.

   f. Suspended ceiling systems with an area of 144 square feet or less, and fire rated
ceiling systems with an area of 96 square feet or less, surrounded by walls which connect directly to the structure above, do not require bracing assemblies when attached to at least two adjacent walls.

2. Alternate System: Design as a diaphragm, similar to plywood diaphragm concept, subject to acceptance by the DSA Regional Office.

3. Diaphragm Ratios:
   - Horizontal 2:1 maximum
   - Vertical 1:1 maximum

4. A maximum diaphragm shear equal to 50 lbs./ft. is allowed with 1 inch or 1-1/4 inch Hi-Lo Type S, or S-12, bugle head screws at 12 inches o.c. at all gypsum board edges (3/8 inch screw edge distance) and at all intermediate supports. A wall constructed similarly can resist the same shear force provided the gypsum board is on the same side of the studs as the ceiling is, and a positive connection between the ceiling and the wall is detailed. The gypsum board diaphragms are to resist lateral loads due to their own weight and/or the ceiling diaphragms(s) only.

5. Details are required providing for lateral load transfer from the gypsum board to shear walls, or other lateral load resisting elements, on all four sides of the diaphragm.

END OF SECTION
SECTION 09 30 00

TILE

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Interior floor and base tile installed over waterproofing/crack-isolation/anti-fracture membrane using thinset method with epoxy grouted joints.

B. Exterior floor tile installed using full mortar bed method with cementitious grouted joints.


1.2 RELATED SECTIONS

A. Section 03336 - Architectural Concrete - Building: Concrete topping slabs with embedded radiant heat tubing.

B. Section 03350 - Concrete Finishing: Troweling and finishing of concrete floor slabs to receive waterproofing membranes.

C. Section 05512 – Metal Stairs with Precast Concrete Treads: Precast concrete treads, risers and intermediate landings to receive thinset floor tile.

D. Section 07140 - Fluid Applied Waterproofing: Waterproofing below mortar beds at exterior tile.

E. Section 07900 – Joint Sealers: Sealants and backing material other than specified in this section.

F. Section 09110 - Non-Load Bearing Metal Framing: Metal stud framing and backing.

G. Section 09250 - Gypsum Board: Gypsum board to receive thinset wall tile outside toilets.

H. Section 09251 – Cementitious Backing Board: Cementitious backing units to receive ceramic wall tile within toilets.

I. Section 10163 – Stainless Steel Toilet Compartments: Toilet partitions and urinal screens secured to framing through tile finish.

J. Section 10800 - Toilet and Bath Accessories: Toilet accessories secured to framing through tile finish.
K. Division 15 - Mechanical: Floor drains.

1.3 REFERENCES

A. American National Standards Institute:

1. ANSI A108.1B – Installation of Ceramic Tile on a Cured Portland Cement Mortar Bed with Dry-Set or Latex-Portland Cement Mortar.

2. ANSI A108.4 – Ceramic Tile Installed with Organic Adhesives or Water Cleanable Tile-Setting Epoxy Adhesive.

3. ANSI A108.5 - Ceramic Tile Installed with Dry-Set Portland Cement Mortar or Latex-Portland Cement Mortar.

4. ANSI A108.6 - Ceramic Tile Installed with Chemical Resistant, Water Cleanable Tile Setting and Grouting Epoxy.

5. ANSI A118.3 - Chemical-Resistant, Water Cleanable, Tile Setting and Grouting Epoxy and Water Cleanable Tile Setting Adhesive.

6. ANSI A118.4 - Latex-Portland Cement Mortar.

7. ANSI A118.7 - Polymer Modified Tile Grouts for Tile Installation.

8. ANSI A118.10 – Load Bearing, Bonded Waterproof Membranes for Thin-Set Ceramic Tile and Dimension Stone Installation.

9. ANSI A118.12 – Crack Isolation Membranes for Thin-Set Ceramic Tile and Dimension Stone Installation.

B. ASTM International:

1. ASTM A185 – Specification for Steel Welded Wire Fabric, Plain, for Concrete Reinforcement.

2. ASTM C144 – Specification for Aggregate for Masonry Mortar.


5. ASTM C482 - Test Method for Bond Strength of Ceramic Tile to Portland Cement.


10. ASTM C1028 - Test Method for Static Coefficient of Friction of Ceramic Tile and Other Like Surfaces by the Horizontal Dynameter Pull-Meter Method.

11. ASTM F1869 - Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride.

C. EN 101 - Method for Determination of Scratch Hardness of Surface According to MOHS.


E. TCNA 137.1 - Specifications for Ceramic Tile.

1.4 SUBMITTALS

A. Product Data: Submit data and installation instructions for membranes, bond coats, mortars, grouts, grout releases and grout release removers, sealants and grout sealers.

B. Samples:

1. Submit samples of each type and color of tile specified.

2. Submit samples, minimum 3 inches long, of grout in each color selected.

3. Submit samples illustrating full range of sealant colors available for Architect's selection.

1.5 OPERATION AND MAINTENANCE DATA

A. Submit maintenance procedures for epoxy grouted tile installations.
1.6 QUALITY ASSURANCE


B. Tile: Conform to TCNA 137.1.

1.7 FIELD SAMPLES

A. Provide 1 field sample, 24 inches by 24 inches in size, for each type and color of tile selected. Construct sample in place with selected colored grout.

B. Locate where directed by Architect.

C. Rebuild samples not meeting specified requirements as directed by Architect.

D. Accepted samples will establish minimum standard of quality and workmanship for ceramic tile work.

E. Retain and protect accepted field samples in undisturbed condition during work of this section.

F. Accepted samples may remain as part of Work.

1.8 DELIVERY, STORAGE AND HANDLING

A. Deliver, store and handle products in accordance with manufacturer's instructions and recommendations.

B. Arrange deliveries of products in accordance with lead times and construction schedules. Order products with long lead times in timely fashion to ensure delivery that avoids conflict with sequence of construction and allows continuity of work.

C. Deliver products and store products in their original unbroken cartons.

D. Store tile in dry covered area.

1.9 EXTRA STOCK

A. Provide 1 carton of each type and color of tile used.

B. Wrap and label identifying manufacturer, size, color, project name and areas installed.

C. Deliver to Owner; obtain receipt.
PART 2 PRODUCTS

2.1 TILE MATERIALS

A. CT1: Unglazed porcelain floor tile; coefficient of friction not less than 0.60 when tested in accordance with ASTM C1028; imported product with long lead time; Ariostea S.p.A., "Legni High Tech" Collection.
   1. Size: 33 percent 4 x 36 inch, 33 percent 6 x 36 inch and 33 percent 9 x 36 inch.
   2. Color: "Rovere Grigio."

B. CT1A: Unglazed porcelain base tile; bull nosed along one long edge; imported product with long lead time; Ariostea S.p.A., "Legni High Tech" Collection.
   1. Size: 3-1/2 x 35-1/2 inch.
   2. Color: "Rovere Grigio."

C. CT2: Glazed ceramic wall tile composed of 50 percent pre-consumer waste from drilling aggregate, 20 percent post-consumer cullet from ground windshields and other glass and 30 percent new material; trim for thinset application; EcoSpec® Green Products Division of SpecCeramics Inc., "Environments" Collection.
   1. Size: 8-1/2 x 2-1/2 inches.
   2. Color: "Moon."

D. CT3: Unglazed porcelain floor tile; coefficient of friction not less than 0.60 when tested in accordance with ASTM C1028; imported product with long lead time; Ariostea S.p.A., "Legni High Tech" Collection.
   1. Size: 6 x 36 inch.
   2. Color: "Rovere Grigio."

2.2 SETTING AND GROUTING MATERIALS

A. Mortar: Latex Portland cement mortar for thick cement mortar beds consisting of factory prepared blend of selected raw materials, Portland cement and graded aggregates mixed with latex admixture; suitable for interior and exterior exposures; Laticrete 226 Thick Bed Mortar mixed with Laticrete 3701 Mortar Admixture or equal product substituted under provisions of Division 1.

<table>
<thead>
<tr>
<th>Property</th>
<th>Test Method</th>
<th>Result</th>
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Contra Costa Community College District
Diablo Valley College
AB Restroom Renovation
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<tr>
<td>TCNA Service Rating</td>
<td>ASTM C627</td>
<td>Extra Heavy</td>
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B. Tile Bond Coats:

1. To Metal Substrate: EN12004, R2 Classification; 2 component epoxy adhesive in factory-proportioned kit consisting of epoxy resin, hardener and chemically resistant silica filler; water cleanable; non-staining, high bond strength; maximum chemical resistance; Greenguard certified; recommended by manufacturer for adhering tile to steel, plywood and cement backer board; Laticrete Latapoxy® 300 Adhesive or equal product substituted under provisions of Division 1.

2. To Other Substrates: ANSI A118.4; factory pre-blended polymer fortified dry set mortar in powdered form for mixing with water; containing antimicrobial protection; gray color; Laticrete International, Inc. Laticrete® 254 Platinum or equal product substituted under provisions of Division 1.

<table>
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<tr>
<th>Property</th>
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<tr>
<td>Shear Bond Water Immersion</td>
<td>ANSI A118.4</td>
<td>5.2.3 150 to 300 psi</td>
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C. Tile Grouts:

1. Epoxy Grout: ANSI A118.3; multi-component epoxy type consisting of liquid resin, liquid hardener and colored powder; non-sag formula suitable for floors and walls; containing anti-microbial protection; water cleanable; chemically resistant; stain resistant; Greenguard Indoor Air Quality Certified®; Laticrete International, Inc. Laticrete® Spectralock® Pro Grout or equal product substituted under provisions of Division 1.

a Properties:

<table>
<thead>
<tr>
<th>Property</th>
<th>Test Method</th>
<th>Result</th>
</tr>
</thead>
</table>
Shrinkage \hspace{1cm} ANSI A118.3 \hspace{0.5cm} E5.3 \hspace{1cm} <0.25\%
Vertical Joint Sag \hspace{1cm} ANSI A118.3 \hspace{0.5cm} E5.4 \hspace{1cm} Passes
Bond Strength \hspace{1cm} ANSI A118.3 \hspace{0.5cm} E5.5 \hspace{1cm} 1,000 psi
Compressive Strength \hspace{1cm} ANSI A118.3 \hspace{0.5cm} E5.6 \hspace{1cm} 3,500 psi
Tensile Strength \hspace{1cm} ANSI A118.3 \hspace{0.5cm} E5.7 \hspace{1cm} 1,100 psi
Thermal Shock \hspace{1cm} ANSI A118.3 \hspace{0.5cm} E5.8 \hspace{1cm} 510 psi
Water Absorption \hspace{1cm} ANSI A118.3 \hspace{1cm} \hspace{0.5cm} <0.50\%

b. Colors: To be determined.

2. Cementitious Grouts:

a. For Joints 1/8 Inch Wide and Wider: ANSI A118.7; polymer modified cement dry grout recommended by manufacturer for heavy duty use in interior and exterior environments; sanded; Laticrete International, Inc. Laticrete® 1500 Sanded Grout fortified with Laticrete® 1776 Grout Enhancer or equal products substituted under provisions of Division 1.

i. Properties:

<table>
<thead>
<tr>
<th>Property</th>
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<td>Linear Shrinkage</td>
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<td>Compressive</td>
<td>ANSI A118.7</td>
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<td>Water Absorption</td>
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<td>7%</td>
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<tr>
<td>TCNA Service</td>
<td>ASTM C627</td>
<td>Extra heavy</td>
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<tr>
<td>Rating</td>
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</table>

ii. Colors: To be determined.

b. For Joints Less Than 1/8 Inch Wide: ANSI A118.7; polymer modified cement dry grout recommended by manufacturer for use in interior and exterior environments; unsanded; Laticrete International, Inc. Laticrete® 1600 Unsanded Grout fortified with Laticrete® 1776 Grout Enhancer or equal products substituted under provisions of Division 1.

i. Properties:

<table>
<thead>
<tr>
<th>Property</th>
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<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Linear Shrinkage  
ANSI A118.6  
<0.3%

Flexural Strength  
ANSI A118.6  
400 psi

ii. Colors: To be determined.

2.3 ACCESSORIES

A. Interior Floor Waterproofing/Crack Isolation/Anti-Fracture Membrane: ANSI A118.10 and A118.12; cold-applied single-component self-curing liquid rubber polymer that cures to flexible seamless waterproofing membrane without use of fabric reinforcing in field, coves and corners and that provides anti-fracture protection of up to 1/8 inch over shrinkage and other non-structural cracks; load bearing; non-flammable; contains antimicrobial protection; contains no solvents; 0.020 to 0.030 inch thick when cured; IAPMO approved; Greenguard Indoor Air Quality Certified®; Laticrete International, Inc. Laticrete® Hydro Ban™ or equal product substituted under provisions of Division 1.

1. Properties:

<table>
<thead>
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<th>Property</th>
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<tr>
<td>7-Day Hydrostatic Test</td>
<td>ANSI A118.10</td>
<td>Passes</td>
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<tr>
<td>7-Day Tensile Strength</td>
<td>ANSI A118.10</td>
<td>265 to 300 psi</td>
</tr>
<tr>
<td>7-Day Water Immersion</td>
<td>ANSI A118.10</td>
<td>95 to 120 psi</td>
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<tr>
<td>7-Day Shear Bond</td>
<td>ANSI A118.10</td>
<td>200 to 275 psi</td>
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<tr>
<td>28-Day Shear Strength</td>
<td>ANSI A118.10</td>
<td>214 to 243 psi</td>
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<tr>
<td>System Crack Resistance Test</td>
<td>ANSI A118.12 5.4</td>
<td>Passes</td>
</tr>
</tbody>
</table>

2. Accessory Materials:


b. Sealant: ASTM C920, Type S, Grade NS, Uses Mand G; single component silicone; non-sag formula; neutral cure; Laticrete International, Inc. Laticrete® Latasil™.

B. Reinforcing:

1. Floor Reinforcing: ASTM A185; 16 gauge welded wire mesh; 2 x 2 inch grid; galvanized.
2. Wall: Expanded metal lath; diamond mesh; self-furring; minimum 3.4 lbs/sq yd; galvanized.

C. Restroom Base Cove: Coved shape profile fabricated from Type 304 stainless steel with brushed finish on exposed surfaces; coved section with 23/32 inch radius forms visible surface; 7/16 inch offset between cove and anchoring legs to receive wall and floor tile; anchoring legs with trapezoid shaped perforations to secure profile in wall and floor mortar bond coats; supplied with inside corners, outside corners, connectors and end caps; Schuler Systems L.P. Schluter® - DILEX-EHK U11/011 or equal product substituted under provisions of Division 1.

D. Exterior Edge Trim: Color coated aluminum T-shaped edging profile for balconies and terraces; 3-1/8 inch wide anchoring leg with trapezoid shaped perforations to secure profile in mortar bed; 1-9/16 inch tall vertical section with 1-1/16 inch tall drip lip with 3/4 inch offset for 2-5/8 inch total visible surface height; matching inside corners, out side corners and connector pieces; Schuler Systems L.P. Schluter® - BARA-RK in color SB "Black Brown" or equal product substituted under provisions of Division 1.

E. Expansion Joints:

1. Backing Material: Closed cell polyurethane foam; 2.7 pcf; approximately 20 percent thicker than width of expansion joint.

2. Sealants:
   a. Between Floor and Walls and at Door Frames: ASTM C920, Type S, Grade NS, Uses M and G; single component silicone; non-sag formula; neutral cure; colors to match grout.
   b. In Traffic Areas: ASTM C920, Type M, Grade P, Use T; 2-part polyurethane; Shore A hardness of 35; color to match grout.

F. Grout Release: Removable; biodegradable; odor free; formulated to prevent grout penetration or staining of unglazed quarry tile; TEC Specialty Products, Inc. #TA-264 Grout Release or equal product substituted under provisions of Division 1.

G. Grout Release Remover: Concentrated ammoniated stripper; water-based formula; non-flammable; liquid form; TEC Specialty Products, Inc. #TA-258 Floor Finish Stripper or equal product substituted under provisions of Division 1.

H. Grout Cleaner: Type recommended by grout manufacturer to remove grout haze from face of tile; Laticrete International, Inc. Laticrete® Cleaning Additive.

2.4 MORTAR AND GROUT MIXES

A. Mix and proportion factory packaged bond coats and grout materials in accordance with manufacturer's instructions.
PART 3 EXECUTION

3.1 EXAMINATION

A. Examine condition of substrates to determine acceptability for installation. Verify that substrates are acceptable for product installation in accordance with manufacturers' instructions and recommendations.

8. Verify that surfaces to receive tile and waterproofing/anti-fracture membrane are level, plumb, and with maximum variation in backing surface not to exceed 1/4 inch in 10'-0" from required plane with not more than 1/16 inch in 1 foot variation in high spots.

C. Verify that studs supporting gypsum board and cementitious backing board to receive thinset tile are plumb, aligned and properly placed. Verify that metal studs are minimum 20 gauge with minimum 3-5/8 inch web depth and are spaced at 16 inches oc maximum.

D. Verify that spaces between cementitious backer boards and adjacent slabs and curbs to receive waterproofing/anti-fracture membrane have been filled with latex-Portland cement mortar.

E. Verify that joints in gypsum board and cementitious backing board to receive thinset tile have been treated with tape and bedding coat of joint compound with no finish coats. Verify that fasteners heads have been treated with 1 coat of joint compound.

F. Verify that concrete slabs to receive waterproofing/anti-fracture membrane are structurally sound, clean, free of dirt, grease, paint, laitance, efflorescence, concrete sealers and curing compounds and have been steel troweled and fine broom finished.

G. Verify that moisture vapor emission rate of concrete subfloors and mortar beds to receive waterproofing/anti-fracture membrane does not exceed 5.0 pounds per 1,000 sq ft in 24 hrs or that recommended by membrane manufacturer by conducting calcium chloride tests in accordance with ASTM F1869 and test manufacturer's instructions.

1. Conduct minimum 1 calcium chloride test for every 1,000 square feet of flooring or portion thereof, around perimeter, at columns and where moisture is present.

2. Prepare diagram of area or room showing location and results of each test.

3. If test results indicate moisture emission in excess of specified rate, do not proceed with membrane installation until corrective action has been completed. Consult membrane manufacturer regarding use of vapor reduction membrane or other available corrective actions.

H. Verify that concrete slabs to receive waterproofing/anti-fracture membranes slope to drains.
I. Verify that deflection of concrete slabs to receive waterproofing/anti-fracture membranes and thinset tile under live, dead and impact loads does not exceed L/360.

J. Ensure surfaces are clean and well cured.

K. Do not begin installing tile until deficiencies are corrected.

3.2 INSTALLATION - MORTAR BEDS

A. Install factory blended mortars in accordance with referenced TCNA methods and with manufacturer's instructions and recommendations.

1. Ensure surfaces to receive mortar are between 40°F and 90°F.

2. Ensure surfaces to receive mortar are structurally sound, clean and free from dirt, oil, grease, laitance, paint, concrete sealers and curing compounds.

3. Ensure construction and expansion joints in substrate surfaces are continued through mortar beds.

B. Install reinforced mortar bed for exterior floor tile over drainage composite and fluid applied waterproof membrane in accordance with TCNA F121.

1. Place mortar over drainage composite to approximately 1/2 depth of mortar bed.

2. Place reinforcing over mortar; ensure reinforcing remains at mid-depth of mortar bed.

3. Place balance of mortar bed; spread and compact well. Apply mortar bed to uniform thickness not less than 1-1/4 inches and not more than 2 inches.

4. Incorporate exterior edge trim into mortar bed in accordance with manufacturer's instructions where indicated on Drawings.

B. Install reinforced mortar bed for exterior wall tile over fluid applied waterproof membrane in accordance with TCNA W201.

1. Install reinforcing over waterproofing membrane; cut lath at expansion joints.

2. Trowel apply scratch coat to cover reinforcing but not exceeding 1/2 inch thickness; scratch mortar before it hardens.

3. After scratch coat mortar hardens; trowel apply mortar bed over scratch coat so that combined thickness of scratch coat and mortar bed is not less than 3/4 inch. Float with steel trowel and straight edges to form plumb and true mortar surface.

C. Allow mortar beds to cure minimum 24 hours prior to installing tile.
3.3 INSTALLATION - MEMBRANES

A. Interior Floor Waterproofing/Crack Isolation/Anti-Fracture Membrane: Apply waterproofing/crack isolation/anti-fracture membrane in accordance with manufacturer’s instructions and recommendations.

1. Dampen hot and dry surfaces; sweep off excess water.

2. Pretreat cracks, joints, coves, corners, seams, drains and penetrations. Allow pre-treated areas to dry to touch prior to applying waterproofing/anti-fracture membrane.

   a. Cracks and Joints: Apply liberal coat of membrane liquid with brush or trowel to fill non-structural joints and cracks; apply liberal coat of membrane liquid approximately 8 inches wide with brush or roller over substrate cracks, cold joints and control joints.

   b. Coves and Floor/Wall Transitions: Apply liberal coat of membrane liquid with brush or trowel to fill cove joints and floor/wall transitions less than 1/8 inch; apply liberal coat of membrane liquid approximately 8 inches wide with brush or roller over substrate coves and floor/wall transitions.

   c. Drains: Apply liberal coat of membrane liquid around and over bottom half of drain clamping ring; cover with second coat of membrane liquid. Allow membrane liquid to dry; apply bead of sealant where membrane liquid meets drain throat. Install top half of drain clamping ring.

   d. Other Penetrations: Pack gaps around pipes, electrical boxes and other penetrations with tile bond coat material. Apply liberal coat of membrane liquid around penetration opening; cover with second coat of membrane liquid. Extend membrane liquid applications on to penetration up to level of tile. When dry, seal membrane liquid flashing with sealant.

3. Brush or roller apply 2 coats of membrane liquid over substrate including pretreated areas; cover floor and extend minimum 6 inches up walls at toilets and 4 inches up walls at kitchens.

4. At expansion joints, apply liberal coat of membrane liquid approximately 8 inches wide; embed and loop 6 inch wide reinforcing fabric allowing liquid to bleed through fabric. Top coat with second coat of membrane liquid.

5. Allow topcoat to dry to touch. Examine surface for pinholes, voids, thin spots and other defects. Seal defects with additional application of membrane liquid.

6. Allow membrane to fully cure prior to testing. Protect membrane from damage during curing process.

7. Flood completed membrane to test for leaks.

   a. Dam installation area. Flood to minimum depth of 2 inches with clean water. After 2 hours, inspect for leaks.
b. If leaking is found, remove water and repair leaking areas. Repeat flood test. Repair damage to building due to leaks.

c. When area is proven watertight, drain water and remove dam.

8. Do not permit traffic over unprotected or uncovered membrane.

3.4 INSTALLATION - TILE

A. Floor Tile and Base Tile:

1. Interior Floor Tile Over Concrete: Install interior floor tile over concrete over waterproofing/crack-isolation/anti-fracture membrane over concrete slabs-on-grade and raised concrete slabs with latex Portland cement bond coat in accordance with TCNA F122 and ANSI A108.5

2. Interior Floor Tile Over Concrete Topping Slabs with Embedded Radiant Heating Tubing: Install interior floor tile over waterproofing/crack-isolation/anti-fracture membrane over concrete topping slabs with latex Portland cement bond coat in accordance with TCNA RH110 and ANSI A108.5.

3. Exterior Floor Tile: Install exterior floor tile over cured reinforced mortar bed over drainage composite on fluid applied waterproofing with latex Portland cement bond coat in accordance with TCNA F121 and ANSI A108.1B.

B. Wall and Base Tile:

1. Interior Wall Tile Within Toilets: Install interior wall tile over cementitious backer board over water resistive barrier on metal studs with latex-Portland cement mortar bond coat in accordance with TCNA W244C and ANSI A108.5.

2. Interior Wall Tile in Other Locations: Install interior wall and base tile over gypsum board on metal studs with latex-Portland cement mortar bond coat in accordance with TCNA W243 and ANSI A108.5.

3. Exterior Wall Tile: Install exterior wall tile over cured reinforced mortar bed over fluid applied waterproofing on concrete wall with latex-Portland cement mortar bond coat in accordance with TCNA W201 and ANSI A108.5.

4. Exterior Wall Cap Tile: Install exterior wall cap tile over metal cap flashing with epoxy cement bond coat in accordance with TCA F116 and ANSI A108.4.

C. Install expansion joints in accordance with TCA EJ171:

1. Where tile abuts restraining surfaces such as curbs, columns, pipes and door frames.

2. To perimeter walls in rooms and spaces larger than 16 feet on a side.
3. At 16 foot maximum spacing where expanse of interior or exterior tile exceed 12 feet in either direction.

D. Place tile in accordance with patterns indicated on Drawings. Carefully plant tile layouts, ensure pattern is uninterrupted from one surface to next and through doorways.

E. Neatly cut tile around fixtures; accurately form corners, base, intersections and returns.

F. Form tile joints to widths recommended by manufacturer unless otherwise directed.
   1. Ensure tile joints are uniform in width, subject to normal variance in tolerance allowed in tile size.
   2. Ensure joints are watertight, without voids, cracks, excess mortar or grout.

G. Form internal wall angles square, external angles and exposed edges bullnosed unless otherwise directed. Provide coved base at wall-floor intersection unless otherwise specified or directed.

F. Sound tile after setting, remove and replace hollow sounding units.

3.5 GROUTING

A. Apply grout release to unglazed tile in accordance with ANSI A108.6 and manufacturer's instructions and recommendations prior to applying grout.
   1. Protect adjacent surfaces not designated to receive grout release.
   2. Rake out high ridges of mortar from grout joints.
   3. Apply thin coat grout release to tile using sponge brush, short napped roller or paint pad; cover tiles thoroughly and allow to dry.
   4. Apply second coat grout release at right angles to first coat; allow to dry.
   5. Ensure grout is applied within 12 hours after second coat is thoroughly dry.

B. Epoxy Grout: Mix and apply epoxy grout to interior floor and wall tile in accordance with manufacturer's instructions and recommendations.
   1. Remove excess mortar and construction debris from tile joints.
   2. Wipe face of tile with slightly dampened sponge to remove dirt and dust. Ensure no standing water remains in joints.
   3. Verify that colored powder packages bear same batch number.
   4. Mix epoxy grout components. Stir contents of hardener and resin bags; blend
entire contents of hardener and resin bags together. Add colored powder and mix to smooth trowelable consistency; do not over mix.

5. Remove mixed grout from mixing container and place in small piles on floor to be grouted; place grout for walls and bases on mortar boards on floor.

6. Pack joints full of grout using stiff rubber float; ensure no voids are left during application.

7. Allow grout to settle and firm slightly then use rubber float at 90 degree angle to remove as much excess material as possible before initial cleaning. Avoid gouging joints while removing as much epoxy from tile surface as possible.

8. Initial Cleaning: Begin initial cleaning to remove grout haze approximately 15 minutes after grouting an area to ensure grout joints begin to firm; do not allow grout to set on face of tile.
   a. Use grout cleaning solution with white nylon scrub pad. Wipe tile and grout surface in light circular motion to loosen grout residue and smooth out joints. Rinse scrub pad and change solution frequently.
   b. Drag damp clean sponge diagonally over scrubbed surface to remove grout. Rinse sponge and change solution frequently.

9. Final Cleaning: Begin final cleaning to remove grout haze approximately 90 minutes after initial cleaning to ensure no grout haze or other contaminates remain on surface of tile.
   a. Use grout cleaning solution and clean white nylon scrub pad. Wipe tile surface in light circular motion; avoid contact with grout. Rinse scrub pad and change cleaning solution frequently.
   b. Drag damp clean sponge diagonally over scrubbed tile surface to remove grout haze. Rinse sponge and change solution frequently.
c. Allow application to dry and examine for areas where residual haze remains. If haze is present, immediately repeat final cleaning procedures until no haze remains.

C. Cementitious Grout: Apply cementitious grout to exterior floor tile in accordance with ANSI A108.10 and manufacturer's instructions.

1. Dampen surface with water.

2. Spread grout with sharp firm rubber grout float forcing maximum grout into joints. Use diagonal strokes to pack joints; fill joints smooth without voids, pinholes or low spots.

3. Before grout sets, tool joints to depth of bevel.

4. Upon completion of grouting, sponge and wash tile thoroughly removing excess grout.
   a. Remove excess grout from face of tile with edge of grout float; hold float at 90 degree angle and pull diagonally across joints.
   b. Remove remaining grout with damp sponge or towel; work diagonally to joints. Allow to dry.
   c. When grout joints are firm, polish surface with coarse nylon pad or coarse cloth and minimal water taking care not to damage soft glazed tile or polished stone.

5. Cure grout in accordance with manufacturer's instructions.

D. As soon as possible after grout has sufficiently cured, remove remaining grout release residue using grout release remover in accordance with manufacturer's instructions and recommendations.

1. Mix grout release remover with water in accordance with manufacturer's recommendations.

2. Apply grout release remover solution liberally over small area. Allow solution to soak until grout release film becomes white; do not allow solution to dry.

3. Scrub treated area with nylon stripping pad until grout release film is removed; rinse surface with clean water.

4. Examine surface for residual traces of grout release film; repeat procedure if necessary to remove remaining traces.
3.7 CLEANING
   A. Remove excess mortar, grout and sealer from tile and adjacent surfaces.
   B. Clean soiled surfaces.

3.8 PROTECTION
   A. Prohibit traffic from grouted floor finish for 48 hours after installation.

END OF SECTION
SECTION 09 70 00
CONCRETE FLOOR SEALER

PART 1 - GENERAL
1.1 SUMMARY
   A. Section Includes: Provide concrete floor sealer.

1.2 SUBMITTALS
   A. Product Data: Submit product data on floor treatment.

1.3 QUALITY ASSURANCE
   A. Installer: Manufacturer’s trained personnel or factory-trained authorized installer, with
      minimum five years successful experience preparing substrates where old flooring
      has been removed and installing concrete vapor emission control systems.
   B. Slip Resistance: Provide materials tested under ASTM D2047, James Slip Test with
      minimum 0.6 rating for floors, 0.8 rating for ramps.
   C. Mock-Up: Provide not less than 100 sf mock-up of floor substrate preparation.

1.4 PROJECT CONDITIONS
   A. Apply floor sealer materials within temperature range and under conditions as
      recommended by manufacturer, but no higher than 100 degrees F and no lower than
      65 degrees F.

PART 2 - PRODUCTS
2.1 MATERIALS
   A. Concrete Floor Sealer: Provide system specified.
      2. Additional Acceptable Manufacturers:
         a. Contractors Chemical, Inc./Clear Acryl Seal.
         b. Sonneborn/Sonoplex Clear.

PART 3 - EXECUTION
1.1 EXAMINATION
   A. Examine concrete slabs just prior to beginning flooring finish installation.
   B. Concrete surfaces shall be clean and free of residue, debris, and sealing compounds.
1.2 SURFACE PREPARATION

A. Clean substrate surfaces using standard non-toxic cleaning materials designed to remove basic dirt and residue; harsh chemical cleaners are not to be used.

B. Prepare concrete in accordance with concrete floor sealer system manufacturer recommendations.

1.3 APPLICATION

A. Apply concrete floor sealer control system in accordance with manufacturer’s instructions.

B. Comply with manufacturer recommended coverage rates.

C. Allow materials to penetrate and cure.

1.4 CLEANING

A. Remove floor sealer from adjacent materials not intended to be sealed.

1.5 PROTECTION

A. Do not allow traffic on cleaned surfaces prepared for finish.

B. Protect sealed concrete from traffic for time required by manufacturer.

END OF SECTION
SECTION 09 91 00
PAINTING

PART 1 - GENERAL

1.01 WORK INCLUDED

A. Furnish and install all paint and similar finishes, where shown on the drawings and as necessary to complete the work, including but not limited to:

1. Interior and exterior of new construction.
2. Exposed duct work on the roofs.
3. Exposed exterior galvanized metals.
4. All other work as shown and indicated on the drawings.

B. Related Work: Shop priming of ferrous metal items is included under various Specification Sections.

C. Surfaces Not to Be Painted:

1. Factory-prefinished items as specified in various sections.
2. Prefinished wall, ceiling, and floor coverings.
3. Painting specified elsewhere and included in respective Sections, including but not necessarily limited to, shop priming.
5. Surfaces concealed in walls and above ceilings except as specifically indicated otherwise.
6. Ducts, piping, conduit, and equipment concealed in walls and ceilings, unless specifically indicated otherwise.

1.02 SUBMITTALS

A. Product Data:

1. Submit a complete list of materials proposed for use, together with manufacturer's specifications.
2. Paint materials and products shall be subject to the Architect's acceptance.
B. Substitutions:

1. See Section 01 25 00 – Product Options & Substitutions. Further, submit in quintuplicate a schedule listing the specified items in the first column and the proposed substitution items in the second column.

C. Colors:

1. As selected by the Architect.

   a. Hand Samples of Selected Colors and Finishes for Initial Selection: Submit (4) four samples of each color (samples to be stepped in a clearly visible manner, defining each separate coat, including block fillers and tinted primers) on substrate for Architect's review of color, sheen, and texture only on 8.5 inch x 11 inch heavy cardboard (unless requested on actual substrate by Architect at no extra cost) with manufacturer's product number, color, sheen, and texture clearly identified on each sample. For transparent and stained finished, prepare (4) samples of each finish on 8.5 inch x 11 inch material, species, and quality of wood to be used in the Work. Contractor to resubmit painted brush-outs of all colors as needed at no extra cost until acceptable sheen, color and texture is selected by the Architect.

   b. Field Samples for Verification: Prepare samples of colors and finishes for approval by the Architect sufficiently in advance of the work to allow time for deliberation, on an area minimum 4 feet x 4 feet to permit evaluation by the Architect. Contractor to provide minimum 4 feet x 4 feet painted brush-out (samples to be stepped in a clearly visible manner, defining each separate coat, including block fillers and tinted primers) of all exterior paint colors on intended materials under ideal lighting conditions in a location approved by Architect. For linear material elements (i.e. metal rails, gutters, flashing, coping, etc.), a 4 feet long section of the material’s natural width is acceptable to serve as a field sample mock-up. Clearly label and identify each sample as to color, location and application. Brush-outs may occur either on existing conditions, final exterior materials of new construction, or mock-ups as needed to verify colors in a timely manner to meet the project schedule. Contractor to provide as many painted brush-outs of all colors as needed at no extra cost until the final colors are selected by the Architect.

1.03 QUALITY ASSURANCE

A. Include on label of containers:

1. Manufacturer's name.

2. Type of paint.

3. Manufacturer's stock number.

5. Instructions for reducing, where applicable.

B. Regulatory Requirements: Comply with Bay Area Air Quality Control Management District (BAAQMD) regulations for Volatile Organic Contents (VOC's).

C. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this section.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Deliver sealed containers with labels legible and intact.

B. Storage of Materials:
   1. Store only acceptable Project materials on Project site.
   2. Store in a suitable location.
   3. Restrict storage to paint materials and related equipment.
   4. Comply with health and fire regulations.

1.05 PROJECT CONDITIONS

A. Environmental Requirements:
   1. Comply with manufacturer's recommendations as to environmental conditions under which coatings and coating systems can be stored and applied.
   2. Do not apply finish in areas where dust is being generated.

B. Protection: Cover or otherwise protect finished work of other trades and surfaces not being painted concurrently or not be painted.

1.06 WARRANTY

A. Color and Life of Film:
   1. At the end of two (2) years, colors of surfaces shall have remained free from serious fading, and variations (if any) shall be uniform.
   2. Materials shall have their original adherence at end of two (2) years, and there shall be no evidence of blistering, running, peeling, scaling, chalking, streaking, or stains at end of this period.
1.07 EXTRA STOCK

A. Extra Materials:

   1. At completion of the Work, deliver to Owner extra stock of paint of one (2) gallons of each color used in each coating material used.

   2. Stock shall be in tightly sealed and clearly labeled containers.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Product numbers specified are as manufactured by Kelly Moore Paint Company, unless otherwise indicated. Equivalent products manufactured by ICI or Pittsburgh are acceptable.

B. Materials selected for coating system of each type of surface shall be the product of a single manufacturer.

C. Thinner: As recommended by each manufacturer for his respective product.

2.02 COLORS

A. The Architect will prepare a color schedule with samples for guidance of painter and reserves the right to select, allocate, and vary colors on different surfaces throughout building.

   1. Submit/provide samples of selected colors as specified in Article 1.02.

2.03 MIXING AND TINTING

A. All primers, undercoats, and/or sealers used for interior surfaces and exterior walls are to be tinted pink to verify adequate coverage.

B. Deliver paints and stains ready mixed to jobsite.

C. Accomplish job mixing and job tinting only when acceptable to the Architect.

D. Mix only in mixing pails placed in suitable sized nonferrous or oxide-resistant metal pans.

E. Use tinting colors recommended by manufacturer for specific type of finish.
PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine surfaces scheduled to receive paint and finishes for conditions that will adversely affect execution, permanence, or quality of work and which cannot be put into acceptable condition through preparatory work.

B. Proceed with preparation or coating application when conditions are suitable.

C. Contractor will provide ventilation for any fumes that might adversely affect other workmen or people in the vicinity of coating application.

D. Contractor will also provide advance notice to other workmen or building occupants of exposure to fumes that might cause irritation.

3.02 PREPARATION

A. According to Kelly-Moore Paint Company specifications.

B. General Surface Preparation:

1. All surfaces must be cured, cleaned, sound, dry and free from dust, dirt, wax, oil, grease, mildew, efflorescence or other contaminants that might adversely affect the appearance and performance of the primer or finish coat.

2. All voids, cracks and holes should be filled with a suitable patching compound to reflect the texture and appearance of the surrounding substrate.

3. All hardware or built-in items should be fitted and removed or protected during painting.

4. Fill cracks and steel dents in steel door frames and doors with fender putty.

5. At existing window sash, remove all loose putty and replace and repair to obtain a smooth even surface without any voids or cracks.

C. Ferrous Metal:

1. Iron and steel preparation may require the removal of millscale and/or rust by sandblasting or sanding.

2. Exposed metal must be primed immediately to prevent rusting with 1710 Kel-Guard Red Oxide Primer or 1711 Kel-Guard White Rust Inhibitive Primer.

3. All shop-primed items are to be fully re-primed in the field.

D. Galvanized Metal and Aluminum:
1. Galvanized and aluminum surfaces must receive an etching wash prior to painting. A test area with the complete paint system is suggested to assure proper adhesion.

E. Wood and Hardboard:

1. Prime millwork and tops and bottoms of doors at mill or immediately upon arrival at the job site. After fitting, immediately prime all door edges and face.

2. Remove all stains, marks and dirt from surfaces to receive a semi-transparent stain finish.

3. Seal all tannic acid, water and asphalt stains with one or more coats of Kelly-Moore 255 Stain Resistant Primer.

4. Back prime all wood prior to installation against metal, concrete, stucco, plaster or brick with one coat of primer specified for exposed surfaces.

F. Concrete Surfaces:

1. All concrete surfaces should cure for a minimum of thirty (30) calendar days prior to coating.

2. Surfaces that are highly glazed or where bond breaker or form oil are present must be cleaned and etched to provide a suitable surface.

3. Surfaces with efflorescence, lime salts or other highly alkaline conditions must be cleaned and neutralized.

4. Cracks, holes or other surface imperfections should be filled with a suitable patching material to match the textural profile of the surface.

G. Plaster or Stucco:

1. Surfaces should cure for a minimum of thirty (30) calendar days before coating.

2. Neutralize surfaces with efflorescence or high alkalinity.

3. Rake out and fill all cracks, holes or other imperfections and fill with a suitable patching material to match the textural profile of the surface.

H. Gypsum Wallboard:

1. All wallboard joints, nail heads, and metal corners will be taped, topped and sanded ready to receive paint according to specifications.

2. To receive the most uniform texture appearance, seal the wall with Kelly-Moore PVA Sealer and allow to dry prior to texturing.
I. Performance:

1. All work to be performed by qualified craftsmen skilled in the application of the materials specified.

2. All materials to be mixed, thinned and applied in strict accordance with the manufacturer's printed instructions.

3. All materials to be applied evenly with no runs, sags or skips.

4. All work to be performed in acceptable weather conditions.

5. Proper ventilation to be provided to aid drying and prevent an accumulation of odors or vapors.

3.03 APPLICATION

A. According to paint manufacturer's specifications and recommendations. Kelly Moore Paint Company specifications shall be referred to as governing document in the event that clarification is needed for surface preparation, materials, application or any other matter connected with painting work.

B. Condition of surfaces to be painted shall be approved by the Inspector before the first coat is applied. Each coat of paint material to be inspected and approved by the Inspector before succeeding coat is applied. Request inspections by the Project Inspector. If succeeding coat or coats are applied without the approval of the Project Inspector, no credit will be given that work and it shall be redone.

C. Prime and back-prime all millwork and trim to be painted or stained immediately upon delivery to the site.

D. Do not apply initial coating until moisture content of surface is within limitations recommended by paint manufacturer. No concrete to be painted until moisture reading is less than fifteen percent (15%) to eighteen percent (18%).

E. Application:

1. Apply paint with suitable brushes, rollers, or spraying equipment.

2. Apply stain in accordance with manufacturer's recommendations.

3. Rate of application shall not exceed that recommended by paint manufacturer for surface involved.

F. Comply with recommendation of product manufacturer for drying time between succeeding coats.

G. Finish coats shall be smooth and free from brush arks, streaks, laps or pileup of paints, and skipped or missed areas.
H. Leave all parts of moldings and ornaments clean and true to details with no undue amount of paint in corners and depressions.

I. Make edges of paint adjoining other materials or colors clean and sharp with no overlapping.

J. Refinish whole wall where portion of finish is not acceptable.

K. Adjust natural finishes as necessary to obtain identical appearance on veneers and solid stock.

L. Hardware, hardware accessories, plates, lighting fixtures, and similar items in place shall be removed prior to painting and replaced upon completion of each space. Paint mark on above listed items will not be accepted.

M. Equipment adjacent to walls shall be disconnected, using workmen skilled in appropriate trades, and moved to permit wall surfaces to be painted.

1. Following completion of painting, they shall be expertly replaced and reconnected.

N. Do not paint over fusible links, UL labels, or sprinkler heads.

O. Exposed Plumbing and Mechanical Items: Items without factory finish such as conduits, pipes, access panels, and items of similar nature shall be finished to match adjacent wall and ceiling surfaces, unless otherwise directed.

P. Paint duct interiors exposed to view through grilles and diffusers with flat black.

Q. Field touch-up all structural and miscellaneous steel.

R. Paint all exposed sheet metal.

S. If adequate coverage of any surface is not attained with the number of coats specified, apply additional coat or coats to cover.

3.04 CLEANING

A. Touch up and restore finish where damaged.

B. Remove spilled, splashed, or spattered paint from surfaces.

C. Do not mar surface finish of item being cleaned.

D. Leave storage space clean and in condition required for equivalent spaces in Project.

3.05 PAINT SYSTEMS

A. General

1. Number of coats scheduled is minimum.
a. Additional coats shall be applied at no additional cost if necessary to completely hide base material, produce uniform color, and provide satisfactory finish result.

2. This specification shall serve as a guide and is meant to establish procedure and quality.

3. Acceptance of Final Colors: Final coat of paint for both exterior and interior shall not be applied until colors have been accepted by the Architect.

B. Unless otherwise noted, all items listed below are Kelly-Moore Paint Company products. The products listed below are intended to establish the quality of paint products for this project.

1. **Exterior Concrete, Portland Cement Plaster, Stucco:**
   
   1. Acrylic Latex:
      
      a. 1 coat 247 ACRY-SHIELD 100% Acrylic Exterior Masonry Primer
      b. 2 coats 1245 ACRY-SHIELD 100% Acrylic Exterior Low Sheen Finish
   
   2. Acrylic Latex, Accent Colors:
      
      a. 1 coat 247 ACRY-SHIELD 100% Acrylic Exterior Masonry Primer
      b. 2 coats 1135 KEL-COLOR Acrylic Low Sheen Accent Base
   
   3. Elastomeric Coating:
      
      a. 1 coat 247 ACRY-SHIELD 100% Acrylic Exterior Masonry Primer
      b. 2 coats 1128 KEL-SEAL TERPOLYMER 100% Acrylic Elastomeric Coating, Smooth or
      c. 2 coats 1129 KEL-SEAL TERPOLYMER 100% Acrylic Elastomeric Coating, Textured

2. **Exterior Concrete Block:**
   
   1. Block Filler: 1 coat 521 FILL & PRIME Acrylic Block Filler.
   
   2. Acrylic Latex Flat:
      
      a. 2 coats 1240 ACRY-SHIELD 100% Acrylic Exterior Flat Finish
   
   3. Acrylic Latex Accent Colors:
      
      a. 2 coats 1170 KEL-COLOR Acrylic Flat Accent Base
   
   4. Elastomeric Coating:
a. 2 coats 1128 KEL-SEAL 100% Acrylic Elastomeric Coating, Smooth

3. **Exterior Rough Lumber, Plywood Siding:**
   1. 100-percent Acrylic-Flat:
      a. 2 coats 1240 ACRY-SHIELD 100% Acrylic Exterior Flat Finish

4. **Exterior Wood Trim, Doors (Doors, Door Bottom), Fascia:**
   1. 100-percent Acrylic:
      a. 1 coat 255 ACRY-SHIELD 100% Acrylic Exterior Wood Primer
      b. 2 coats 1685 DURA-POXY + 100% Acrylic Semi-Gloss Enamel
   2. 100-percent Acrylic Accent Colors:
      a. 1 coat 255 ACRY-SHIELD 100% Acrylic Exterior Wood Primer
      b. 2 coats 1370 KEL-COLOR 100% Acrylic Semi-Gloss Accent Base

5. **Exterior Galvanized Steel:**
   Preparation: Treat with Eco-prime.
   First Coat: KM 1725 - Kel-Guard Acrylic Metal Primer
   Second and Third Coats: KM 1680 – Dura-Poxy Acrylic Gloss Enamel

6. **Exterior Metal other than Galvanized Steel:**
   First Coat: KM 1710 – Alkyd Kel-Guard Red Oxide Primer
   Second and Third Coats: KM 1680 – Dura-Poxy Acrylic Gloss Enamel

7. **Rust-Inhibiting Primer and Spot Painting for Ferrous Metal:**
   First Coat: KM 1710 - Kel-Guard Red Oxide Primer or KM 1711 - Kel-Guard White Rust Inhibitive Primer

8. **Interior Painted Wood Doors:**
   First Coat: KM 975 - Flo-Cote Enamel Undercoat
   Second and
Third Coats: KM 1685 - Dura-Poxy Semi-Gloss Acrylic Enamel

9. **Steel Doors, Doors and Window Frames:**

First Coat: Shop coat of rust inhibitive primer applied by door frame manufacturer. Field touch up as required.

Second and Third Coats: KM 1680 – Dura-Poxy Acrylic Gloss Enamel

10. **Painted Interior Wood Trim:**

First Coat: KM 975 - Flo-Cote Enamel Undercoat

Second and Third Coats: KM 1685 - Dura-Poxy Semi-Gloss Acrylic Enamel

11. **Interior Wood Trim, Railing, Base - Stained, Clear Finish:**

Stain: 1 Coat Varathane Stain

Sealer: 1 Coat 2083 Wood Craft Sanding Sealer

Finish: 2 Coats 2090 Kel-Thane II Satin/Semi-Gloss Clear Stain

12. **Gypsum Board Smooth Finish:**

First Coat: KM 971 - Acry-Plex Hi-Hide Vinyl Wall Sealer.

Second and Third Coats: KM 1500 - Enviro-Cote flat wall enamel.

13. **Gypsum Board Textured Finish:**

First Coat: KM 971 - Acry-Plex Hi-Hide Vinyl Wall Sealer

Second and Third Coats: KM 1500 - Enviro-Cote wall enamel, sheen to be determined by Architect.

14. **Pipes, Grilles, and other Interior Metal:**

First Coat: KM 1710 - Kel-Guard Red Oxide Primer for ferrous metal

KM 1725 - Kel-Guard Acrylic Metal Primer for galvanized metal and non-ferrous metal. If shop primed, omit first coat.

Second and Third Coats: KM 1520 – Enviro-Cote Semi-gloss Acrylic Enamel
15. **Duct Interiors (Exposed to View) and Framing Behind Eave Vents:**

   Heavy-duty plastic enamel, low luster – color to be determined by Architect.

16. **Miscellaneous:**

   Finish surfaces to be painted and not covered in the categories above, if any, according to the recommendations of the paint manufacturer as approved by the Architect.

END OF SECTION
SECTION 10 16 30

STAINLESS STEEL TOILET COMPARTMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Floor-mounted overhead-braced stainless steel toilet partitions. Wall hung stainless steel urinal screens.
B. Attachment and door hardware.

1.2 RELATED SECTIONS

A. Section09110–Non-Load Bearing Metal Framing: In-wall and in-ceiling framing for partition panel supports.
B. Section 09300 - Tile: Wall and floor tile systems.
C. Section 10800 - Toilet and Bath Accessories: Size and location details for factory installed reinforcing for toilet accessories.
D. Division 15 - Mechanical: Plumbing fixtures.

REFERENCES

E. ASTM A666 – Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate and Flat Bar.
F. ASTM B221 - Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles and Tubes.

1.3 DESIGN REQUIREMENTS

A. Sustainable Design Requirements:

1. Steel and aluminum used in work of this section are intended to:
   a. Contribute to meeting requirements for recycled content outlined in LEED™-NC3.0 for Credit MR4.
   b. Reduce quantity of indoor air contaminants that are harmful to comfort and
well-being of installers and occupants and are not to contain urea-formaldehyde resins outlined in LEED™-NC3.0 Credit EQ4.4.

2. Adhesives used in work of this section are intended to reduce quantity of indoor air contaminants that are harmful to comfort and well-being of installers and occupants and are to be formulated to be within VOC content limits outlined in LEED™_NC3.0 Credit EQ4.1.

1.5 SUBMITTALS

A. Shop Drawings: Indicate partition and screen layout with dimensions, elevations, panel and door sizes, door swings, materials and panel thicknesses, reinforcing fittings, hardware fastenings, anchorage and mounting details, size and location factory reinforcing, finishes and requirements of related work.

B. Product Data: Submit data for components, hardware and accessories.

C. Samples:
   1. Panel Finish: Submit samples, minimum 3 x 6 inch in size, illustrating material, embossed pattern, color and finish.
   2. Hardware: Provide samples of each type of hardware.

E. LEED Documentation:
   1. Steel: Submit letter or product data from manufacturer indicating recycled content. Designate percentage of post-consumer and post-industrial recycled content.
   2. Aluminum: Submit letter or product data from manufacturer indicating recycled content. Designate percentage of post-consumer and post-industrial recycled content.
   3. Stainless Steel Toilet Compartments: Submit letter or product data from manufacturer stating that no materials used in this product contain added urea-formaldehyde resins.
   4. Adhesives: Submit letter or product data from manufacturer stating that adhesives used in work of this section do not exceed VOC content limits established in South Coast Air Quality Management District Rule #1168.
   5. Submit hard copies of completed Online Documentation required for LEED™ MR Credit 4, EQ Credit 4.1 and EQ Credit 4.2.
1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacture of stainless steel toilet compartments with minimum 5 years documented experience.

B. Installer: Company specializing in installation of stainless steel toilet compartments with minimum 3 years documented experience and factory trained and approved by manufacturer.

1.7 REGULATORY REQUIREMENTS

A. Accessibility for Persons with Disabilities: Comply with requirements of CBC Section 11158.

1.8 DELIVERY, STORAGE AND HANDLING

A. Deliver products to site, store, handle and protect in accordance with manufacturer's instructions and recommendations.

B. Deliver items in manufacturer's original unopened protective packaging.

C. Discharge materials carefully and store on clean concrete surface or raised platform in secure dry area. Do not dump onto ground.

D. Store materials in original protective packaging to prevent soiling, physical damage or wetting.

E. Handle so as to prevent damage to finished surfaces.

1.9 FIELDMEASUREMENTS

A. Verify field measurements are as shown on shop drawings.

1.10 COORDINATION

A. Coordinate work with placement of support framing and anchors specified under Section 09110 – Non-Load Bearing Metal Framing. Provide information required for proper placement of blocking and structural support.

B. Coordinate work with installation of plumbing fixtures specified in Division 15-Mechanical.
1.11 WARRANTY

A. Manufacturer's Warranty: Provide manufacturer's limited warranty for stainless steel panels, doors and pilasters which corrode or discolor within 5 years from date of Substantial Completion. Cover cost of replacement materials for materials found defective within warranty period.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Global Steel Products Corporation:


B. Manufacturers Offering Acceptable Equivalent Products:

1. Accurate Partitions Corporation.

2. Hadrian Manufacturing, Inc.


2.2 MATERIALS

A. Stainless Steel Sheet: ASTM A666, Type 304; stretcher leveled.

B. Extruded Aluminum: ASTM B221, 6063 alloy, TS temper.

2.3 ACCESSORIES

A. Headrail: Extruded aluminum; tubular construction with anti-grip top.

B. Pilaster Shoes: Stainless steel; minimum 3 inches high; internal cross section conforming to pilaster.

C. Mounting Brackets:

2. Pilaster-to-Floor: Inverted stirrup mounting foot with cadmium plated jack bolt; L-brackets mechanically fastened each end of mounting foot and equipped with spring clips.

D. Fasteners:

1. Mounting Brackets to Walls: Sheet metal screws with full thread and tamper resistant heads; length sufficient to penetrate framing minimum 3/8 inch; chrome-plated steel.

2. Mounting Brackets to Floors: Sleeve type expansion anchors; length sufficient to for minimum 1-1/2 inch embedment into concrete; corrosion resistant steel.

3. Mounting Brackets to Panels and Pilasters: Internally threaded through-bolt fasteners consisting of barrel nuts and machine screws with tamper resistant heads; chrome-plated steel.

4. Hinges and Strike/Keeper to Pilasters: Internally threaded through-bolt fasteners consisting of barrel nuts and machine screws with tamper resistant heads; chrome-plated steel.

5. Other Hardware: Sheet metal screws with full thread and tamper-resistant heads; chrome-plated steel.

E. Adhesive: Non-toxic with volatile organic contents not exceeding VOC content limits established in South Coast Air Quality Management District Rule #1168.

2.4 HARDWARE

A. Hinges: Chrome plated die-case Zamac cam-action hinges; cams adjustable to allow door to rest at any position within 270 degree range.

1. Upper Hinge: Recessed and interlocked in door with nylon pin within plane of door.

2. Lower Hinge: Recessed in door; includes mating box and pintle nylon cams which provide bearing surface.

B. Latch: Chrome plated die-case Zamac concealed mortise style configured for emergency access.

1. Compartments with Grab Bars: Paddle handle providing access without grasping or twisting; manufacturer's ADA paddle handle.

2. Other Compartments: Manufacturer's standard handle.

C. Keeper/Strike: Chrome plated die-case Zamac; 1 piece with rubber bumper.
D. Door Pulls: U-shape wire type; chrome plated.

E. Combination Coat Hook/Door Stop: Chrome plated Zamac hook with rubber bumper tip.

2.5 FABRICATION

A. Fabricate partition doors, panels and pilasters and urinal screen panels with 22 gauge embossed stainless steel sheets formed and bonded under pressure with adhesive to full face honeycomb core.

1. Panels: 1 inch thick; partition panel sized to suit cubicle depths indicated on Drawings; urinal screen panel sized as indicated on Drawings.

2. Pilasters: 1-1/4 inch thick; widths to suit cubicle widths and spacing; height as required for 83 inch overall partition height.

3. Doors: 1 inch thick; sizes to suit access requirements.

B. Seal door and panel edges with 22 gauge stainless steel interlocking moldings welded to face sheets and each other at corners to form rigid frame around component. Grind welds smooth.

C. Seal pilaster edges with 22 gauge stainless steel interlocking moldings. Weld inverted stirrup with leveling jack bolt to base of pilaster.

D. Provide internal reinforcement in areas of attached hardware, fittings, grab bars and toilet accessories. Mark locations of reinforcement for partition mounted grab bars and toilet accessories.

2.6 FINISHES

A. Stainless Steel Sheet:

1. Door, Panel and Pilaster Faces: Embossed pattern to match Global "Diamond Finish."

2. Other Locations: #4 brushed finish.

B. Extruded Aluminum: Clear anodized with stain finish.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine installed work of other trades to determine acceptability for installation. Verify that
such work is complete to point where work of this section may begin and is acceptable for product installation in accordance with manufacturer’s instructions and recommendations.

B. Verify that plumbing fixtures are correctly located and correctly spaced.

C. Verify correct location of built-in framing, anchorage, and bracing. Verify that walls are plumb.

D. Verify that doors are correctly located.

E. Do not begin installation until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install toilet partitions and urinal screens in accordance with manufacturer’s instructions and final reviewed shop drawings.

B. Install partition and screen components secure, straight, plumb, level, square and aligned.

C. Maintain 3/8 to 1/2 inch space between wall and panels and between wall and end pilasters.

D. Attach mounting brackets securely to wall framing and floor slabs. Wet drill ceramic tile prior to installing fasteners.
   1. Securely mounting brackets to wall framing using threaded fasteners.
   2. Secure mounting brackets to floor slabs with expansion anchors. Adjust for floor variations with leveling bolt integral with pilaster anchoring shoe; conceal floor fastenings at toilet partitions with stainless steel pilaster shoe trim.

E. Attach panels and pilasters to brackets with tamper resistant metal screws. Locate headrail joints at pilaster center lines.

F. Level, plumb and tighten installation. Align tops of panels. Secure pilaster shoe trims in position.

G. Install doors using specified hardware. Equip each door with hinge, latch, keeper/strike and combination coat hook/door stop. In addition, equip each outswinging door with 1 additional combination coat hook/door stop and equip each door to compartments having grab bars with back-to-back door pulls.
   1. Install strike/keeper on each pilaster in alignment with latch. Locate strike/keepers and latches at midpoints of doors between 30 and 44 inches above floor.
2. Install combination coat hook/door stops on interior faces of each door.
   
   a. Locate combination coat hook/door stops 48 inches above floor on doors to compartments having grab bars.
   
   b. Locate combination coat hook/door stops 3 inches below tops of doors to other compartments.
   
3. Equip each door to compartments having grab bars with door pull on both sides. Locate pulls immediately below latches.

4. Install additional combination coat hook/door stops on exterior faces of each outswinging door. Locate 3 inches below tops of doors.

H. Set tops of doors parallel with line of finished ceiling when doors are in closed position.

I. Align tops and bottoms of doors with tops and bottoms of panels.

3.3 ERECTION TOLERANCES

A. Maximum Variation From True Position: 1/4 inch.

B. Maximum Variation From Plumb: 1/8 inch.

3.4 ADJUSTING

A. Adjust and align partition hardware to uniform clearance at vertical edges of doors not exceeding 3/16 inch.

B. Adjust partition hinges to locate in-swing doors in partial open position when unlatched. Adjust hinges of outswinging doors to return doors to closed position.

C. Field repair of scratches and damaged components will not be permitted. Replace damaged and scratched materials with new materials.

3.5 CLEANING

A. Remove protective maskings. Clean surfaces.

END OF SECTION
SECTION 10 26 00
WALL PROTECTION

PART 1 - GENERAL

1.01 SUMMARY
   A. Section includes corner guards.
   B. Related Sections:
      1. Section 06 10 00 – Rough Carpentry
      2. Division 9

1.02 PERFORMANCE REQUIREMENTS
   A. Corner Guards: Resist lateral impact force of 200 lbs at any point without damage or permanent set.

1.03 SUBMITTALS
   A. Division 1 - Submittals
   B. Product Data: Submit physical dimensions, features, details, and rough-in measurements.
   C. Samples: Submit two sections of corner guard 24 inches long, illustrating component design, configuration, color and finish.
   D. Manufacturer's Installation Instructions: Submit procedures, perimeter conditions requiring special attention.

1.04 QUALITY ASSURANCE
   A. Perform Work in accordance with best practice.

1.05 FIELD MEASUREMENTS
   A. Verify field measurements prior to fabrication.

1.06 COORDINATION
   A. Coordinate Work with wall or partition sections for installation of concealed blocking or anchor devices.

PART 2 - PRODUCTS

2.01 WALL AND CORNER GUARDS
   A. Manufacturers:
      1. Pawling Corp. Model CG 51, Korogard, or equal.
2.02 COMPONENTS
A. Corner Guard - Surface Mounted:
   2. Wing projection: 2 inches.
   3. Length: One piece.
   4. Preformed end caps.
B. Mounting Brackets and Attachment Hardware: Appropriate to component and substrate.
C. Exposed fasteners to be stainless steel tamper proof.

2.03 FABRICATION
A. Fabricate components with tight joints, corners and seams.
B. Pre-drill holes for attachment.
C. Form end trim closure by capping and finishing smooth.

2.04 FACTORY FINISHING
A. Corner Guard: Type 304 stainless steel with No. 4 finish.

PART 3 - EXECUTION

3.01 EXAMINATION
A. Division 1 - Coordination: Coordination and project conditions.
B. Verify rough-in for components are correctly sized and located.

3.02 INSTALLATION
A. Position corner guard from top of wall base and flush with finished ceiling.
B. Coordinate installation of wall coverings with corner guard.
C. Seal to adjacent finishes.

3.03 ERECTION TOLERANCES
A. Division 1 – Quality Control: Tolerances.
B. Maximum variation from plumb: 1/8 inch in 8 feet.

3.04 LOCATION
A. Refer to interior elevations for location of wall corner guards.

3.5 CLEANING
A. Remove protective film and clean surfaces.

END OF SECTION
SECTION 10 28 00
TOILET ACCESSORIES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes the following:

1. Toilet and bath accessories.
2. Warm-air dryers.
3. Underlavatory guards.

B. Related Sections include the following:

1. Division 10 Section "Toilet Compartments" for compartments and screens.

1.03 SUBMITTALS

A. Product Data: Include construction details, material descriptions and thicknesses, dimensions, profiles, fastening and mounting methods, specified options, and finishes for each type of accessory specified.

B. Samples: For each accessory item to verify design, operation, and finish requirements.

1. Approved full-size Samples will be returned and may be used in the Work.

C. Setting Drawings: For cutouts required in other work; include templates, substrate preparation instructions, and directions for preparing cutouts and installing anchoring devices.

D. Maintenance Data: For accessories to include in maintenance manuals specified in Division 1. Provide lists of replacement parts and service recommendations.

E. Design Calculations: Computations demonstrating design and/or test data to Architect for review and/or submittal to the Division of the State Architect. Design calculations shall be proposed and signed by a registered professional engineer to comply with the requirements of the 2001 C.B.C., Section 1115B.8.3 regarding structural strength of grab bars, fasteners and mounting devices to be secured to the toilet partitions.
1.04 QUALITY ASSURANCE

A. Source Limitations: Provide products of same manufacturer for each type of accessory unit and for units exposed to view in same areas, unless otherwise approved by Architect.

B. Product Options: Accessory requirements, including those for materials, finishes, dimensions, capacities, and performance, are established by specific products indicated in the Toilet and Bath Accessory Schedule.

1. Products of other manufacturers listed in Part 2 with equal characteristics, as judged solely by Architect, may be provided.
2. Do not modify aesthetic effects, as judged solely by Architect, except with Architect’s approval. Where modifications are proposed, submit comprehensive explanatory data to Architect for review.

1.05 COORDINATION

A. Coordinate accessory locations with other work to prevent interference with clearances required for access by disabled persons, proper installation, adjustment, operation, cleaning, and servicing of accessories.

B. Deliver inserts and anchoring devices set into concrete or masonry as required to prevent delaying the Work.

1.06 WARRANTY

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

1. Manufacturer’s written 2 year warranty against defects in materials and workmanship on all accessories.

B. Hand Dryers:

1. Minimum Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide accessories by one of the following:

1. Toilet and Bath Accessories:
a. Bobrick Washroom Equipment, Inc.*
b. American Specialties, Inc.
c. Bradley Corporation.

*Indicates manufacturer's numbers elsewhere to indicate project requirements.

2. High Flow Warm-Air Dryers:
   a. American Dryer.
   b. Bobrick.
   c. Excel Dryer.
   d. Pinnacle Dryer Corporation.
   e. World Dryer.

3. Underlavatory Guards:
   a. Brocar Products, Inc.
   b. Truebro, Inc.

B. Products: Subject to compliance with requirements, provide one of the products indicated for each designation in the Toilet and Bath Accessory Schedule at the end of Part 3.

2.02 MATERIALS

A. Stainless Steel: ASTM A 666, Type 304, with No. 4 finish (satin), in 0.0312-inch minimum nominal thickness, unless otherwise indicated.

B. Brass: ASTM B 19, leaded and unleaded flat products; ASTM B 16, rods, shapes, forgings, and flat products with finished edges; ASTM B 30, castings.

C. Sheet Steel: ASTM A 366/A 366M, cold rolled, commercial quality, 0.0359-inch minimum nominal thickness; surface preparation and metal pretreatment as required for applied finish.

D. Galvanized Steel Sheet: ASTM A 653/A 653M, G60.

E. Chromium Plating: ASTM B 456, Service Condition Number SC 2 (moderate service), nickel plus chromium electrodeposited on base metal.


G. Mirror Glass: ASTM C 1036, Type I, Class 1, Quality q2, nominal 6.0 mm thick, with silvering, electroplated copper coating, and protective organic coating complying with FS DD-M-411.


I. Fasteners: Screws, bolts, and other devices of same material as accessory unit, tamper and theft resistant when exposed, and of galvanized steel when concealed.
2.03 FABRICATION

A. General: One, maximum 1-1/2-inch- diameter, unobtrusive stamped manufacturer logo, as approved by Architect, is permitted on exposed face of accessories. On interior surface not exposed to view or back surface of each accessory, provide printed, waterproof label or stamped nameplate indicating manufacturer's name and product model number.

B. Surface-Mounted Toilet Accessories: Unless otherwise indicated, fabricate units with tight seams and joints, and exposed edges rolled. Hang doors and access panels with continuous stainless-steel hinge. Provide concealed anchorage where possible.

C. Recessed Toilet Accessories: Unless otherwise indicated, fabricate units of all-welded construction, without mitered corners. Hang doors and access panels with full-length, stainless-steel hinge. Provide anchorage that is fully concealed when unit is closed.

D. Framed Glass-Mirror Units: Fabricate frames for glass-mirror units to accommodate glass edge protection material. Provide mirror backing and support system that permits rigid, tamper-resistant glass installation and prevents moisture accumulation.

1. Provide galvanized steel backing sheet, not less than 0.034 inch and full mirror size, with nonabsorptive filler material. Corrugated cardboard is not an acceptable filler material.

E. Mirror-Unit Hangers: Provide mirror-unit mounting system that permits rigid, tamper- and theft-resistant installation, as follows:

1. One-piece, galvanized steel, wall-hanger device with spring-action locking mechanism to hold mirror unit in position with no exposed screws or bolts.
2. Heavy-duty wall brackets of galvanized steel, equipped with concealed locking devices requiring a special tool to remove.

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

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install accessories according to manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.

B. Secure mirrors to walls in concealed, tamper-resistant manner with special hangers, toggle bolts, or screws. Set units level, plumb, and square at locations indicated, according to manufacturer's written instructions for substrate indicated.

C. Install grab bars to withstand a downward load of at least 250 lbf, when tested according to method in ASTM F 446.
D. Toilet Tissue Dispensers: Supplied by District Vendor and installed by Contractor. 3 inch maximum profile from wall surface in accessible stalls, typical.

3.02 ADJUSTING AND CLEANING

A. Adjust accessories for unencumbered, smooth operation and verify that mechanisms function properly. Replace damaged or defective items.

B. Remove temporary labels and protective coatings.

C. Clean and polish exposed surfaces according to manufacturer's written recommendations.

3.03 TOILET AND BATH ACCESSORY SCHEDULE

A. Accessible Toilet Tissue Dispenser (Bobrick B-4388): or approved equal, recessed multi-roll toilet tissue dispenser, type 304 22-gauge stainless steel, all welded construction, exposed surfaces shall have satin finish (at accessible stalls only).

B. Toilet Tissue Dispenser (Bobrick B-2888) or approved equal, stainless steel, multi-roll (surface-mounted).

C. Combination Waste Receptacle: (Bobrick No. B-3944) Where this designation is indicated, provide stainless-steel waste receptacle complying with the following:

1. Provide one of the following:
2. Fabricated for nominal 4 inch wall depth and with continuous seamless 1 inch wall flange. Provide towel compartment in upper portion of unit, designed to dispense not less than 600 C-fold or 800 multi-fold towels, double panel door with continuous piano hinge and tumbler lock. Waste receptacle in lower portion of unit provided with reusable heavy duty vinyl liner, minimum 12 gallon capacity, secured in place with tumbler lock.

D. Soap Dispenser (Bobrick No. B-2111): Supplied by District and installed by Contractor.

E. Grab Bars Bobrick, or approved equal (At accessible stalls only). Heavy duty, 18 gauge, 304 stainless steel tubing, welded 11 gauge flanges, concealed mounting. Safety grip finish, no peening.

1. Bobrick B - 6806 x 48”, or approved equal.
2. Bobrick B - 6806 x 36”, or approved equal.

F. Sanitary Napkin Disposal Unit (Bobrick No. B-270): Where this designation is indicated, provide stainless-steel sanitary napkin disposal unit complying with the following:

1. Products: Provide one of the following:
2. Surface Mounted Type: With seamless exposed walls; self-closing top cover; locking bottom panel with stainless-steel, continuous hinge; and removable, reusable receptacle.
G. Seat-Cover Dispenser (Bobrick No. B-221): Where this designation is indicated, provide seat-cover dispenser complying with the following:

1. Surface-Mounted Type: Stainless-steel unit with concealed opening at bottom for filling; minimum 250-seat-cover capacity.

H. Mirror Unit: Where this designation is indicated, provide mirror unit complying with the following:

1. Stainless-Steel, Channel-Framed Mirror (Bobrick No. B-290): Fabricate frame from stainless-steel channels in manufacturer’s standard satin or bright finish with square corners mitered to hairline joints and mechanically interlocked.
   a. Size: 24 inches by 42 inches.

2. Fixed Tilt Frame Mirror (Bobrick No. B-293): Fabricate frame of 22 gauge, stainless steel with all joints mitered, welded and ground smooth. Frame tilt shall extend 4 inches from wall at top tapering to 1 inch at bottom.
   a. Size: 24 inches by 42 inches.

I. Mop and Broom Holder (Bobrick No. B-239-34): Where this designation is indicated, provide mop and broom holder complying with the following:

1. Products: Provide one of the following.
   2. Mop and Broom Holder with Utility Shelf: 34-inch- long unit fabricated of minimum nominal 0.05-inch- thick stainless steel with shelf; support brackets for wall mounting; four hooks for wiping rags; three spring-loaded, rubber hat, cam-type, mop/broom holders mounted on front of shelf.

J. Warm-Air Dryer: Where this designation is indicated, provide warm-air dryer complying with the following:

High Flow Warm-Air Dryer:

1. Products: Provide one of the following:
   a. American Dryer, Inc; Extreme Air GXT- MR (recessed)
   b. Excel Dryer, Inc. Xlerator w/ Recess Kit

K. Underlavatory Guard: Where this designation is indicated, provide underlavatory guard complying with the following:

1. Insulating Piping Coverings: White, antimicrobial, molded-vinyl covering for supply and drain piping assemblies intended for use at accessible lavatories to prevent direct contact with and burns from piping. Provide components as required for applications indicated with flip tops at valves that allow service access without removing coverings.
SECTION 22 00 00
PLUMBING

PART 1  GENERAL

1.1  SECTION INCLUDES

A.  The bidding requirements and contract forms, including General Conditions and Supplemental General Conditions, all Division 01 Sections and Section 23 0500 - General Mechanical apply to all work herein.

1.2  DESCRIPTION

A.  This Specification establishes the required standards for all labor, materials, equipment, and workmanship in connection with the furnishing, fabrication, and installation of “Plumbing” systems. Plumbing includes, but is not necessarily limited to, the following items of work:

1.  A complete system of soil, waste, vent and sanitary sewer piping and structures, including provisions for mechanical equipment drainage; and connection of same to existing soil, waste, vent and sanitary sewers, located approximately as indicated on the Drawings.

2.  Cold water distribution system, complete, from points of contact with site domestic water systems (located approximately as indicated on the Drawings) to all plumbing fixtures, mechanical equipment, building specialties, and Owner supplied equipment scheduled for service on the Drawings.

3.  Hot water distribution system, complete, from serving water heaters and/or points of contact with site domestic hot water, to all plumbing fixtures, mechanical equipment, building specialties, and Owner supplied equipment scheduled for service on the Drawings.

4.  Natural gas piping system, complete from utility company meters (located as indicated on the Drawings) and terminating in stopcocks adjacent to all natural gas fired equipment, as noted on the Drawings. All gas-fired equipment shall be equipped with a gas pressure regulator as hereinafter specified.

5.  All plumbing fixtures and trim as scheduled on the Drawings, inclusive of setting of fixtures and connections to drainage and water supply systems.

6.  Rough in and connection of all fixtures and equipment furnished by the Owner and/or Tenant.
7. Final connection of water and natural gas to equipment furnished under other Sections.

8. Condensate drainage piping and connections from points of attachment to equipment to indirect waste locations, as noted on the Drawings.

9. Flashing of all plumbing pipe penetrations through exterior walls, roofs, and foundations.

10. Testing and adjusting of all piping systems and equipment herein specified.

11. Sterilization of domestic water systems.

12. Pipe wrapping and insulation.

B. Should any work or material not be included in the Drawings or Specifications but is nevertheless necessary for the proper execution of the stated scope therefore for full compliance with codes, laws, rules and regulations, the Contractor shall understand such work and material is required, and shall perform all such work and furnish such material as fully as if it were particularly delineated or described.

1.3 RELATED WORK SPECIFIED IN OTHER SECTIONS

A. Sealants and Firestopping – Division 07 – Thermal and Moisture Protection.

B. Line voltage wiring: Division 26 - Electrical.

C. Water service, meter, and piping in connection with Landscape Irrigation System: Division 32, Landscaping and Irrigation Sections.

D. Final connection of water and gas to equipment furnished under other Sections of the Specifications.

E. Finish painting: See Section 09 9100 for painting requirements.

1.4 QUALITY ASSURANCE

A. Codes and Standards: Conform to all applicable codes and standards as stated herein and as described in Division 01 of the Specifications, including the following:

1. American Gas Association (AGA)

2. American National Standards Institute (ANSI)

3. Adhesive and Sealant Council (ASC)

4. American Society of Mechanical Engineers (ASME)
5. American Society for Testing and Materials (ASTM)
6. American Society of Civil Engineers (ASCE)
7. California Building Code (CBC)
8. California Plumbing Code (CPC)
9. California Fire Code (CFC)
10. California Energy Conservation Code, Title 24
11. State of California Administrative Code (CAC) Titles 8, 17, and 24
12. California Electric Code (CEC)
13. National Electrical Manufacturers Association (NEMA)
15. Underwriters’ Laboratories (UL)
16. Comply with all ADA and California Title 24 requirements for disabled access.
17. City Fire Marshal requirements
18. Comply with the latest edition of all applicable standards, including AWWA, PDI, and OSHA
19. NSF/ANSI 61 Standard, Drinking Water System Components - Health Effects for fixture materials that will be in contact with potable water.
20. AB 1953, Amendments to Section 116875 of the Health and Safety Code relating to lead plumbing.

B. Minimum requirements: The requirements of these are the minimum that will be allowed unless such requirements are exceeded by applicable codes or regulations, in which the regulatory codes or regulation requirements shall govern.

1.5 SUBMITTALS

A. All submittals shall be submitted under the provisions of Section 01 33 00.

1. Product Data
   a. Cut sheets for each plumbing fixture. Include selected fixture and trim, fittings, accessories, appliances, appurtenances, equipment, and supports
and indicate materials and finishes, dimensions, construction details, and flow control rates for each fixture indicated.

b. Manufacturer’s product data, specifications, and installation instructions for plumbing piping, fittings, materials, and equipment

2. Shop Drawings

a. Prepare complete consolidated and coordinated layout drawings for all new systems, and for existing systems that are in the same areas. Shop drawings shall be prepared using AutoCAD 2012 or newer and shall be drawn at a minimum ¼” = 1’ - 0” scale. Sections, details, and diagrams shall be to required scales for specified areas.

b. Submit shop drawings to Architect for approval, prior to fabrication or installation of any work. Do not install equipment or piping until layout drawings have been approved. Any work installed without prior shop drawing approval shall be removed at the Contractor’s expense.

c. Complete and detailed shop drawings shall be maintained throughout the coordination and construction phase indicating all equipment and trades’ work clearly. All equipment including piping, etc. shall clearly identify both top and bottom elevations as well as distances from equipment to established building lines. Coordinate with other trades and field conditions and show dimensions and details including building construction and access for servicing.

d. Use of contract documents for shop drawings is not acceptable

e. Any work installed without prior shop drawing approval shall be removed at the Contractors expense.

1.6 AS-BUILT DRAWINGS

A. Comply with the requirements of Section 01 78 39 – PROJECT RECORD DOCUMENTS and the following.

1. A complete set of Contract Drawings shall be maintained at the work site, and all changes in the work shall be recorded on this set on a daily basis. In addition to changes made during course of work, show the following:

   a. Exact location, type and function of concealed valves and controllers.

   b. Exact size, elevations and location of underground and under floor piping.

B. Submit to Architect for final approval.
1.7 OPERATION & MAINTENANCE DATA (Closeout)

A. Comply with the requirements of Section 01 78 23 – OPERATION AND MAINTENANCE DATA and the following.

1. Installing contractor shall provide all operating and maintenance instructions provided by the manufacturer, describing proper operation and maintenance of any equipment and devices installed. Operating and maintenance instructions shall cover maintenance, adjustment, and operation of each piece of apparatus.

2. Contractor shall also provide a parts list of all equipment and component parts for all equipment under this Section. The equipment list shall include manufacturer’s name, model number, and local representative, service facilities and normal channel of supply for each item.

3. Data shall be bound in a hard cover 3-ring binder, with table of contents identifying items therein, and index tabs for each system. Neatly obscure or cross out inapplicable data from manufacturer’s literature. Include the following:
   a. Manufacturer’s brochures, ratings, certified shop drawings, lubrication charts and data, and parts list with part numbers. Mark each sheet with equipment identification number and actual installed condition or system and location of installation. Specifically identify which options are provided.
   b. Description of start-up and operating procedures for each system, including controls diagrams and description of operating sequences.
   c. Recommend preventative maintenance schedule and procedures.

B. Submit data to the Architect for approval. Final acceptance of the work will not be made until a satisfactory submission of this material is received and approved by the Architect.

1.8 COORDINATION

A. All work shall be coordinated with water, gas, sanitary sewer, and other services on the site. The locations of points of connection to the site services shall be confirmed prior to commencement of any and all work required under this Section of the Specifications.

B. Coordinate roughing-in and final plumbing fixture locations, and verify that fixtures can be installed to comply with original design and referenced standards.

PART 2 PRODUCTS

2.1 GENERAL
A. Only specified materials shall be utilized in the work of this Section unless substitutions have been approved in accordance with the General Conditions and Division 01 Sections of the Specifications.

B. All materials shall be new and unused, of the best quality for the intended use, and shall be listed by the ASA, AGA, and UL as meeting their requirements and bearing their label wherever standards have been established and label services are regularly furnished by them.

C. Tracer wire shall be installed with all non-metallic piping below grade. Tracer wire shall be solid core copper, 14-gauge minimum, lain continuously along pipes. Wire shall be “ty-wrapped” to pipe at eight feet (8’ o.c.) on center. Tracer wire shall terminate in concrete access boxes at the beginning and terminal ends of the buried pipe.

D. Vent piping shall have vandal resistant mushroom vent caps.

2.2 PIPE, FITTINGS

A. Below Ground Sanitary Soil, Waste, Vent, and Storm Drainage Piping:

1. Lines 2" and larger shall be standard weight, no-hub cast iron soil pipe and fittings manufactured from gray cast iron with a tensile strength of not less than 21,000 psi, bituminous coated interior and exterior, conforming to the requirements of ASTM A888 and CISPI Standard 301. Each length of pipe shall be hydrostatically (water) tested by the manufacturer to verify compliance. All pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute and listed by NSF international. All pipe and fittings shall be of the same manufacturer. Approved manufacturers: AB&I, Charlotte, or Tyler.

2. Joints:

a. Super-duty no-hub couplings shall have a shield constructed of type 304 stainless steel with a minimum thickness of 0.016" (28 gauge). The worm gear drive clamps shall have a hexagon head to accept a 3/8" socketed torque wrench. The clamps shall be tightened to a minimum of 80 in pounds. The gaskets shall be manufactured using neoprene rubber meeting the requirements of ASTM C-564. Couplings shall meet FM 1680 class 1. Smooth shielded couplings shall have a 304 stainless steel shield with a minimum thickness of 0.025" (24 gauge). Couplings 1-1/2" through 4" shall have four bands and 5" through 10" shall have six bands. The clamps shall be tightened between 115 and 125 inch pounds. Approved manufacturers: Husky SD4000, Clamp-All High Torq 125, or MG Couplings.

b. Couplings shall be installed in accordance with manufacturer’s installation instructions, local code requirements, and shall be tightened using a calibrated torque wrench.
B. Above Ground Soil, Waste, Drain, and Vent Pipe:

1. Lines 2” and larger shall be no-hub cast iron soil pipe and fittings manufactured from gray cast iron with a tensile strength of not less than 21,000 psi, bituminous coated interior and exterior, conforming to the requirements of ASTM A888 and CISPI Standard 301. Each length of pipe shall be hydrostatically (water) tested by the manufacturer to verify compliance. All pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute and listed by NSF international. All pipe and fittings shall be of the same manufacturer. Approved manufacturers: AB&I, Charlotte, or Tyler.

2. Joints:
   a. Heavy duty no-hub couplings shall have a shield constructed of type 304 stainless steel with a minimum thickness of 0.010” (32 gauge). The worm gear drive clamps shall have a hexagon head to accept a 5/16” socketed torque wrench. The clamps shall be tightened to a minimum of 80 in pounds. The gaskets shall be manufactured using neoprene rubber meeting the requirements of ASTM C-564. Couplings shall meet FM 1680 class 1. Smooth shielded couplings shall have a 304 stainless steel shield with a minimum thickness of 0.016” (28 gauge). Couplings 1-1/2” through 4” shall have four bands and 5” through 10” shall have six bands. The clamps shall be tightened a minimum of 80 inch pounds. Approved manufacturers: Husky HD2000, Tyler Wide Body, or Clamp All 80.
   b. Couplings shall be installed in accordance with manufacturer’s installation instructions, local code requirements, and shall be tightened using a calibrated drive click torque wrench.

3. Lines under 2” shall be galvanized steel pipe, with threaded cast iron drainage fittings.

4. At the option of this Contractor, all soil, waste, and vent piping above ground may be DWV copper, with wrought copper fittings, with “Stay-Safe 50” lead free solder and a suitable non-corrosive flux.

C. Natural Gas Piping:

1. Above ground piping shall be Schedule 40, black steel.
   a. All concealed pipe and all pipe 2½” and larger shall be welded. Fittings for welded pipe shall be seamless steel, weld neck. All welding shall be performed by a certified welder and inspected by a certified welding inspector.
b. All accessible pipe 2" and smaller shall be threaded. Fittings for threaded pipe shall be 150-lb. malleable iron, screwed and banded.

c. All exposed above grade piping shall be painted with rust resistant paint and lead-free primer.

D. Hot & Cold Water Piping:

1. All domestic hot and cold water piping 3" and smaller shall be Type L, hard temper, copper pipe with wrought copper or cast brass solder joint fittings or ProPress fittings. Pipe shall be NSF 61 Certified and bear the NSF Certification mark.

2. Pipes below grade inside buildings shall be soft drawn, Type K, soft drawn copper with no joints below slabs. Pipes shall be sleeved with 20-mil plastic sheathing.

3. All joints shall be made up with lead free solder with matching flux. Solder joints with 95-5 tin-antimony.

E. Condensate Drainage Pipe:

1. Condensate drainage piping shall be Mueller or approved equal.
   a. 2" and larger shall be type DWV copper tube, ASTM B306.
   b. 1 ½" and smaller shall be type M, hard temper copper, standard copper fittings.

2. Drainage fittings shall be ASME B16.23, cast copper or ASME B16.29, wrought copper, solder-joint fittings. 1 ¼" & smaller, standard pressure fittings.

3. Solder shall be ASTM B 32, lead free with ASTM B 813, water-flushable flux

2.3 UNIONS

A. Steel pipe unions shall be malleable iron, 150 lb., ground joint, Grinnell Fig. 463.

B. Copper pipe unions shall be soldered joint, Nibco series 633 or 733, Mueller, or equal.

C. Dielectric unions shall be EPCO, Watts, or equal.

2.4 DIELECTRIC FITTINGS

A. Precision Plumbing Products, “Clear Flow” series, threaded dielectric fittings, sizes 19100P thru 19195P.

B. Dielectric fittings shall have zinc electroplated steel casing, and NSF/FDA listed lining. Fittings shall meet the requirements of ASTM standard F1545 for continuous use at
temperatures up to 225°F (-5°F) and for pressures up to 300 psi, and shall achieve a
dielectric waterway in all potable water and appropriate HVAC applications.

2.5 VALVES, SPECIALTIES

A. Ball Valves: Valves shall be rated 600 PSI non-shock CWP and have 2-pc. Lead-free
dezincification-resistant body, end piece, stem and ball, TFE seats, full port, separate pack
nut with adjustable stem packing and anti-blowout stems. Valves ends shall have full depth
ANSI threads. Valves shall be 3rd party certified to Annex G of NSF/ANSI 61. Nibco T-685-
80-LF, Watts LFB-6080, or KITZ 858.

B. Gate Valves: 3” and smaller shall be Nibco T134, Stockholm B-120, or KITZ 42T; bronze
body, union bonnet, rising stem, solid wedge, 150 lb. with wheel handle.

C. Gate Valves: Larger than 3” shall be Nibco F-617-0 or KITZ 72; iron body, bolted bonnet,
outside screw and yoke, solid wedge, 125 lb. with wheel handle.

D. Lift Check Valves (vertical): Nibco T-480-Y-LF or KITZ 836; bronze body, inline lift type,
Teflon seat, and discs, spring actuated, 125 lb.

E. Swing Check Valves (horizontal): Nibco T-413-Y-LF, Stockholm B-345, or KITZ 822T; bronze
body, Y-pattern swing-type, rated 200 PSI non-shock CWP. Body, bonnet, and disc hanger
shall be of lead-free dezincification-resistant material and TFE seat disc. Valve ends shall
be threaded type. Valves shall be 3rd party certified to Annex G of NSF/ANSI 61.

F. Gas Shut-off Valves:

1. At Building Service: Homestead Fig. 601, semi-steel, lubricated plug, lever handle,
200 lb. Install CALIFORNIA(KOSO) Series 300 seismic actuated shut off valve at
meter (or entrance to building if not new construction). Brace per manufacturer’s
instructions.

2. At Connection to Equipment: Jomar T-203 gas ball valves, 1/4-turn, hot forged
brass, 2-piece design, standard port, appliance type with side tap/drain. Provide
with AGA/csa certified stainless steel flex connection 12” max.

G. Gas Pressure Regulators: American Meter, Series 1813B. Regulators shall be sized for full
gas capacity of equipment as scheduled on the Drawings. Inlet pressure shall be 3 psig.
Outlet pressure shall be 7” water column. Regulators installed indoors shall have relief
opening piped to outdoors. Size relief pipe in accordance with ANSI Z223.1 "National Fuel
Gas Code”.

H. Hose Bibbs

1. HB-#1: Interior Hose Bibbs shall be Chicago No. 293 with No. E-27 vacuum
breaker, polished chrome plated, tee handle, adjustable threaded flange inlet,
hose thread outlet. Provide a Chicago No. 1771 loose key stop at each hose bibb.
a. Provide (1) hose bibb in all toilet rooms equipped with a floor drain. Hose bibb shall be 24” above finished floor, adjacent to or in between lavatories.

2. **HB-2:** Narrow Wall Hydrants: Zurn Z-1350, or equal Jay R Smith; encased, moderate climate type, bronze body, all bronze interior parts, replaceable seat washer, screwdriver operated stop valve in supply, key operated control valve, and ¾ IP female inlet and ¾ male hose connection. Adjustable stainless steel box with hinged cover, cylinder lock and “WATER” stamped on cover.

### 2.6 CLEANOUTS

A. Cleanouts in membrane dampproofed floors shall have flashing flange and membrane clamps. Plugs shall be bronze, with cast iron body ferrule for cast iron pipe.

B. Floor Cleanouts (FCO): Zurn ZN 1400-HD, “Level-trol” adjustable floor cleanouts, dura-coated cast iron with gas and water-tight ABS tapered thread plug, and round scoriated top, adjustable to finished floor.

C. Grade (COTG): Zurn Z-1474-IN or equal JR Smith. Housing to be dura-coated cast iron body with integral anchor flange and scoriated cover with lifting device. Cleanouts in un-paved areas shall be set in 18" x 18" x 4" concrete pads.

D. Accessible:

1. Cast iron pipe: Zurn Z-1440, dura-coated with gas and water-tight, bronze, taper thread plug

2. Steel pipe: Zurn Z-1470-A bronze, raised head, cleanout plug.

3. Copper tubing: Nibco figure 816 or 817.

E. Wall Cleanouts (WCO):

1. Copper tubing: Nibco figure 816 or 817, with Zurn Z-1462, 6” x 6” polished chrome-plated bronze wall plate and frame.

2. Cast iron pipe: Zurn Z-1441, dura-coated with gas and water-tight bronze, taper thread plug and round smooth stainless steel access cover with securing screw

3. Steel pipe: Zurn Z-1468, round stainless steel wall access cover, complete with securing screw and bronze raised hex head plug for steel pipe.

### 2.7 SHOCK ABSORBERS
A. Zurn “Shoktrol” series or equal Jay R Smith, stainless steel bellows. Install with gate valve shut-off and access door at all flush valves or other automatic valves. A single unit sized in accordance with the manufacturer’s recommendations may serve batteries of valves.

2.8 FLOOR DRAINS

A. Floor Drains: Drains in membrane dampproofed floors shall have flashing flange and membrane clamp.

B. **FD-1:** Zurn ZN-415-SS-P. Dura-Coated cast iron body with bottom outlet, combination invertible membrane clamp and adjustable collar with type "S" polished nickel bronze strainer with trap primer connection. 5 x 5 top size. Drains in sheet vinyl floors shall have a 14” square latex flange (ZN-415-SL-P).

2.9 TRAP PRIMERS

A. Trap primers shall be installed for all floor drains as follows: Trap primers shall be Precision Plumbing Products (model P2-500 or PR-500). Trap Primers shall be pressure drop activated and be of all brass construction including a brass body with ½” male NPS inlet and ¾” female NPT discharge. Internal components shall consist of a stainless steel debris screen, brass piston and brass discharge jet. Lubricated O-rings shall be EPDM and seal O-rings shall be nitrile.

1. Trap primers shall be installed on fresh cold water lines of 1 ½” diameter or less and shall be located where they will be subjected to frequent pressure drops of at least 10 psi. Install with shut off valve and access doors in Janitor's closets, Mechanical Rooms and other areas not served by, or in close proximity to, flushometer valve operated water closets.

2. Working pressure shall be 35 psi to 75 psi. Valves shall be listed with ASSE under standard #1018.

2.10 PIPE INSULATION

A. Insulate all hot water supply piping, all hot water return piping, all tempered water supply piping and all tempered water return piping with Johns Manville "Micro-Lok HP", or equal, rigid fiberglass one-piece pipe insulation or Knauf Insulation “Earthwool 1000™” or “Earthwool Redi-Klad 1000™” rigid glass mineral wool one-piece pipe insulation, or approved equal.

B. Pipe covering shall have factory applied All Service Jackets (ASJ). Jackets shall be constructed of high density, white kraft bonded to aluminum foil with fiber glass yarn, with a pressure sensitive closure system, or of aluminum foil reinforced with a glass scrim bonded to a kraft paper interleaving with an outer film layer leaving no exposed paper. Adhesives or staples shall not be required to seal the jacket and butt strips.
C. All insulation shall have composite (insulation, jacket, tape seal, and adhesive used to adhere the jacket to the insulation) Fire and Smoke Hazard ratings as tested under Procedure ASTM E 84 and NFPA 255, not exceeding: Flame Spread - 25, Smoke Developed - 50. PVC fitting covers, jacketing and accessories such as adhesives, mastics, cements and cloth for fittings should have the same component ratings.

D. Insulation thickness shall conform to Title 24, Part 6 requirements as indicated in the following table:

<table>
<thead>
<tr>
<th>FLUID TEMPERATURE RANGE (°F)</th>
<th>CONDUCTIVITY RANGE (in Btu-inch per hour per square foot per °F)</th>
<th>INSULATION MEAN RATING TEMPERATURE (°F)</th>
<th>NOMINAL PIPE DIAMETER (in inches)</th>
<th>INSULATION THICKNESS REQUIRED (in inches)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>1 and less</td>
<td>1 to &lt;1.5</td>
</tr>
<tr>
<td>Above 350</td>
<td>0.32-0.34</td>
<td>250</td>
<td>4.5</td>
<td>5.0</td>
</tr>
<tr>
<td>251-350</td>
<td>0.29-0.31</td>
<td>200</td>
<td>3.0</td>
<td>4.0</td>
</tr>
<tr>
<td>201-250</td>
<td>0.27-0.30</td>
<td>150</td>
<td>2.5</td>
<td>2.5</td>
</tr>
<tr>
<td>141-200</td>
<td>0.25-0.29</td>
<td>125</td>
<td>1.5</td>
<td>1.5</td>
</tr>
<tr>
<td>105-140</td>
<td>0.22-0.28</td>
<td>100</td>
<td>1.0</td>
<td>1.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>40-60</td>
<td>0.21-0.27</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Below 40</td>
<td>0.20-0.26</td>
</tr>
</tbody>
</table>

E. Fittings, valves and flanges shall be covered with Manville “Zeston 2000” insulated PVC fitting covers and Hi-Lo Temp insulation inserts or Knauf “Proto LoSmoke”. Insulation for all exposed piping and all piping in crawl spaces shall be covered with Zeston PVC jacketing. PVC jackets shall be 20 mils thick and shall be bonded with Zeston Perma-Weld adhesive. In crawl spaces, Knauf Earthwool RediKlad 1000° pipe covering shall serve as an acceptable alternate to standard pipe covering and PVC.

F. All piping exposed to the weather shall be finished with aluminum jacketing with a laminated moisture retarder or Earthwool RediKlad 1000° with Venture Clad embossed jacket. Aluminum jacketing shall be overlapped 2 to 3 inches and held in place with stainless steel bands to form a weather tight system. Elbows and tees shall be fitted with matching aluminum fitting covers. Other fittings in metal-jacketed systems shall be finished with conventional weather-resistant insulating materials with painted aluminum finish.
2.11 SLEEVES, WALL PLATES

A. Service pipe through exterior walls, roofs; interior walls, ceilings: Sioux Chief or equal, wall and ceiling plates; chrome plated at finished rooms.

B. Pipes through, under footings: 18 gauge iron sleeves two diameters larger than pipe, cast in concrete, annular space filled with mastic or plastic bituminous cement.

C. Pipes through fire rated walls shall be protected with fire retardant mastic as detailed on the drawings. Installation shall be in full accordance with the requirements of the UL system number. Hilti or approved equal.

D. Pipes through floors, interior concrete walls, and through fire rated walls and smoke stop partitions: 18 gauge iron sleeves, two diameters larger than pipe, annular space filled with 3M Brand Fire Barrier CP-25 caulk.

E. Pipes through 1-hour walls shall be protected with fire retardant mastic as detailed on the drawings. Installation shall be in full accordance with the requirements of the UL system number. Hilti or approved equal.

2.12 FIXTURES

A. The quantity and location of fixtures shall be taken from the Architectural and Plumbing drawings. Provide adequate supports and all standard trim normally furnished for fixtures. All enamel shall be acid resisting. Traps, unless otherwise noted shall be 17 gauge brass tubing, chrome plated when exposed.

B. Except as otherwise shown, provide ¼" steel backing plates, 36" wide by 12" high minimum size, secured to a minimum of three studs by welding, or with ¾" x 2½" lag screws for all wall hung fixtures for which no other means of support is specified.

C. Stops and supplies: Provide stops for all fixtures. Unless otherwise specified, stops exposed at lavatories and similar fixtures shall be Chicago #1016ABCP, chrome plated, loose key. Concealed stops shall be Chicago #1771ABCP.

D. All fixtures shall be Zurn or equivalent Kohler or American Standard, except where specifically noted otherwise. All fixtures shall be standard white color, except as noted.

E. All fixtures shall meet or exceed the requirements of the California Administrative Code, Title 24, Part 5.

1. P-1 - WATER CLOSET

   a. Fixture: Kohler "Kingston" K-4325; vitreous china, elongated bowl, siphon jet; wall mounted; 1.28 gpf. See Architectural Drawings for mounting height.
b. Flush Valve: Toto TET3LA "EcoPower" high-efficiency flush valve; self-powered hydroelectric infra-red sensor operated flush valve; 4" x 4" stainless steel coverplate; manual flush override; sensor w/self-adjusting detection;

c. Seat: Olsonite #955SCT; open front; elongated; self-sustaining hinges; Sta-Tite fastening system; white.

d. Carrier: Zurn Z-1201 or 1202, no-hub; 500 lb. capacity with auxiliary inlets as required.

2. P-1A - WATER CLOSET (ADA)

a. Fixture: Kohler "Kingston" #K-4325; vitreous china, elongated bowl, siphon jet; wall mounted; 1.28 gpf. See Architectural Drawings for ADA mounting height.

b. Flush Valve: Toto TET3LA "EcoPower" high-efficiency, self-powered hydroelectric infra-red sensor operated flush valve; 4" x 4" stainless steel coverplate; manual flush override; sensor w/self-adjusting detection;

c. Seat: Olsonite #955SCT; open front; elongated; self-sustaining hinges; Sta-Tite fastening system; white.

d. Carrier: Zurn Z-1201 or 1202, no-hub; 500 lb. capacity with auxiliary inlets as required.

3. P-2 LAVATORY

a. Fixture: Kohler "Kingston" K-2007; wall mounted; 21 ¾" x 18 1/8"; overflow; backsplash; single faucet hole; vitreous china.

b. Faucet: Kohler "Sculpted Insight" K-7515; with mixer. single hole; 5 ¾" spout; vandal resistant aerator; 0.5 gpm (HW/CW).

c. Drain: McGuire #155A; open grid P.O. plug

d. P-Trap: McGuire #8902 adjustable trap w/cleanout

e. Carrier: Zurn Z-1251

f. Lav shield Trubro Lave shield factory precut for Koler Kingston Lavatory. Verivy color with owner.

4. P-3A – URINAL (ADA):

a. Fixture: Kohler "Bardon" L-4904-ET; high efficiency; vitreous china; washout type; ADA compliant; 0.125 gpf

b. Flush Valve: Toto "EcoPower" ultra high-efficiency self-powered hydroelectric flush valve; manual flush override; 0125 gpf

c. Carrier: Zurn Z-1222
2.13 ELECTRIC WATER HEATER

A. Chronomite "Instant Temp" — low flow, model E-60L/208, tankless water heater, as scheduled on the Drawings. Unit shall have a steel housing and be provided with Celcon waterways and Nichrome heating coils. Temperature shall be controlled by a digital microprocessor.

PART 3 EXECUTION

3.1 SURFACE CONDITIONS

A. This Contractor shall be held to have examined the site and compared it with the Contract Documents, and to have satisfied himself as to the conditions under which the work is to be performed. In the event of discrepancy, he shall notify the Architect and proceed as he directs. He shall be held responsible for all existing conditions, whether or not accurately described, and no allowance shall subsequently be made on his behalf for any error, omission, or extra expense to which he may be put due to failure or neglect on his part to make such examination and notification.

B. Prior to commencing the work of this Section, this Contractor shall inspect the installed work of other trades and verify that their work is sufficiently complete to permit the start of work under this Section and that the completed work will be in complete accordance with the original design. In the event of discrepancy immediately notify the Architect and proceed as he directs.

3.2 ACCESSIBILITY

A. Equipment shall be placed and piping connections made in such a manner that all routine adjustments and maintenance operations may be carried out without inconvenience and so that all code requirements for clearances are maintained.

3.3 VIBRATION AND SOUND CONTROL

A. Make all necessary provisions to prevent the transmission of vibration to the building structure and the passage of noise from the equipment rooms to other rooms. Provisions shall include: vibration isolators for motor driven equipment; flexible pipe connections to motor driven equipment; resilient mounting for piping; sealing off pipe and duct penetrations of walls, floors and ceilings of equipment rooms.

3.4 INSTALLATION, GENERAL

A. Provide all necessary cutting in connection with the work of this Section. NO structural members shall be drilled, bored, or notched in a manner that will impair their structural capacity; all penetrations of concrete or masonry shall be made with core drills; NO cutting shall be done without the approval of the Architect.
3.5 INSULATION

A. Insulation shall be applied in complete accordance with the manufacturer’s published installation instructions. All insulation shall be applied on clean, dry surfaces and shall be continuous through wall and ceiling openings and sleeves, except where fire stop materials are required.

B. All joints shall be firmly butted together and longitudinal jacket laps and butt strips shall be smoothly secured.

C. Specified adhesives, mastics and coatings shall be applied at the manufacturer’s recommended minimum coverage per gallon.

D. Insulation on all cold surfaces must be applied with a continuous, unbroken vapor seal. Hangers, supports, anchors, etc. that are secured directly to cold surfaces must be adequately insulated and vapor sealed to prevent condensation. Seal all pipe terminations with vapor barrier mastic.

E. All surface finishes are to be extended to protect all surfaces, ends and raw edges of insulation.

F. Inserts shall be installed at outside hangers. Inserts between the pipe and pipe hangers shall consist of rigid closed cell pipe insulation of thickness equal to the adjoining insulation. Inserts shall not be less than 12” long for pipe sizes through 2½” and not less than 18” long for pipes larger than 2 ¾”. Refer to manufacturer’s recommendations for densities, sectional length, gauge of metal shield and distance between centering.

G. Galvanized metal shields shall be applied between hangers or supports and the pipe insulation. Shields shall be formed to fit the insulation and shall extend up to the centerline of the pipe and the length specified for hanger inserts less 4” to allow for vapor retarding butt joints on each side of shields.

H. All pipe insulation ends shall be tapered and sealed, regardless of service.

3.6 INSTALLATION, PIPING

A. Soil, Waste, Vent, Drain Piping:

1. Soil, waste, and vent piping occurring within the building shall be installed to a uniform minimum grade of ¼” per foot unless otherwise noted. Vent piping shall be graded so that all condensation shall flow directly to a soil or waste line.

2. Exterior soil and waste lines shall be installed to inverts or grades indicated on the drawings.

3. Bell and Spigot pipe shall be installed with the bell up grade.
4. Changes in direction of drainage piping shall be accomplished by the use of appropriate drainage and sanitary fittings.

5. Drilling and tapping of drains, soil, waste, or vent pipes and the use of saddle hubs and bands are prohibited.

6. Protection against breakage of piping passing under or through walls shall be provided using specified sleeves and caulking.

7. Adapters shall be installed between threaded iron and soil pipe.

8. Test tees shall be installed at the foot of all soil, waste, and storm water stacks.

9. Cleanouts shall be located where indicated on the Drawings; at all horizontal offsets; at ends of waste or sewer branches more than 5' in length; at intervals of 100' in straight runs of piping, or at closer intervals if directed or required by local code. Location of cleanouts in finished spaces shall be approved by the Architect prior to installation.

B. Hot, Cold Water Systems:

1. Di-electric unions shall be installed where copper pipe is connected to galvanized steel piping or stub outs.

2. Connections from copper pipe to fixture supply fittings shall be made with copper or brass nipples.

3. Provide 18" high vertical air chambers, of size equal to "local connection schedule" size, at all domestic water connections to fixtures and/or equipment that are not specified to have shock absorbers.

4. All domestic water piping shall be kept clear of the building structure. Where it is within 1" of the building structure it shall be wrapped with felt (3/16" minimum thickness).

5. To the greatest extent possible, domestic cold water piping shall be kept separated from hot piping and where there is a choice shall be run in the coolest portion of the available space.

C. Plumbing Fixtures:

1. Space between wall mounted fixtures and wall surface shall be neatly pointed up with G.E. silicone rubber compound of color matching fixture.

2. All exposed bolt heads and nuts used to secure fixtures shall be concealed with vitreous china caps.
D. Natural Gas Piping Systems:

1. Natural gas piping shall slope back to meter where possible; bottom of vertical natural gas lines shall be fitted with 6" long capped drip legs.

2. In addition to main shut-off valve, a natural gas stopcock shall be installed at each natural gas fired piece of equipment.

E. Indirect Waste Piping:

1. Indirect waste piping shall be installed to a uniform minimum grade of ¼" per foot unless otherwise noted.

2. Changes in direction of indirect waste piping shall be accomplished by the use of appropriate drainage fittings.

3. Drilling and tapping of indirect waste pipes and the use of saddle hubs and bands are prohibited.

4. Protection against breakage of piping passing under or through walls shall be provided using specified sleeves and caulking.

F. Excavation, Backfill:

1. Provide all excavation, trenching, and backfill in connection with the work of this Section.

2. Excavation shall be carried to 4" below the bottom of pipes. Provide a sand bedding for all sloped drainage piping, and provide smooth uniformly graded bedding of firm but yielding material for all other piping, catch basins, and similar structures.

G. Flashing:

1. All roof and wall penetrations shall be flashed and counterflashed water tight with 26 gauge sheet metal, except as noted.

2. Vents through roof shall be flashed with Semco #1100-4 lead flashing assemblies. Flashing shall extended over top of pipe and shall be turned down inside top of pipe.

3.7 CONNECTION, OWNER FURNISHED EQUIPMENT

A. All electrical wiring and connections for equipment furnished under this Section shall be furnished and installed under the Electrical Sections.
3.8 TESTING, INSPECTIONS

A. This Contractor shall not allow or cause any work of this Section to be covered or enclosed until it has been inspected, tested, and approved by the Architect and the authorities having jurisdiction over the Work. Should any of this work be enclosed or covered up before such inspection, testing, and approval, this Contractor shall uncover the work, have the necessary inspections, tests, and approvals made and, at no expense to the Owner, make all repairs necessary to restore both his work and that of other contractors that may have been damaged, to be in conformity with the Contract Documents.

B. In any test, proper safety procedures and equipment should be used, including personal protective equipment such as protective eyewear and clothing. Installers should always consider local conditions, codes and regulations, manufacturer’s installation instructions, and Architects'/Engineers’ specifications in any installation.

C. Tests:

1. This Contractor shall make all tests required by all local, state, and federal laws, codes, ordinances, and regulations having jurisdiction over this work.

2. Furnish all necessary labor, materials, and equipment for conducting tests, and pay all expenses in connection therewith. Should leaks develop while testing, repairs shall be made, and tests shall be repeated until a satisfactory test is obtained.

3. Water Piping: Shall be hydrostatically tested for 6 hours at 150 psi. All equipment shall be tested water tight at utility pressure.

4. Drainage and Vent Piping: Shall be tested for 1 hour by plugging all outlets and filling the pipes with water to the top of vertical sections of pipes. No loss of water shall be permitted.

5. Natural Gas Piping: Shall be tested for twenty-four (24) hours at a pressure of 50 psig with nitrogen or compressed air. NO pressure drop shall be allowed during the last four (4) hours of the test. Tests joints of natural gas piping with Leak-Tek or Nupro-Snoop solution while maintaining ten (10) psig minimum internal pressure.

3.9 DOMESTIC WATER SYSTEM STERILIZATION

A. Upon completion of this work, the new domestic water system shall be thoroughly flushed, sterilized and flushed. Sterilization and flushing shall be performed using the procedure below. All work shall be performed in the presence of the inspector.

B. All domestic water outlets shall have signs posted at their location stating that the water has not been sterilized and shall not be used for human consumption. The signs shall remain until the sterilization process is complete.
C. Procedure

1. Introduce chlorine or a solution of sodium hypochlorite, filling the lines slowly and supplying the sterilization agent at a rate of 200 parts of chlorine per million. The entire system shall be completely filled with the solution. All valves shall be operated and ends of all branches tested for residual chlorine. Continue to inject the solution until at least 200 ppm of free chlorine is indicated.

2. After the sterilizing agent has been applied, the system shall be isolated with the solution retained for at least 3 hours. Test for residual chlorine after retention. If less than 200 ppm is indicated, repeat the sterilization procedure.

3. After satisfactory sterilization, flush the system until all traces of the chemical are removed or until the chlorine content is no greater than that in the existing supply.

D. After a period of 48 hours minimum, bacteriological tests, using samples from at least 3 representative points, shall be made by recognized testing agency, who shall certify to the Architect that the system is bacteriologically safe and at least equal in safety to that of the principal water supply. The laboratory report and certification shall be transmitted to the Architect.

3.10 CLEANING

A. Flush all water piping systems. Remove, clean and replace all strainer baskets prior to final inspection.

B. Blow out all compressible fluid piping with compressed air before connecting with regulators or equipment.

3.11 ADJUSTING

A. Properly adjust all stops, and controls, and demonstrate safe and satisfactory operation of all equipment.

3.12 CLEANUP

A. Upon completion of the work of this Section, remove all surplus material, debris, and equipment associated with or used in the performance of this work.

END OF SECTION
SECTION 23 0000
HEATING, VENTILATING, AIR CONDITIONING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. The requirements of the General Conditions, Supplemental General Conditions, Division 01 Sections and Section 23 0500 General Mechanical applies to all work herein.

1.2 DESCRIPTION

A. This Specification establishes the required standards for all labor, materials, equipment and workmanship in connection with the furnishing, fabrication and installation of complete “Heating, Ventilating, Air Conditioning” systems. Heating, ventilating, air conditioning work includes but is not necessarily limited to the following:

1. Split system fan coil/heat pump units;
2. Exhaust fans;
3. HVAC & piping insulation;
4. Refrigerant piping and appurtenances;
5. Flashings, curbs and caps in connection with all equipment, piping and ductwork supplied under this Section;
6. Condensate drainage piping, inclusive of all pipe, fittings, anchors, support and bracing;
7. Temperature control wiring and control devices;
8. Start up, adjusting, and balancing.

1.3 RELATED WORK

A. Sheet metal flashing and trim: Section 07 60 00.

B. Line voltage wiring, disconnect switches, conduit for temperature control wiring, and final connection of electrical equipment: See Section 26 27 00 - Basic Electrical Materials & Methods.

C. Finish painting: See Section 09 91 00 - “Painting and Coatings”.

Contra Costa Community College District
Diablo Valley College
AB Restroom Renovation
1.4 SUBMITTALS

A. All submittals shall be submitted under the provisions of Section 01 33 00 – SUBMITTAL PROCEDURES.

1. Product Data

   a. For all HVAC equipment, include manufacturer’s specifications, data sheets, and certified drawings in compliance with specification and/or as scheduled.

   b. Include physical and performance data such as weights, sizes, capacities, required clearances, performance curves, acoustical characteristics, finishes, color selection, and accessories. Include certified drawings on major equipment.

2. Coordination/Layout Shop Drawings

   a. Prepare complete consolidated and coordinated layout drawings for all new systems, and for existing systems that are in the same areas. Shop drawings shall be prepared using AutoCAD 2012 or newer and shall be drawn at a minimum \(\frac{1}{4}\)" = 1' - 0" scale. Sections, details, and diagrams shall be to required scales for specified areas.

   b. All drawings shall be fully coordinated with Plumbing, Fire Protection, Electrical, Structural, and Architectural work. Drawings shall be coordinated and dimensioned indicating equipment, pipe, duct, fire protection, and electrical in relation to architectural and structural features. Indicate exact locations of valves, piping specialties, access doors, etc. Clearly identify and dimension the proposed locations of the principal items of equipment and adequate clearance for all equipment, piping, pumps, valves and other items. Provide detailed layout of all piping systems showing the proposed routes.

   c. Show the access means for all items requiring access for operations and maintenance.

   d. Submit shop drawings to Architect for approval, prior to fabrication or installation of any work. Do not install equipment or piping until layout drawings have been approved. Any work installed without prior shop drawing approval shall be removed at the Contractor’s expense.

   e. Complete and detailed shop drawings shall be maintained throughout the coordination and construction phase indicating all equipment and trades’ work clearly. All equipment including piping, etc. shall clearly identify both top and bottom elevations as well as distances from equipment to
established building lines. Coordinate with other trades and field conditions and show dimensions and details including building construction and access for servicing.

f. Use of contract documents for shop drawings is not acceptable

g. Any work installed without prior shop drawing approval shall be removed at the Contractors expense.

3. Samples - (not required)

4. Shop-wiring diagrams of temperature controls and air conditioning unit controls, as shown on Drawings.

B. Equipment manufacturer shall design, construct, and certify that his equipment satisfies the special minimum seismic resistance requirements and shall submit calculations or test results supporting his certification.

C. Refer to mechanical equipment specified herein for additional requirements

1.5 AS-BUILT DRAWINGS

A. Comply with the requirements of Section 01 78 39 – PROJECT RECORD DOCUMENTS and the following.

B. A complete set of Contract Drawings shall be maintained at the work site, and all changes in the work shall be recorded on this set on a daily basis. In addition to changes made during course of work, show the following:

1. Exact location, type and function of concealed valves and controllers.

2. Exact size, elevations and location of underground and under floor piping.

C. Submit to Architect for final approval.

1.6 OPERATION & MAINTENANCE DATA (Closeout)

A. Comply with the requirements of Section 01 78 23 – OPERATION AND MAINTENANCE DATA and the following.

B. Installing contractor shall provide all operating and maintenance instructions provided by the manufacturer, describing proper operation and maintenance of any equipment and devices installed. Operating and maintenance instructions shall cover maintenance, adjustment, and operation of each piece of apparatus.

C. Contractor shall also provide a parts list of all equipment and component parts for all
equipment under this Section. The equipment list shall include manufacturer’s name, model number, and local representative, service facilities and normal channel of supply for each item.

D. Data shall be bound in a hard cover 3-ring binder, with table of contents identifying items therein, and index tabs for each system. Neatly obscure or cross out inapplicable data from manufacturer’s literature. Include the following:

1. Manufacturer’s brochures, ratings, certified shop drawings, lubrication charts and data, and parts list with part numbers. Mark each sheet with equipment identification number and actual installed condition or system and location of installation. Specifically identify which options are provided.

2. Description of start-up and operating procedures for each system, including controls diagrams and description of operating sequences.

3. Recommend preventative maintenance schedule and procedures.

E. Submit data to the Architect for approval. Final acceptance of the work will not be made until a satisfactory submission of this material is received and approved by the Architect.

1.7 OPERATING & MAINTENANCE INSTRUCTIONS

A. Comply with the requirements of Section 01 79 00 – DEMONSTRATION & TRAINING and the following.

B. The Owner’s authorized representative shall be instructed in the operation and servicing of all heating, ventilating, and air conditioning systems. Provide a minimum of one man-day of instruction time. All instruction shall be provided at no cost to the Owner.

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PART 2 - PRODUCTS

2.1 GENERAL

A. Only specified materials shall be utilized in the work of this Section unless substitutions have been approved by the Architect and in accordance with Section 01 25 00 – SUBSTITUTION PROCEDURES.

B. All materials shall be new, of the best quality for the intended use, shall be listed by the ASA, AGA or UL as meeting their requirements and bearing their label wherever standards have been established and label services are regularly furnished by them.

C. Provide fan drives rated at 150% of motor horsepower. Drives shall be adjustable sheave type unless specified otherwise. Listed fan speeds are only approximate; select and/or change drives to operate at approximately midpoint of adjustable range after final balancing.

D. Provide guards to enclose exposed moving equipment components in accordance with California Department of Industrial Relations, CAL/OSHA Title 8 regulations. Fabricate belt guards with rigid angle iron frame, expanded metal screen, pivoted 4" diameter tachometer opening covers, and in two pieces to permit lubrication or sheave and belt adjustment without removing guard. Provide removable sheet metal guards at shafts and couplings and removable framed wire mesh guards at openings in mechanical systems.

2.2 REFRIGERANT PIPING

A. Refrigerant piping shall be Type “ACR” ASTM B 280, drawn temper, seamless copper tube. Note: Internal pressure shall be as shown in the latest edition of the Copper Tube Handbook for annealed pipe.

B. Mechanical joints on refrigerant piping are prohibited. All refrigerant piping joints shall be brazed. Use lead-free, silver solder, minimum 15% silver content.

C. Pipe fittings shall be wrought-copper with soldered joints; ASME B16.22.
D. Flexible connections shall be bronze, double braided, sweat solder ends.

E. Sight glasses shall be color change moisture indication type, replaceable element, filter screen and pad, sweat solder ends; Sporlan “See-All”, Henry, or equal.

F. Charging and purge valves shall be forged brass, diaphragm packless, globe type, angle or straight through, one end solder, one end flare; Henry 623 and 643 series, Sporlan, or equal.

G. Solenoid valves shall be forged brass, extended end connections, solder ends, molded coil; Sporlan “E” series or equal. Comply with ARI 760 & UL 429.

H. Filter driers shall be replaceable media, angle type; Henry “Dri-Cor” or equal; ARI 730.

I. Electronic thermostatic expansion valves shall have stainless steel body and connections, ceramic slide and port, linear flow capacity, continuous modulation, and direct coupling of motor and valve; Emerson “EX” series or equal.

J. Pipe hangers: All refrigerant piping shall be supported 8’ on center. Hangers and supports shall be as specified in Section 23 0500 - General Mechanical”.

K. Split system fan-coil units and heat pump units shall have brazed sweat-fitting connections on the refrigerant piping between the units with a flexible piping section at the outdoor unit.

2.3 CONDENSATE DRAINAGE PIPE

A. Condensate drainage piping shall be Mueller or equal.

1. 1 ½” and larger shall be type DWV copper tube, ASTM B306.

2. 1 ¾” and smaller shall be type M, hard temper copper, standard copper fittings.

B. Drainage fittings shall be ASME B16.23, cast copper or ASME B16.29, wrought copper, solder-joint fittings. 1 ½” & smaller, standard pressure fittings.

C. Solder shall be ASTM B 32, lead free with ASTM B 813, water-flushable flux.

2.4 VALVES

A. Ball Valves: Nibco T-685-80, Watts B-6080, or KITZ 58; bronze body, two-piece, full port, lever handle, 600 psi CWP.

B. Check Valves:

1. 2” and smaller:

b. Vertical: Nibco T-480 or KITZ 36; bronze body, inline lift type, Teflon seat, and discs, spring actuated 125 lb. SWP.

2. 2¾” and larger:

a. Horizontal: Nibco F918, Stockholm G-931, or KITZ 78; IBBM, iron body, bolted cap, flanged, horizontal swing, renewable seats and discs, 125 lb. SWP

b. Vertical: Nibco F-910 or KITZ 7032; iron body, globe style, spring actuated, renewable seats and disc, 125 lb. class rating.

C. Air Eliminators: Air vents shall be installed at all high points in all water piping systems.

D. Automatic air vents: Spirotherm Spirotop Air Release Valve, cast brass, rated for 150 psig design pressure and 270°F operating temperature. Units shall include non-ferrous floats, stainless steel linkage and a Viton seal, which closes against a brass spring operated seat.

E. Manual air vents: 1” IPS x 2” long air chambers with readily accessible Dole No. 10 vent valve and 1/8” copper tubing.

F. All valves, except pressure reducing and control valves, shall be the same size as the pipe to which they are installed.

G. Provide a union immediately downstream from each valve, unless the valve is flanged.

H. All valves shall be installed with the stem 45 degrees above horizontal, if possible. In no case shall the stem be installed below horizontal.

2.5 UNIONS

A. Steel Pipe: malleable iron, 150 lb., ground joint, Anvil figure 463, Kuhns, or equal.

B. Copper Pipe: soldered joint, Nibco series 633 or 733, Mueller, or equal.

C. Dielectric: EPCO, Watts, or equal.

2.6 FLEXIBLE CONNECTORS

A. Pipe: Bronze, double braided, sweat solder ends, Metraflex BBS series, equivalent Keflex, or approved equal.

2.7 SPLIT SYSTEM OUTDOOR UNIT
A. Daikin 3MXS24NMVJU heat pump as scheduled on the Drawings.

2.8 SPLIT SYSTEM INDOOR UNITS

A. Daikin FFQ09LVJU fan coil 2 x 2 ceiling cassette as scheduled on the Drawings.
   1. Fresh air intake knockout.
   2. Built-in condensate pump.

2.9 TEMPERATURE CONTROLS

A. Each heating, ventilating, and air conditioning system shall be controlled by an individual electronic night setback thermostat, mounted 48” above finished floor.
   2. Multiple stage units: White Rogers 1F95-371 with F29 series metal guard

2.10 FILTERS FOR AIR HANDLING EQUIPMENT

A. Filters shall be 2" completely disposable type with fiberglass media, Flanders “Pre-Pleat M13”, AAF, Farr, or approved equal, UL Class 2 listed. Permanent washable types are not acceptable. Change filters at job completion and furnish one complete filter change boxed at the jobsite for owner.

B. Each filter shall consist of synthetic only media, with corrosion-resistant expanded metal backing and moisture resistant enclosing frame. The filter shall be 2” nominal depth. The grid shall be 100% bonded to the media on the air exiting side to eliminate media vibration and pull-away.

C. The grid shall be formed to provide a uniform V-wedge shaped pleat with the open area on the air exiting side for maximum utilization of the media and low airflow resistance. The filter shall be classified for flammability by Underwriters Laboratories, Standard 900 as Class 2.

D. The filter shall have a Minimum Efficiency Reporting Value (MERV) of 13 by ASHRAE Standard 52.2.

E. During construction, protect all filters upstream of air handling units with blankets of 2” fiberglass filter media or 2” disposable panel filters. UL Class 2 listed. Remove after balancing, and prior to acceptance.

F. Systems shall not be operated without properly installed filters, including temporary filters for use during construction. If the final pressure drop of the temporary filters is reached during the construction or test and balance, replace them with the spare set. If not used,
the spare set is to be delivered to the Owner at the time of acceptance.

2.11 INSULATION

A. General

1. All duct insulation materials including jackets, tapes, adhesives and coatings shall meet ASTM E84 25/50 Flame Spread/Smoke Development requirements.

B. Exterior of Ductwork: (Flexible Duct Wrap)

1. Unless specified to be lined, all ductwork shall be wrapped with formaldehyde-free, flexible glass-fiber or mineral-wool, blanket type insulation with factory applied FSK aluminum foil facing. Thickness shall be 2”.


C. Interior of Ductwork: (Duct Liner)

1. All ducts exposed to the weather shall be internally insulated. All other ductwork within 10 feet of a fan (supply and return) shall be internally insulated. Duct liner shall be installed in supply and return ducts and plenums where noted on the Drawings. Exhaust ductwork need not be insulated.

2. Duct liner shall meet the requirements of ASTM C 1071, NFPA 90A or NFPA 90B Type I and Type II. Operating temperature shall meet ASTM C411. Microbial growth shall meet ASTM C1338, G21 and G22.

   a. Type I - Plenum Liner Board: Johns Manville “Permacote Linacoustic R-300” or Knauf “Rigid Plenum Liner”, or approved equal. Thickness shall be 1½” unless otherwise noted.

   b. Type II - Flexible Duct Liner: Johns Manville “Linacoustic RC” or Knauf “Sonic XP Duct Liner”, with fire resistant facing; or approved equal. Thickness shall be 1½” unless otherwise noted.

D. Refrigerant Piping

1. Insulate all refrigerant suction lines, fittings, and valves with ¼” thick flexible elastomeric thermal insulation, Resolco Insul-Phen rigid closed cell phenolic foam, or equal, according to manufacturer’s suggested insulation thickness and installation procedures, UV protected.

E. Insulation thickness shall be as follows:
<table>
<thead>
<tr>
<th>FLUID TEMPERATURE RANGE (°F)</th>
<th>CONDUCTIVITY RANGE (in Btu-inch per hour per square foot per °F)</th>
<th>INSULATION MEAN RATING TEMPERATURE (°F)</th>
<th>NOMINAL PIPE DIAMETER (in inches)</th>
</tr>
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<tr>
<td></td>
<td></td>
<td></td>
<td>1 and less</td>
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<td>10</td>
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<tr>
<td>Space heating, hot water systems (steam, steam condensate and hot water) and Service Water heating systems</td>
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<td>4.5</td>
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<tr>
<td>Above 350</td>
<td>0.32-0.34</td>
<td>250</td>
<td>3.0</td>
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<td>251-350</td>
<td>0.29-0.31</td>
<td>200</td>
<td>2.5</td>
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<td>201-250</td>
<td>0.27-0.30</td>
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<tr>
<td>141-200</td>
<td>0.25-0.29</td>
<td>125</td>
<td>1.0</td>
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<tr>
<td>105-140</td>
<td>0.22-0.28</td>
<td>100</td>
<td>0.5</td>
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<tr>
<td>Space cooling systems (chilled water, refrigerant and brine)</td>
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<td>1.0</td>
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<td>40-60</td>
<td>0.21-0.27</td>
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<tr>
<td>Below 40</td>
<td>0.20-0.26</td>
<td>50</td>
<td>1.0</td>
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</table>

F. All tanks, expansion tank, pumps, volutes, valves and strainers shall be completely insulated with ½” Armaflex glued and sealed, vapor tight, in place with Armstrong #520 adhesive.

2.12 CEILING MOUNTED EXHAUST FANS

A. Panasonic “Whisper Green” series ventilation fans, “FV” series as scheduled on the Drawings or approved equal.

B. Ventilating fan shall be of the ceiling mount, ENERGY STAR rated type, with variable speed control that shall be built-in with a high/low delay timer and activated by a motion sensor. The motor shall be enclosed with a brushless DC motor engineered to run continuously. Power rating shall be 20v/60Hz. Detachable dual 4" or 6" diameter duct adaptor shall be included.

C. Fan shall be UL listed for tub/shower enclosure when used with GFCI branch circuit wiring. Fan shall be ASHRAE 62.2, LEED, ENERGY STAR IAP, EarthCraft, and California Title-24 compliant.

2.13 REGISTERS, GRILLES, AND DIFFUSERS

A. Air terminals shall be Price, Titus, or approved equal, as scheduled on the Drawings.

1. SDGE — Spiral Duct Supply Grille
2. **510 — Supply Grilles**
   a. Steel supply grilles shall be single deflection type with one set of fully adjustable deflection blades spaced $\frac{3}{4}$ in. on center. The blades shall run parallel to the long dimension of the grille.

3. **Series 80 Ceiling Exhaust and Return Grilles**
   a. Eggcrate return grilles shall be of aluminum construction, consisting of aluminum 1/2 in. x 1/2 in. x 1/2 in. grid (eggcrate core) and an extruded aluminum border. The grille shall be finished in B12 White Powder Coat.

4. **SMD Ceiling Diffusers**
   a. Fixed air pattern steel directional louvered face diffusers consisting of an outer frame assembly, which facilitates mounting in the application shown. A collar that allows connection to the square (or rectangular) duct size indicated shall be an integral part of the frame assembly.
   b. An inner core assembly consisting of fixed louvers capable of producing the air flow discharge pattern indicated on the Drawings shall be fully removable from the installed diffuser frame for access to any dampers or other ductwork components located in or near the diffuser neck. The inner core assemblies shall be identically constructed so that directional core assemblies providing different air flow discharge patterns may be interchanged between frames, provided the frame duct connections are of the same size.

5. **Series 96 Return Grille**
   a. Grilles shall be 45 degree deflection fixed louver type with blades spaced $\frac{3}{4}$ in. on center. The outlet shall have 14 gauge steel blades and heavy duty steel support bars and frame. Blades shall run parallel to the long dimension of the grille.

B. All terminals shall be steel and shall be factory painted “off-white”, unless otherwise noted.

C. Air terminals for installation in gypsum board shall have a 1” border for surface mounting. All air terminals for installation in lay-in ceilings shall have a lay-in frame to match the
specified grid system.

PART 3 - EXECUTION

3.1 SURFACE CONDITIONS

A. Prior to commencing the work of this Section, the Contractor shall inspect the installed work of other trades and verify that their work is sufficiently complete to permit the start of work under this Section, and that the completed work shall be in complete accordance with the original design. In the event of discrepancy, immediately notify the Architect and proceed as directed.

3.2 GENERAL INSTALLATION

A. Provide all necessary cutting in connection with the work of this Section. No structural members shall be drilled, bored, or notched in a manner which shall impair their structural capacity. All penetrations of concrete or masonry shall be made with core drills. No cutting shall be done without the approval of the Architect.

3.3 HEATING & AIR CONDITIONING EQUIPMENT INSTALLATION

A. All units shall be set with curbs plumb, level, and securely attached through framed opening with bolts and/or lag screws as noted on the Drawings. Connections to ductwork shall be secured, filter racks shall be aligned, enclosures and ductwork connections shall be fully waterproofed, and all utility and control connections shall be complete.

3.4 INSULATION INSTALLATION

A. Exterior Ductwork:

1. Duct wrap shall be cut in a manner to meet the manufacturers’ stretch-out guideline to provide a 2" staple lap and have minimum compression at the corners. All joints shall be lapped 2" and stapled with outward clinching staples 2" on center. The insulation shall be mechanically fastened to the underside of all ducts 24" wide or more using cup-head pins, weld pins, or stick pins with speed clips 18" on center. Insulation shall not be compressed to comply with required installed R-value. All joints and penetrations of the vapor barrier jacket shall be sealed with a minimum 3" wide matching pressure sensitive tape. Pressure-sensitive tape shall be firmly rubbed in place immediately after application using a “squeegee” type tool.

2. When a vapor seal is required, two coats of vapor retarder mastic reinforced with one layer of 4" wide, open weave glass fabric may be used in lieu of pressure-sensitive tape. Mastic shall be brushed onto joint and glass fabric imbedded in it. A second coat of mastic shall be brushed over the glass fabric until the fabric is filled. Mastics shall be applied in accordance with application instructions on the
container.

B. Interior Duct Liner

1. Apply to the inside face of ducts, coated side facing air stream. Fasten using fire retardant adhesive and secure with mechanical fasteners at 12" maximum o.c., both directions, for velocities up to 2,500 fpm. Velocities over 2,500 fpm shall have fastener spacing of 6" o.c.

2. Exposed edges must be factory or field coated with adhesive. Metal nosing shall be installed in all liner leading edges facing the airstream at fan discharge, at access doors, and at any interval of lined duct preceded by unlined duct.

3. Insulation with torn or broken coatings shall be removed and replaced. Loose corners, edges, and butt joints will not be accepted.

4. Maximum velocity: 5,000 ft/min.

C. Refrigerant Piping:

1. The insulation shall be installed in accordance with the manufacturer's instructions. All joints and seams shall be sealed with waterproof vapor retarder adhesive. All pipes exposed to the weather shall be coated to protect the insulation from ultra-violet radiation in accordance with the manufacturer’s published instructions.

3.5 INSTALLATION, REFRIGERANT PIPING

A. Piping installation shall comply with all federal, state, and local regulations and industry guidelines. In addition, the following practices shall be followed.

B. All piping shall be stored with ends sealed to prevent entry of moisture and debris.

C. A pipe cutter specific to the piping material applied shall be used.

D. All factory and field cut tube ends shall be de-burred and cleaned.

E. Flared fittings shall be formed using tools recommended by the equipment manufacturer.

F. Flare nuts shall be tightened with torque wrench furnished by the equipment manufacturer.

G. Piping shall be continuously purged with dry nitrogen while soldering. Care shall be taken when soldering near valves or other equipment that may be damaged by extreme heat.

H. Drawing plans, schematics, and diagrams indicate general location and arrangement of
piping systems; indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Shop Drawings.

I. Install refrigerant piping according to ASHRAE 15.

J. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

K. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

L. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

M. Install piping adjacent to machines to allow service and maintenance.

N. Install piping free of sags and bends. Install fittings for changes in direction and branch connections. Install piping as short and direct as possible, with a minimum number of joints, elbows, and fittings.

O. Arrange piping to allow inspection and service of refrigeration equipment. Install valves and specialties in accessible locations to allow for service and inspection.

P. Install refrigerant piping in protective conduit where installed belowground. Install refrigerant piping in rigid or flexible conduit in locations where exposed to mechanical injury.

Q. Slope refrigerant piping as follows:

R. Install horizontal hot-gas discharge piping with a uniform slope downward away from compressor.

S. Install horizontal suction lines with a uniform slope downward to compressor.

T. Use double-suction riser for maximum compressor efficiencies if load variation is expected.

U. Install traps and double risers to entrain oil in vertical runs.

V. Liquid lines may be installed level.

W. When brazing or soldering, remove solenoid-valve coils and sight glasses; also remove valve stems, seats, and packing, and accessible internal parts of refrigerant specialties. Do not apply heat near expansion-valve bulb.

X. Install piping with adequate clearance between pipe and adjacent walls and hangers or
between pipes for insulation installation.

Y. All refrigerant piping and valves shall be identified.

3.6 EXHAUST FAN INSTALLATION:

A. Install fans in accordance with manufacturer’s instructions and as indicated in the Installation, Operation and Maintenance Manual (IOM) and contract drawings

B. Examine areas to receive fans. Notify the Architect of conditions that would adversely affect installation or subsequent utilization and maintenance of fans. Do not proceed with installation until unsatisfactory conditions are corrected.

C. Ensure roof openings are square, accurately aligned, correctly located, and in tolerance. Ensure duct is plumb, sized correctly, and to proper elevation above roof deck.

D. Adjusting

1. Adjust exhaust fans to function properly

2. Adjust belt tension

3. Lubricate bearings

4. Adjust drive for final system balancing

5. Check wheel overlap

E. Clean as recommended by manufacturer. Do not use material or methods which may damage finish surface or surrounding construction

F. Protection

1. Protect installed product and finished surfaces from damage during construction.

2. Protect installed exhaust fans to ensure that, except for normal weathering, fans will be without damage or deterioration at time of substantial completion.

3.7 FILTERS

A. Systems shall not be operated without properly installed filters. Filters used during construction shall be removed and replaced with new filters after construction is completed and the systems are ready for final acceptance by the owner.

3.8 TESTS, INSPECTIONS

A. Make all necessary control adjustments and balancing of air and water flows. Operate the
entire system for a period of time not less than three (3) working days for the purpose of proving satisfactory performance. During this period, instruct such persons as the Owner and/or Architect may designate in the proper operation of the systems. Should further adjustment prove necessary, operating tests shall be repeated until a satisfactory test is obtained.

B. This Contractor shall not allow or cause any work of this Section to be covered or enclosed until it has been inspected, tested, and approved by the Architect and the authorities having jurisdiction over the Work. Should any of this work be enclosed or covered up before such inspection, testing, and approval, this Contractor shall uncover the work, have the necessary inspections, tests, and approvals made and, at NO expense to the Owner, make all repairs necessary to restore both his work and that of other contractors which may have been damaged to be in conformity with the Contract Documents.

C. Furnish all necessary labor, materials, and equipment for conducting tests, and pay all expenses in connection therewith. Should leaks develop while testing, repairs shall be made, and tests shall be repeated until a satisfactory test is obtained.

D. Condenser water piping shall be hydrostatically tested at 125-psi pressure and proved tight before covering. Tests may be made in sections provided connection to service previously tested is included in each succeeding test. Systems shall be tight for eight hours.

E. Refrigerant piping shall be tested for leaks under 650 psi (410A) pressure. Joints shall be tested for leaks using soapsuds. Be sure that all controls, relief valves or rupture discs that could be damaged by test pressure are removed before beginning pressure test.

F. Pressure tests on refrigeration piping and equipment shall be done in accordance with the American Standard Safety Code for Mechanical Refrigeration USAS B9.1-1953.

3.9 REFRIGERANT PIPING TESTING

A. Mechanical joints in refrigerant piping systems are unacceptable. All refrigerant piping joints shall be brazed. Use silver solder, minimum 15% silver content.

B. Piping shall be continuously purged with dry nitrogen while soldering. Care shall be taken when soldering near valves or other equipment that may be damaged by extreme heat.

C. Be sure that all controls, relief valves or rupture discs that could be damaged by test pressure are removed before beginning pressure test.

D. Prior to charging with refrigerant, piping shall be tested for leaks under 650 psi pressure using a mixture of 90% nitrogen and 10% hydrogen gas. All joints shall be tested for leaks using an electronic hydrogen leak detector. (WARNING! OXYGEN OR ACETYLENE SHALL NOT BE USED IN PLACE OF DRY NITROGEN. A VIOLENT EXPLOSION MAY RESULT!). Pressure and leak tests on refrigeration piping and equipment shall be done in accordance with local code requirements and the American Standard Safety Code for Mechanical
Refrigeration (ASA B9.1).

E. Precautions shall be taken to keep moisture out of the system and a drier shall be used.

F. After successful completion of pressure tests, the entire system shall be blown out and evacuated with a standard vacuum pump to remove all air and moisture. Three evacuations shall be required, and shall be down to 250 microns absolute pressure. Break the first two vacuums with dry nitrogen. Charge with refrigerant after third evacuation.

G. The contractor shall notify the Architect 48 hours prior to the time and date of the evacuation.

H. The refrigerant charge shall be calculated and weighed into the system.

I. Service technicians shall be certified in the use of CFC and HCFC refrigerant recovery and recycling equipment and shall use UL listed and labeled recovery equipment when discharging refrigerant.

3.10 CLEANUP

A. Upon completion of the work of this Section, remove all material, debris, and equipment associated with or used in the performance of this Work.

END OF SECTION
SECTION 23 05 00

GENERAL MECHANICAL

PART 1 - GENERAL

1.1 INCLUSION OF GENERAL CONDITIONS AND GENERAL REQUIREMENTS

A. The Contract Documents, including Bidding Requirements, Contract Forms, General Conditions, Supplemental General Conditions, and Division 01 Sections, General Requirements are a part of this Section and the Contract for this work and apply to this Section as fully as if repeated herein.

1.2 SUMMARY

A. The requirements of this Section apply to all work of Division 22 and Division 23.

B. Furnish and install any incidental work not shown or specified, which can be reasonably inferred as part of the work necessary to provide complete functional systems. When an item not shown or listed is clearly necessary for proper operation of equipment which is shown or listed, provide an item that will allow the system to function properly, at no increase in Contract Sum.

1.3 QUALITY ASSURANCE

A. Regulatory compliance: All work performed under Divisions 21, 22 & 23 shall comply with the latest currently adopted editions of all codes and regulations and all requirements of all Authorities having Jurisdiction. The following references and standards are hereby made a part of these sections and work shall conform to applicable requirements herein, except as otherwise specified herein or shown on the Drawings.

B. Codes, Standards: Conform to all applicable codes and standards as stated herein and as described in Division 01 of the Specifications, including the following:

1. American Gas Association (AGA)
2. American National Standards Institute (ANSI)
3. American Society of Mechanical Engineers (ASME)
4. American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE) Standards 55 and 62.1
5. American Society for Testing and Materials (ASTM)
6. California Building Code (CBC)
7. California Code of Regulations Titles 8, 17, 19, 20, 21 & 22
8. California Electric Code (CEC)
9. California Energy Conservation Code (Title 24)
10. California Fire Code (CFC)
11. California Mechanical Code (CMC)
12. CAL Green Building Standards
13. California Plumbing Code (CPC)
14. City Fire Marshal requirements
15. National Electrical Manufacturers Association (NEMA)
17. NSF/ANSI 61 Standard, Drinking Water System Components – Health Effects for fixture materials that will be in contact with potable water.
18. Office of Statewide Health Planning and Development (OSHPD)
19. Sheet Metal and Air Conditioning Contractors Nation Association (SMACNA) Standards
20. Underwriters Laboratories (UL)
21. Comply with all ADA requirements for disabled access.
22. Comply with the latest edition of all applicable standards, including AWWA, PDI and OSHA

C. Minimum requirements: The requirements of these are the minimum that will be allowed unless such requirements are exceeded by applicable codes or regulations, in which the regulatory codes or regulation requirements shall govern.

D. When the Contract Documents call for materials or construction of a higher standard than is required by the above, the Contract Document requirements shall take precedence over the requirements of the said laws, rules, and/or regulations, accepting that nothing in the Contract Documents shall be interpreted as permitting work in violation of said laws, rules, and/or regulations. The Contractor for this work shall furnish any additional materials and/or labor as may be required for compliance with these laws, rules, and/or regulations though such materials and/or labor are not specifically set forth in the Contract Documents, with no additional charges to Owner.
E. Seismic construction and restraints shall be in accordance with the requirements of Title 17 and Title 24 of the California Code of Regulations. All equipment mounts, isolators, and hanging systems must meet local authority approval requirements.

F. Comply with the Safety Orders issued by Cal-OSHA and any other regulations of the State of California and any districts having jurisdictional authority.

1.4 LICENSES, PERMITS, FEES

A. The Contractors for this Section of work shall provide, procure and pay for all licenses, permits, fees, etc. as required to carry on and complete their work.

1.5 LICENSING REQUIREMENTS

A. All work of Divisions 21, 22 and 23 shall be performed by an appropriately licensed contractor. The licenses shall be current, valid through the term of the contract and in the name of the contractor.

1. All HVAC work, which includes warm air heating systems and water heating pumps, ventilating systems, air conditioning systems, and ductwork, registers, flues, humidity, and thermostatic controls in connection with these systems, shall be performed by a C-20 - Warm-Air Heating, Ventilating and Air-Conditioning Contractor.

2. All Fire Protection work, which includes lay out, fabrication and installation of all types of fire protection systems; including all the equipment associated with these systems, excluding electrical alarm systems, shall be performed by a C-16 Fire Protection Contractor.

3. All plumbing systems shall be installed by a C-36 Plumbing Contractor. Plumbing systems include: waste removal and connection of on-site waste disposal systems; piping, storage tanks, and venting for supply of gases and liquids for any purpose; all gas appliances, flues, and gas connections; water and gas piping from the owner’s side of utility meter to the structure or fixed works; installation of any type of equipment to heat water or fluids to a suitable temperature; and maintenance and replacement of the items described above, including health and safety devices.

1.6 CONTRACT DRAWINGS

A. The Contract Drawings indicate diagrammatically the general layout of the mechanical systems and other related work. Field verification of scaled dimensions taken from the Drawings is required. The Contractors for the work shall review and compare the Architectural, Structural, Plumbing, Mechanical and Electrical Drawings and all Owner supplied equipment Drawings, and adjust their work to be in conformity with the conditions indicated thereon. Discrepancies between different Drawings, between
Drawings and actual field conditions, or between Drawings and Specifications, shall be brought to the attention of the Architect promptly for a determination of the modifications to be effected.

1.7 SUBMITTALS

A. General:

1. All submittals shall be in accordance with the requirements of the General Conditions and Division 01 Sections for Submittal Procedures and Product Requirements.

2. Before any fixtures, materials, or equipment are purchased, the Contractor shall submit to the Architect for approval, a complete list of materials, fixtures, and equipment, giving the manufacturers' names, catalog number, capacity, size, power requirements, and other pertinent data. Submittal lists and drawings shall be specifically applicable to this project, shall include identifying marks assigned by Specifications and Drawings, and shall not contain extraneous material or optional choices.

3. The Contractor shall submit for the approval of the Architect, shop drawings of proposed material and equipment that differ from the specified materials and equipment, and of any specified materials and equipment with special conditions and/or arrangements. These drawings shall show necessary modifications of Owner, plumbing, electrical and mechanical work required by the proposed materials and equipment.

4. Submittal of substitutions shall be limited to one (1) proposal for each type or kind of item, unless otherwise permitted by the Architect. If the first proposed product submittal is rejected, the Contractor shall then submit the first named or scheduled product.

5. Contractor shall make all necessary field measurements and investigations to assure that the equipment and assemblies will meet contract requirements. Review of drawings and other material submitted shall not be construed as a complete check or constitute a waiver of the requirements of the Drawings and Specifications, but will indicate that the material submitted is acceptable in quality and utility. This review shall not relieve the Contractor of the responsibility to fit the proposed materials to the spaces provided, and to effect necessary rearrangement or construction of other work.

1.8 WARRANTIES

A. Equipment warranties shall be provided for all equipment, with all necessary information filled in, except purchase date, in favor of the Owner.
1.9 DELIVERY, STORAGE, AND HANDLING

A. Contractor shall be responsible for delivery, storage, protection and placing of all equipment and materials.

1. Contractor shall protect the work and materials from damage during construction. Equipment stored at the jobsite shall be protected from dust, water or other damage, and be covered if equipment is exposed to weather. Protect interiors of new equipment and piping systems against entry of foreign matter. Clean both inside and outside before painting or placing equipment in operation.

2. Any items damaged shall be repaired or replaced, at no additional cost to the Owner.

B. Cleanliness of Piping and Equipment Systems:

1. Exercise care in storage and handling of equipment and piping material to be incorporated in the work. Remove debris arising from cutting, threading and welding of piping.

2. Piping systems shall be flushed, blown or pigged as necessary to deliver clean systems.

3. Contractor shall be fully responsible for all costs, damage, and delay arising from failure to provide clean systems.

1.10 COOPERATION WITH OTHER TRades

A. Cooperate fully with other trades doing work on the project as may be necessary for the proper completion of the project. Refer to the Structural, Plumbing, and Electrical Drawings for details of the building structure and equipment installation that will tend to overlap, conflict with, or require coordination with the work of this Section, and schedule this work accordingly.

B. Priority of right of way in space shall be as follows, in decreasing order of authority:

1. Electrical lights, electrical panels and drain piping.

2. Ductwork.

3. Fire protection piping, domestic hot water, domestic cold water and condenser water piping.

C. Any work done without regard for other trades shall be moved, replaced, or redone as required, without extra charges to Owner.

1.11 VERIFICATION OF EXISTING CONDITIONS AND DEMOLITION
A. Before installation of any new work, verify the location, size and other conditions at all points of connection to services or other existing piping, and at all locations where new work will cross or pass near existing piping, electrical, or other facilities.

B. Information shown relative to existing services is based upon available records and data during preparation of the Drawings, but shall be verified. Make reasonable deviations found necessary to conform with actual locations and conditions, without extra charge.

C. Remove piping, controls, fixtures, and equipment that is not to remain in service as shown on the Drawings or as required. This includes the removal of associated appurtenances and supports.

D. Patch, cap, or repair existing works affected by this demolition in concealed spaces within 6" of a live main or branch.

E. Deliver removed material to the Owner as directed by the Architect. Dispose of all other removed material offsite.

1.12 ACCURACY OF DATA

A. The data given herein and on the Drawings are as exact as could be reasonably secured, but absolute accuracy is not guaranteed. Exact locations, distances, elevations, etc. will be governed by shop drawings, the building itself, and actual field conditions.

1.13 UTILITY CONNECTIONS

A. Arrange for all utility connections, determine their exact requirements, and pay all costs incurred.

B. Send proper notices, make necessary arrangements, and perform other services required for care and maintenance of all utilities and assume all responsibility concerning same. Observe all rules and regulations of the respective utilities in executing the work.

1.14 DAMAGE BY LEAKS

A. Contractor shall be responsible for any damage to work of other Contractors that is caused by leaks in any temporary or permanent piping systems due to pipe rupture, disconnected pipes or fittings, or by overflow of equipment.

PART 2 - PRODUCTS

2.1 PRODUCTS CRITERIA

A. All materials, appliances, and equipment shall be new and best of their respective kinds, free from defects, and of the make, brand or quality specified or as accepted by the Architect.
B. Multiple Units: When two or more units of materials or equipment of the same type or class are required, these units shall be products of one manufacturer.

C. Apply and install all items in accordance with the manufacturer’s written instructions. Refer conflicts between the manufacturer’s instructions and the contract drawings and specifications to the Architect for resolution.

D. All fixtures, materials, and equipment equal in quality and utility to these herein mentioned will be accepted. When specific names are used in describing fixtures, materials, and equipment they are mentioned as standards only, but this implies no right on the part of the Contractor to use other fixtures, materials and equipment, or methods, unless approved as equal in quality and utility by the Architect. The decision of the Architect shall govern as to what fixtures, materials, and equipment are equals to those mentioned, but the burden of proof as to the quality of any proposed fixtures, materials, or equipment shall be upon the Contractor. If any tests are necessary to determine the quality of proposed fixtures, materials, or equipment, an unbiased laboratory shall make such tests at the expense of the Contractor satisfactory to the Architect.

2.2 SEISMIC FORCE RESISTANCE: MECHANICAL, PLUMBING


B. Equipment:

1. Each piece of equipment installed under this Section shall be constructed and anchored to structural supports to resist a seismic force and displacement in accordance with CBC Section 1616A.1.17 through 1616A.1.26 and ASCE 7-10 Chapter 13, Sections 13.1 – 13.4 & 13.6. Supports, anchors and braces shown shall be minimum.

2. Equipment manufacturer shall construct and certify that his equipment satisfies the special minimum seismic resistance requirements.

C. Piping:

1. Flexibility of piping systems must be maintained by the use of flexible devices at critical points at junctions of separate building structures. Braces or anchors shall be designed to damp oscillations or check excessive movement. Flexible devices for piping of gas shall be loops or offsets. Flexible devices for other piping may be loops, Victaulic grooved, or roustabout couplings.

2. Piping at tops and bottoms of risers are critical points where flexibility is required, as well as at changes in direction on long runs of piping 4” and larger.
3. Tops of risers shall be restrained from motion in horizontal direction, and midpoints shall be anchored in all directions.

4. All piping systems bracing shall be designed to resist a seismic force and displacement in accordance with CBC Section 1615A1.12 through 1615A.1.22 and ASCE 7-10 Section 13.6.8 & 13.6.9.

5. The following table shows maximum lengths of shapes used for sway bracing:

<table>
<thead>
<tr>
<th>TYPE/SIZE</th>
<th>MAX. LENGTH (l/r=200)</th>
<th>TYPE/SIZE</th>
<th>MAX. LENGTH (l/r=200)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Angle</td>
<td>4'-10&quot;</td>
<td>Flat Bar</td>
<td>1'-2&quot;</td>
</tr>
<tr>
<td>1½ x 1½ x ⅜&quot;</td>
<td></td>
<td>1½ x ⅛&quot;</td>
<td></td>
</tr>
<tr>
<td>2 x 2 x ¼&quot;</td>
<td>6'-6&quot;</td>
<td>2 x ⅛&quot;</td>
<td>1'-2&quot;</td>
</tr>
<tr>
<td>2½ x 2½ x ⅜&quot;</td>
<td>8'-2&quot;</td>
<td>2 x ⅜&quot;</td>
<td>1'-9&quot;</td>
</tr>
<tr>
<td>3 x 3 x ¾&quot;</td>
<td>9'-10&quot;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Threaded Rod</td>
<td></td>
<td>Pipe (Schedule 40)</td>
<td></td>
</tr>
<tr>
<td>⅛&quot;</td>
<td>1'-7&quot;</td>
<td>1&quot;</td>
<td>7'-0&quot;</td>
</tr>
<tr>
<td>⅜&quot;</td>
<td>2'-1&quot;</td>
<td>1¼&quot;</td>
<td>9'-0&quot;</td>
</tr>
<tr>
<td>¾&quot;</td>
<td>2'-7&quot;</td>
<td>1½&quot;</td>
<td>10'-4&quot;</td>
</tr>
<tr>
<td>1&quot;</td>
<td>3'-1&quot;</td>
<td>2&quot;</td>
<td>13'-1&quot;</td>
</tr>
</tbody>
</table>

2.3 HANGERS, SUPPORTS

A. Pipe supports shall be manufactured by Thomas & Betts, “Superstrut” or equivalent Cooper B-Line, Nibco (Toilco), or Anvil International.

B. All hangers shall be electro-chromate finished. Hanger rods shall have electro-galvanized finish.

C. Copper tubing:
   1. C-711 copper tube hanger complete with C-716 isolator.
   2. Copper pipe shall be attached to channels with A-716 “Cush-A-Clamp”.

D. Insulated pipe:
   1. C-711 pipe hanger fitted to outside of insulation with C-790 galvanized shields.

E. Trapeze hangers:
   1. Grouped pipes may be supported by A-1200 channel bolted to rods.
F. Point of support connectors:

1. Wood construction:
   a. Stationary pipes: 540 side beam hanger
   b. Pipes subject to movement: 5541


4. Steel beams: Series 500 beam brackets.

5. Plywood decks: machine bolts, nuts and washers.

G. Vertical pipe risers:

1. Vertical pipe risers shall be securely supported with C-720 pipe clamps anchored to construction.

2. C-720P for bare cold water pipe, anchored to construction.

H. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.

I. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.

J. Strap and Rod Sizes: Comply with SMACNA’s "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."

K. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.

L. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

M. Trapeze and Riser Supports:


3. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.
N. Pipes through studs or joists shall be isolated from structure with properly sized Hubbard "Hold-Rite" suspension clamps or LSP “Acousto-Plumb” system.

2.4 PIPE LABELS

A. Brady, Seton or approved equal pipe labels. Preprinted, color-coded, with lettering indicating service, and showing flow direction.

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

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

D. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.


1. For pipes or covering with outside diameter ¼ to 1¼ inch, minimum length of label: 8 inches, minimum height of letters: ½ inch.

2. For pipes or covering with outside diameter 1½ to 2 inches, minimum length of label: 8 inches, minimum height of letters: ¾ inch.

3. For pipes or covering with outside diameter 2 ½ to 6 inches, minimum length of label: 12 inches, minimum height of letters: 1¼ inch.

4. For pipes or covering with outside diameter 8 to 10 inches, minimum length of label: 24 inches, minimum height of letters: 2½ inches.

5. For pipes or covering with outside diameter over 10 inches, minimum length of label: 32 inches, minimum height of letters: 3½ inches.

2.5 ELECTRICAL MOTORS

A. With exception of motors in AGA or UL labeled equipment, motors for HVAC blowers and fans, pumps, and other general purpose applications using an adjustable speed drive shall be Baldor Premium Efficient Super-E®, three phase, foot mounted, Class H insulated motor with AEGIS shaft grounding ring installed internally, regreaseable ball bearings, dynamically balanced rotors.

B. Motors shall be certified for quiet operation and shall bear a label so stating. Motors shall be drip-proof frame, 1.15 minimum service factor in 40°C, ambient windings specially impregnated and epoxy coated for outdoor service.
C. Torque characteristics of motors shall be as required to accelerate machine to 100% full load speed within 10 seconds. Motors shall be dynamically balanced to maximum deflection as follows:

1. 15 HP and larger: 0.0003 inches.

2. 10 HP and smaller: 0.0002 inches.

D. Motors shall be Inverter duty, meet NEMA MG-1 and part 30 and 31, and shall be guaranteed to satisfactorily operate at ± 10% voltage shown on Drawings. Transformers of adequate capacity shall be provided if necessary to satisfy this requirement.

E. All 3-phase motors shall be provided with phase and brown-out protection to shut down all motors in the unit if the phases are more than 10% out of balance on voltage or the voltage is more than 10% under design voltage.

F. Fractional horsepower fan motors (¼ hp, ½ hp, ¾ hp) shall be Greenheck Vari-Green series motors, DC electronic commutation type, specifically designed for fan applications. Motors shall be permanently lubricated with heavy duty ball bearings to match the fan load and pre-wired to the specific voltage and phase. Internal motor circuitry shall convert AC power supplied to the fan to DC power to operate the motor. Motor shall be controllable down to 20% of full speed (80% turndown). Speed shall be controlled by either a potentiometer dial mounted at the motor or by a 0-10 VDC signal. Motor shall be a minimum of 85% efficient at all speeds.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Provide all necessary cutting in connection with the work of this Section. No cutting shall be done without the approval of the Architect. Comply with requirements specified in Cutting and Patching Section.

B. No structural members shall be drilled, bored, or notched in a manner that will impair their structural capacity.

C. All penetrations of concrete or masonry shall be made with core drills.

3.2 EQUIPMENT

A. Equipment shall operate quietly and without objectionable vibration. Such problems, other than from equipment operating at optimum conditions, shall be the Contractor’s responsibility and shall be eliminated at the direction of the Architect.

B. Install equipment to provide good appearance, easy access, and adequate space to allow replacement and maintenance. Provide bases, supports, anchor bolts, and other items
required to achieve this. Installation shall be level, above moisture level, and adequately braced.

C. Extend ¼” schedule 40 black steel lubrication pipes from hard-to-reach locations to front of equipment or to access doors. Terminate with proper lubrication fittings.

D. Move equipment into building through available openings. Dismantle equipment where necessary to accomplish this. After reassembly, test equipment to verify its satisfactory operating condition.

E. Thoroughly lubricate equipment before operating. Repair of damage resulting from failure to comply with this requirement shall be the Contractor’s responsibility.

F. Connections to piping shall be secured and properly aligned and all utility and control connections shall be properly isolated from the building structure by means of vibration isolators and flexible connections. Any equipment not meeting this requirement will be modified and properly reinstalled at no expense to the Owner.

3.3 MECHANICAL SERVICES

A. Terminals and services weighing no more than 20 pounds, may be supported directly on the runners of a heavy duty grid system but, in addition, they must have a minimum of (2) #12 gage slack safety wires attached at diagonally opposite corners and anchored to the structure above.

3.4 CONCRETE EQUIPMENT BASES

A. Concrete work that is part of the mechanical installations, as such is shown and/or detailed on the Drawings, shall conform to the requirements of the Concrete Section of these Specifications.

B. Bases shall be neatly finished, have rounded corners and smooth trowel finish.

3.5 ELECTRICAL REQUIREMENTS

A. Electrical work in this Section shall conform to the requirements of Division 26. Equipment shall conform to the standards of the National Electric Manufacturer's Association. Electrical equipment shall bear the label of Underwriters' Laboratories, Inc., where examination and listing service is available for such materials. Motors and motor control equipment shall be as specified below.

1. The work shall include the furnishing of:
   a. Motor controls mounted as integral part of equipment assemblies.
   b. Pre-wired control panels as described and shown.
c. Electronic control panels and their components.

d. Wiring for low voltage controls and "interlock work" except where specifically shown otherwise.

2. Installing of:

a. All motors.

b. All control panels and their components.

c. Low voltage wiring, line voltage "interlock" wiring, control wiring for safety devices, alarms, and refrigeration.

B. Wiring includes all connections to devices, and all wiring shall be installed in conduit.

1. Conduit fittings and devices shall be as specified in the basic electrical materials section of Division 26 - Electrical.

2. Line voltage work (in equipment assemblies) shall be as specified in Division 26 - Electrical.

3. Devices shall be installed in NEMA enclosures of type required for location.

a. Flush enclosures: Keystone "Telephone Cabinets" type PF with pull box knockouts.

b. Surface enclosures: Keystone LJC.

C. Electrical Controls:

1. Submit shop-wiring diagrams of temperature controls and air conditioning unit controls for approval. Furnish approved wiring diagrams and assistance to Electrician.

2. Refer to Electrical, Fire Protection, Plumbing and Mechanical documents for work and devices required. All wiring required by plumbing and heating, ventilating and air conditioning work shall be performed by the Controls Contractor.

D. The following work will be furnished and installed under the Electrical Section of these Specifications:

1. Disconnect switches, remote switches, motor starters, relays and test switches not mounted as integral part of equipment assemblies or in temperature control panels.
2. All line voltage controls and interlocks, all other controls, circuits from electric panel board to disconnect switches, starters, motors, switches and/or other motor controls, to temperature controls and safety devices.

3.6 PAINTING

A. Properly prepare work under this Section to be painted under Painting Section, except preservative and special painting as described herein.

B. Priming as required herein, shall conform to Painting Section requirements and be of a material compatible with paint for finish painting.

C. All equipment and materials shall be cleaned of grease, wax, oil, rust or dirt in preparation for finish painting. Any prime coated surfaces showing signs of rust before being finish painted shall be thoroughly cleaned and a new prime coat applied.

D. Prime paint both sides of flashings prior to installation.

E. Furnish can of touch-up paint with each factory finished piece of equipment.

F. Paint all piping in mechanical rooms. Color as selected by the Architect.

G. Black steel piping exposed to the environment shall be painted with rust-inhibiting paint. Color as selected by Architect.

3.7 IDENTIFICATION OF SYSTEMS

A. Piping

1. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:

a. Adjacent to all valves and flanges

b. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.

c. At both sides of wall, or floor penetrations.

d. Near penetrations through ceilings, and inaccessible enclosures.

e. Adjacent to changes in direction.

f. At access doors, manholes, and similar access points that permit view of concealed piping.
g. Near major equipment items and other points of origination and termination.

h. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.

i. On piping above removable acoustical ceilings. Omit intermediately spaced labels.

2. All piping shall be identified.

   
a. Potable, Cooling, Boiler Feed and other Water Piping:
      1) Background Color: Green.

b. Fire Quenching Fluids:
      1) Background Color: Red.

c. Toxic and Corrosive Fluids
      1) Background Color: Orange.
      2) Letter Color: Black

d. Combustible Fluids:
      1) Background Color: Brown.
      2) Letter Color: White

e. Flammable Fluids:
      1) Background Color: Yellow.
      2) Letter Color: Black.

B. Valves

1. For identification and Owner's maintenance records, all valves shall be numbered and identified with clearly stamped 1¼" diameter brass tags, in accordance with drawings and service performed.
2. Control valves shall be also marked whether normally open (N.O.) or normally closed (N.S.).

3. Affix Underwriter’s standard porcelain enameled identification signs to all fire protection sprinkler control valves, drain valves, and flow switches.

C. Equipment

1. All equipment shall be labeled with 1” high stencils showing identifying mark noted on drawings, and usage.

2. Warning signs shall be placed on machines driven by electrical motors that are controlled by fully automatic starters, per California Code of Regulations, Title 8, Subchapter 7 - General Industry Safety Orders, Article 7, Section 3320.

D. A typewritten schedule of all stencils and valve tags used, with identification, shall be framed and posted in mechanical rooms, at locations as directed.

3.8 INSTALLATION, HANGERS & SUPPORTS

A. Installation of piping shall be such that damage cannot result through loading, expansion or contraction of piping. Anchors shall be installed to obtain uniformity of pipe movement.

B. Hanger rod sizes shall be no smaller than 3/8-inch for pipe and tube sizes ½ to 4 inches and ½ inch for sizes 5 - 8 inches.

C. Pipe supports shall be spaced sufficiently close to support pipes properly without formation of pockets. Hangers shall be installed at ends of mains and branches. Maximum horizontal support spacing shall be as follows:

1. Steel Pipe for water or DWV: 10 feet for pipe sizes ¾ inch and smaller and 12 feet for sizes 1 inch and larger

2. Copper Tube and Pipe, soldered or brazed: 6 feet for pipe sizes 1 ½ inches and smaller and 10 feet for sizes 2 inches and larger.

3. Hubless Cast-Iron shall be supported at every other joint, unless over 4 feet, then support each joint. Support adjacent to joint, not to exceed 18 inches, brace at not more than 40 foot intervals to prevent horizontal movement. Support at each horizontal branch connection. Hangers shall not be placed on the coupling.

D. Provide resilient mounting for domestic water piping. Thermal insulation may serve as resilient mounting for insulated piping.

E. Suspended water piping shall be anchored with steel struts installed at midpoint of each run.
F. No valve or piece of equipment shall be used to support piping.

G. Pipes through studs or joists shall be isolated from structure with properly sized Hubbard "Hold-Rite" suspension clamps.

3.9 INSTALLATION, PIPING

A. Rough in shall proceed as rapidly as general construction will permit. All rough-in shall be complete, at locations verified by Architect and Owner, and tested and inspected prior to installation of concrete, lath, plaster, gypsum wallboard, or other finishes.

B. All piping shall be concealed in finished rooms, installed in furred walls and partitions. Where furred or suspended ceilings occur, piping shall be installed in the concealed space at points adjacent to beams and/or other structural members, and coordinated with ductwork and equipment. Where exposed piping occurs, it shall be installed parallel to or at right angles to building walls, unless specifically shown otherwise on the Drawings.

C. Installation of piping shall be such that damage cannot result, through thermal expansion or contraction, to piping, building, or pipe hangers and supports. Anchors shall be installed at midpoints of all runs in main piping for the purpose of localizing pipe expansion or prevention of creepage.

D. All pipe lines shall be installed free from traps and air pockets, true to line and grade, with suitable supports properly spaced. All piping shall be installed without undue stresses and with provision for expansion and contraction.

E. All piping shall be new and free from foreign substances. American standard pipe threads shall be used for IPS threaded work. Joints in threaded piping shall be made up with Teflon tape applied to the male threads only. No screwed pipe joints shall be caulked or packed with rope or other packing materials. Pipe shall be free from tool marks, threads cut accurately with not more than two (2) threads showing beyond fitting. Friction wrenches shall not be used with plated, polished, or soft metal piping. All changes in pipe size shall be made with reducing fitting. Bushings will not be permitted.

F. Protect unattended openings in piping during construction.

G. Weld all pipe 2.5 inches and larger. Use the following procedure. All welders must be AWS certified. AWS B2.1 SMAW 6G Pipe Welding Procedure Specifications

| Welding process: | SMAW | Grove Angle: | 60 degrees |
| Weld Progression: | Up | Thickness (pipe/tube): | Groove (in) .280 |
| Backing: | No | Notes: | Sch. 40 Pipe |
| Current/Polarity: | DCEP | Filler Metal Class: | E6010Rt/E7018F1 |
| Root Opening: | 1/16 to 1/8 | Other Filler Metal Class: | Rt. 1/8, 3/32 Filler |
H. Welded joints shall be beveled and butt-welded. Reductions of pipe shall be made with forged steel welding fittings. Branch reductions of two or more pipe sizes smaller than the main, may be Bonney "Weld-O-Let" fittings, or equal. Job fabricated reductions and branches shall not be used. All pipe burrs shall be reamed out. Welding rods shall be as follows, or approved equal:

<table>
<thead>
<tr>
<th>Pipe Size</th>
<th>Arc Welding</th>
<th>Gas Welding</th>
</tr>
</thead>
<tbody>
<tr>
<td>2&quot; and larger</td>
<td>Fleetweld #5</td>
<td>Oxweld #1 or Page Hi-Test M</td>
</tr>
<tr>
<td>1(\frac{1}{2})&quot; and smaller</td>
<td>None</td>
<td>Oxweld #1 or Page Hi-Test M</td>
</tr>
</tbody>
</table>

I. No water or drainage piping shall pass over electrical equipment unless adequate protection is provided to prevent damage by leaks or condensation.

J. All copper tubing shall be formed in a workmanlike manner, in accordance with the Pipe and Tube Bending Handbook of the Copper and Brass Research Association. A tube bender giving support to the periphery of the tube shall be used. The tubing shall be protected against flattening or other injury.

K. All copper connections and joints shall be made in accordance with the Copper Tube Handbook, Copper and Brass Research Association. No swaged connections will be permitted. All valves, pumps, and similar equipment shall be connected to copper piping through union or flange adapter fittings.

L. All underground hydronic piping shall be installed per manufacturer’s installation instructions. Provide protection of piping from damage due to expansion. Provide thrust blocks where required as indicated by the manufacturers installation instructions.

M. Install air vents at all water piping high points when direction of flow is downward.

N. Install sediment drain faucets at all low points.

O. Valves, cocks, etc., shall be installed to allow convenient accessibility and operation.

P. Unions and flanges shall be installed to allow convenient replacement of all equipment and cleaning tubes.

Q. A union connection shall be installed downstream from all valves, at equipment connections and at other locations as required or directed.

R. Shut off valves shall be provided in all main services, and where required to permit proper servicing of equipment. Valves of one type shall be of one manufacturer.

S. All valves shall be of the same size as the pipelines in which they are installed, unless specifically sized on the Drawings. All hand controlled line valves shall be ball valves, except where throttling control or frequent operation is required, in which case globe or angle valves shall be used. Globe valves in horizontal lines shall be installed with stem in horizontal to permit line draining. All globe and angle valves shall be installed to close
against pressure. Disc valves shall have discs suitable for the services for which they are to be used.

T. All valves shall be accessible and shall not be installed with the stems below the horizontal plane. Provide access panels at walls, ceilings, or floors.

U. Provide prime coated escutcheon plates at all points where exposed piping penetrates finished wall ceilings or floors.

V. Cutting or boring of joists or other structural members shall be done only when alternative routing is impossible and only upon written approval of the Architect or Owner.

3.10 CLEANING OF PIPING

A. All new piping shall be thoroughly cleaned of rust, scale, etc., prior to enclosing and placing in operation. Water shall be forced through pipes until the systems are free from foreign substances.

3.11 CLEANUP

A. Upon completion of the work of this Section, remove all material, debris, and equipment associated with or used in the performance of this work.

END OF SECTION
SECTION 23 0593
TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Balancing Air Systems

2. Additional Tests
   a. Sound testing
   b. Vibration testing
   c. Duct leakage testing

1.3 SCOPE

A. The T&B Agency will provide the following services:

1. Provide all supervision, personnel, instruments, calibration equipment, and all other materials necessary to perform balancing and testing, and compile test data including calculations and services necessary for the heating, ventilating, and air conditioning systems for this project, all in accordance with the project Drawings and Specifications and as specified herein.

2. The T&B Agency shall be responsible for inspecting, balancing, adjusting, testing, and logging the data of the performance of fans, all dampers in the duct systems, all air distribution devices or heat exchangers, and the flows of water through all coils.

3. The T&B Agency shall balance, test, and adjust the systemic components to obtain optimum conditions in each conditioned space in the building. If construction deficiencies are encountered which preclude obtaining optimum conditions, the deficiencies will be recorded and given to the Owner's Representative. The T&B Agency is advised that deficiencies in the HVAC construction are often encountered during final T&B services, and should include in the bid an amount deemed advisable to compensate for time in identifying the deficiencies.

B. During construction, the T&B Contractor shall inspect the installation of pipe systems, sheet metal work, temperature controls, and other component parts of the HVAC systems. Inspections shall be conducted a minimum of three times. Typically this is performed when 60% of the ductwork and
piping are installed and again when 90% of the total system is installed and prior to insulation. A copy of the written report is to be issued to the Mechanical Engineer for review.

1.4 SUBMITTALS


B. System Readiness Checklists: Within 30 days of Contractor’s Notice to Proceed, submit system readiness checklists for use by systems installers in verifying system readiness for T&B. Examination Report: Within 30 days of Contractor’s Notice to Proceed, provide a summary report of the examination review required in Part 3 “Examination”, if issues are discovered that may preclude the proper testing and balancing of the systems.

C. Examination Report: Provide a summary report of the examination review if issues are discovered that may preclude the proper testing and balancing of the systems.

D. Certified T&B reports: Within 30 days of completion of balancing work, submit AABC-certified T&B report.

1. Submit one copy of the final T&B Report directly to the design professional of record. Provide three additional copies to the contractor.

1.5 QUALITY ASSURANCE

A. T&B Contractor Qualifications:

1. General Contractor will employ a T&B Agency that is certified by the Associated Air Balancing Council (AABC). The T&B Agency will have experience in the field of air system balancing, possess calibrated instruments, and employ qualified Supervisors and skilled Technicians to perform all required tests. The T&B Agency shall have a minimum of ten (10) years experience in the Testing, Adjusting, and Balancing field.

B. T&B technician shall perform the following:

1. Review field data reports to validate accuracy of data and to prepare certified T&B reports.

2. Certify that the T&B team complied with the approved T&B plan and the procedures specified and referenced in this Specification.

3. Certify the T&B report

C. T&B Conference: If requested by the Owner or Construction Manager after approval of the T&B Agency’s submittals, meet to develop a mutual understanding of the details

1. Agenda Items:

a. The examination report.

b. The Strategies and Procedures plan.
c. Systems readiness checklists.
d. Coordination and cooperation of trades and subcontractors.
e. Coordination of documentation and communication flow.

D. Approved Test and Balance agencies in the area:

**RS Analysis, Inc.**
1035 Suncast Lane, Suite 130
El Dorado Hills, CA 95762
(916) 358-5672

**National Air Balance Company, Inc.**
4171 Business Center Drive
Fremont, CA 94538
(510) 623-7000

**Raglen System Balance, Inc.**
1121 University Terrace
Reno, NV 89502
(775) 747-0100

**Pacific Test & Balance, Inc.**
724 California Blvd.
Napa, CA 94559
(707) 696-2444


F. Instrumentation Type, Quantity, Accuracy, and Calibration: As described in “AABC National Standards for Total Systems Balance.”

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 CONTRACTOR RESPONSIBILITIES

A. Provide T&B agency one complete set of contract documents, change orders, and approved submittals in digital and hard copy formats. Project Schedule and Mechanical Contractor’s Shop Drawings and Temperature Control Drawings shall be provided as issued or received.

B. Controls contractor shall provide required BAS hardware, software, personnel and assistance to T&B agency as required to balance the systems. Controls contractor shall also provide trending report to demonstrate that systems are complete.

C. Coordinate meetings and assistance from suppliers and contractors as required by T&B agency.

D. Provide additional valves, dampers, sheaves and belts to properly test and balance, which shall be installed by the Mechanical Contractor as directed by T&B agency, at no additional cost to owner.
E. Mechanical Contractor shall install test holes where indicated by the T&B Agency. Test holes shall be complete with removable and replaceable plugs.

F. Flag all manual volume dampers with fluorescent or other high-visibility tape.

G. Provide access to all dampers, valves, test ports, nameplates and other appurtenances as required by T&B agency.

H. Replace or repair insulation as required by T&B agency.

I. Have the HVAC systems at complete operational readiness for T&B to begin. As a minimum verify the following:
   1. Airside:
      a. All ductwork is complete with all terminals installed.
      b. All volume, smoke and fire dampers are open and functional.
      c. Clean filters are installed.
      d. All fans are operating, free of vibration, and rotating in correct direction.
      e. VFD start-up is complete and all safeties are verified.
      f. System readiness checklists are completed and returned to T&B agency.

J. Promptly correct deficiencies identified during T&B.

K. Maintain a construction schedule that allows the T&B agency to complete work prior to occupancy.

L. Before testing or balancing is started, the Mechanical Contractor shall adjust belts and sheaves; align all parts; oil and grease bearings in accordance with manufacturer’s instructions; clean exterior surfaces of coil tubes and fins; flush interior of coil tubes, pull until clean; and check mixing damper operation to insure free operation and activation by the correct thermostat.

M. The Mechanical Contractor shall be responsible for certifying in writing that the system, as scheduled for balancing, is operational and complete. Completeness shall include not only the physical installation, but the Mechanical Contractor’s certification that the prime movers are installed in good working order, and that full load performance has been preliminary tested under the certification of the Mechanical Contractor. Before any testing and balancing is started, a complete report shall be sent to the T&B Agency by the Mechanical Contractor.

N. The Mechanical Contractor shall be responsible for making all modifications to rectify discrepancies reported by the T&B Contractor as indicating non-compliance with the Contract Documents. By completing the work on time, the Mechanical Contractor shall provide sufficient time before the completion date so that balancing can be accomplished.

3.2 EXAMINATION & REVIEW

A. Review the Contractor shop drawing submittals for their effect on the test and balance process and overall performance of the HVAC system. Submit recommendations for enhancements or changes to the system.
B. Review location and type of volume damper inlet conditions to air terminals, air valves, and HVAC equipment.

C. Review location, type, and size of balancing valves, flow metering stations, and automatic control valves in the water flow station.

D. Review location of pressure sensors in the air and water distribution system.

E. Review automatic control systems as they affect the test and balance procedure.

F. Review sheet metal and piping shop drawings to verify the installation of flow control devices.

G. Examine systems for installed balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Note the locations of devices that are not accessible for testing and balancing.

H. Review the approved submittals for HVAC systems and equipment.

I. Examine ceiling plenums and underfloor air plenums used for supply, return, or relief air to verify that they are properly separated from adjacent areas.

J. Review equipment performance data including fan and pump curves.

K. Examine HVAC equipment and verify that bearings are greased, belts are aligned and tight, clean permanent filters are installed, and controls are ready for operation.

L. Examine two-way valves for proper installation and function.

M. Examine three-way valves for proper installation for their intended function of diverting or mixing fluid flows.

N. Examine heat-transfer coils for correct piping connections and for clean and straight fins.

3.3 PREPARATION

A. Prepare a T&B plan that includes:
   1. Equipment and systems to be tested.
   3. Instrumentation to be used.
   4. Sample forms with specific identification for all equipment.

B. Prepare system-readiness checklists, as described in the AABC National Standards for Total System Balance, for use by contractors in verifying system readiness for T&B. These shall include, at a minimum:
   1. Airside:
a. All ductwork is complete with all terminals installed.
b. All volume, smoke and fire dampers are open and functional.
c. Clean filters are installed.
d. All fans are operating, free of vibration, and rotating in correct direction.
e. VFD start-up is complete and all safeties are verified.
f. Automatic temperature-control systems are operational.
g. Ceilings are installed.
h. Windows and doors are installed.
i. Suitable access to balancing devices and equipment is provided.

3.4 GENERAL PROCEDURES FOR TESTING AND BALANCING

A. Perform testing and balancing procedures on each system according to the procedures contained in AABC's "National Standards for Total System Balance" and in this Section.

B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary for T&B procedures.

C. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.

D. Take and report testing and balancing measurements in inch-pound (IP) units.

3.5 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

A. Prepare test reports for both fans and outlets. Obtain approved submittals and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.

B. Prepare single-line schematic diagram of systems for the purpose of identifying HVAC components.

C. For variable-air-volume systems, develop a plan to simulate diversity.

D. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.

E. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.

F. Verify that motor starters are equipped with properly sized thermal protection.

G. Check condensate drains for proper connections and functioning.

H. Check for proper sealing of air-handling-unit components.

3.6 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS
A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.

1. Measure total airflow.
   a. Set outside air, return air and relief air dampers for proper position that simulates minimum outdoor air conditions.
   b. Where duct conditions allow, measure airflow by Pitot-tube traverse. If necessary, perform multiple Pitot-tube traverses to obtain total airflow.
   c. Where duct conditions are not suitable for Pitot-tube traverse measurements, a coil traverse may be acceptable.
   d. If a reliable Pitot-tube traverse or coil traverse is not possible, measure airflow at terminals and calculate the total airflow.

2. Measure fan static pressures as follows:
   a. Measure static pressure directly at the fan outlet or through the flexible connection.
   b. Measure static pressure directly at the fan inlet or through the flexible connection.
   c. Measure static pressure across each component that makes up the air-handling system.
   d. Report any artificial loading of filters at the time static pressures are measured.

3. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.

B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows.

1. Measure airflow of submain and branch ducts.

2. Adjust sub-main and branch duct volume dampers for specified airflow. Re-measure each sub-main and branch duct after all have been adjusted.

C. Adjust air inlets and outlets for each space to indicated airflows.

1. Set airflow patterns of adjustable outlets for proper distribution without drafts.

2. Measure airflow at all inlets and outlets.

3. Adjust each inlet and outlet for specified airflow.

4. Re-measure each inlet and outlet after all have been adjusted.

D. Verify final system conditions.
1. Re-measure and confirm minimum outdoor air, return and relief airflows are within design. Readjust to design if necessary.

2. Re-measure and confirm total airflow is within design.

3. Re-measure all final fan operating data, rpms, volts, amps, static profile.

4. Mark all final settings.

5. Test system in economizer mode. Verify proper operation and adjust, if necessary.

6. Measure and record all operating data.

E. Record final fan-performance data

3.7 PROCEDURES FOR VARIABLE-AIR-VOLUME SYSTEMS

A. Adjust the variable-air-volume systems as follows:

1. Verify that the system static pressure sensor is located 2/3 of the distance down the duct from the fan discharge.

2. Verify that the system is under static pressure control.

3. Select the terminal unit that is most critical to the supply-fan airflow. Measure inlet static pressure, and adjust system static pressure control setpoint so the entering static pressure for the critical terminal unit is not less than the sum of the terminal-unit manufacturer’s recommended minimum inlet static pressure plus the static pressure needed to overcome terminal-unit discharge system losses.

4. Calibrate and balance each terminal unit for maximum and minimum design airflow as follows
   a. Adjust controls so that terminal is calling for maximum airflow (note some controllers require starting with minimum airflow. Verify calibration procedure for specific project).
   b. Measure airflow and adjust calibration factor as required for design maximum airflow. Record calibration factor.
   c. When maximum airflow is correct, balance the air outlets downstream from terminal units.
   d. Adjust controls so that terminal is calling for minimum airflow.
   e. Measure airflow and adjust calibration factor as required for design minimum airflow. Record calibration factor. If no minimum calibration is available, note any deviation from design airflow.
   f. When in full cooling or full heating, ensure that there is no mixing of hot deck and cold deck airstreams unless so designed.
On constant volume terminals, in critical areas where room pressure is to be maintained, verify that the airflow remains constant over the full range of full cooling to full heating. Note any deviation from design airflow or room pressure.

5. After all terminals have been calibrated and balanced, test and adjust system for total airflow. Adjust fans to deliver total design airflows within the maximum allowable fan speed listed by fan manufacturer.
   a. Set outside air, return air and relief air dampers for proper position that simulates minimum outdoor air conditions.
   b. Set terminals for maximum airflow. If system design includes diversity, adjust terminals for maximum and minimum airflow so that connected total matches fan selection and simulates actual load in the building.
   c. Where duct conditions allow, measure airflow by Pitot-tube traverse. If necessary, perform multiple Pitot-tube traverses to obtain total airflow.
   d. Where duct conditions are not suitable for Pitot-tube traverse measurements, a coil traverse may be acceptable.
   e. If a reliable Pitot-tube traverse or coil traverse is not possible, measure airflow at terminals and calculate the total airflow.

6. Measure fan static pressures as follows:
   a. Measure static pressure directly at the fan outlet or through the flexible connection.
   b. Measure static pressure directly at the fan inlet or through the flexible connection.
   c. Measure static pressure across each component that makes up the air-handling system.
   d. Report any artificial loading of filters at the time static pressures are measured.

7. Set final return and outside airflow to the fan while operating at maximum return airflow and minimum outdoor airflow.
   a. Balance the return-air ducts and inlets the same as described for constant-volume air systems.
   b. Verify all terminal units are meeting design airflow under system maximum flow.

8. Re-measure the inlet static pressure at the most critical terminal unit and adjust the system static pressure setpoint to the most energy-efficient setpoint to maintain the optimum system static pressure. Record setpoint and give to controls contractor.

9. Verify final system conditions as follows:
   a. Re-measure and confirm minimum outdoor air, return and relief airflows are within design. Readjust to design if necessary.
   b. Re-measure and confirm total airflow is within design.
   c. Re-measure all final fan operating data, rpms, volts, amps, static profile.
   d. Mark all final settings.
e. Test system in economizer mode. Verify proper operation and adjust, if necessary. Measure and record all operating data.

f. Verify tracking between supply and return fans.

3.8 FINAL TEST AND BALANCE REPORT

A. The report shall be a complete record of the HVAC system performance, including conditions of operation, items outstanding, and any deviations found during the T&B process. The final report also provides a reference of actual operating conditions for the owner and/or operations personnel. All measurements and test results that appear in the reports must be made on site and dated by the AABC technicians or test and balance engineers.

B. The report must be organized by systems and shall include the following information as a minimum:

1. Title Page:
   a. AABC certified company name
   b. Company address
   c. Company telephone number
   d. Project identification number
   e. Location
   f. Project Architect
   g. Project Engineer
   h. Project Contractor
   i. Project number
   j. Date of report
   k. AABC Certification Statement
   l. Name, signature, and certification number of AABC TBE

2. Table of Contents.

3. AABC National Performance Guaranty.

4. Report Summary:
   a. The summary shall include a list of items that do not meet design tolerances, with information that may be considered in resolving deficiencies.

5. Instrument List:
   a. Type.
   b. Manufacturer.
   c. Model.
   d. Serial Number.
6. T&B Data:
   a. Provide test data for specific systems and equipment as required by the most recent edition of the "AABC National Standards."

C. One copy of the final test and balance report shall be sent directly to the Mechanical Engineer of record. Provide five additional copies to the contractor.

3.9 ADDITIONAL TESTS

A. Duct Leakage Test

1. All ductwork shall be tested for leaks, using necessary instruments before insulating any ductwork. Conduct test as follows and as recommended in SMACNA Balancing Manual.
   a. Seal all openings in duct section and plenum to be tested.
   b. Connect test apparatus to test section of ducts, using a flexible duct connection or hose (fitting provided by Mechanical Contractor).
   c. Close damper on blower suction side, to prevent excessive build-up of pressure.
   d. Start blower and gradually open damper on suction side of blower.
   e. Determine amount of air leakage and make repairs as required.
   f. Leakage factor allowable shall be 5% based on the total operating cfm of the section of duct under testing.
   g. Tested sections of ductwork shall be visually marked with certification sticker and initials of field test inspector. Tests shall be made before duct sections are concealed.

2. Witness the duct pressure testing performed by the mechanical/installing contractor.

3. Verify that proper test methods are used and that leakage rates are within specified tolerances.

4. Report any deficiencies observed.

B. Sound Level Reading

1. After the systems are balanced and the spaces are architecturally complete, sound level readings shall be taken in at least ten locations in the building with an Octave Band Analyzer.

2. In order to reduce the ambient noise level, the reading shall be taken at night.

3. Instrumentation:
   a. The sound-testing meter shall be a portable, general-purpose testing meter consisting of a microphone, processing unit, and readout.
b. The sound-testing meter shall be capable of showing fluctuations at minimum and maximum levels, and measuring the equivalent continuous sound pressure level (LEQ).

c. The sound-testing meter must be capable of using 1/3 octave band filters to measure mid-frequencies from 31.5 Hz to 8000 Hz.

d. The accuracy of the sound-testing meter shall be ±1 decibel.

4. Test Procedures

a. Perform test at the quietest background noise period. Note any cause of unpreventable sound that may affect the test outcome.

b. Equipment should be operating at design values.

c. Calibrate the sound-testing meter prior to taking measurements.

d. Use a microphone suitable for the type of noise levels measured that is compatible with the meter. Provide a windshield for outside or in-duct measurements.

e. Record a set of background measurements in dB(A), and sound pressure levels in the eight un-weighted octave bands with the equipment off.

f. Take sound readings in dB(A), and sound pressure levels in the eight un-weighted octave bands with the equipment on.

g. Take readings no closer than 3’ from a wall or from the operating equipment, and approximately 5’ from the floor, with the meter held or mounted on a tripod.

h. For outdoor measurements, move the sound-testing meter slowly and scan the area that has the greatest exposure to the noise source being tested. (This type of reading is generally performed using the A-Weighted scale).

5. Reporting

a. The test data for each area will be recorded on Noise Criteria curves indicating the decibel level read in each Frequency Band - the NC level required and the NC level measured. The sound level shall not exceed NC 30 in all areas.

b. The report must record: the location, the system tested, the dB(A) reading, and the sound pressure level in each octave band with equipment on and off.

c. Plot all the sound pressure levels on the [work sheet, with the equipment on and off.

6. The T&B Agency will submit the test data and test equipment data to the Architect and Engineer for review, and include the approved forms in the T&B report.

C. Vibration Testing

1. After the systems are balanced and the spaces are architecturally complete, read and record vibration levels on all equipment with motor horsepower equal to or greater than 10. Vibration field measurements shall be taken as required for each circulating water pump, water chilling unit, air handling unit, and fan driven by a motor over 10 hp. Reading shall include shaft alignment, equipment vibration, bearing housing vibration, foundation vibration, and building structure vibration.
2. **Instrumentation:**
   a. The vibration meter should be portable, battery-operated, and microprocessor-controlled, with or without a built-in printer.
   b. The meter shall automatically identify engineering units, filter bandwidth, amplitude and frequency scale values.
   c. The meter shall be able to measure machine vibration displacement in mils of deflection, velocity in inches per second, and acceleration in inches per second squared.

3. **Test Procedures:**
   a. Verify that the vibration meter calibration date is current before taking readings.
   b. To ensure accurate readings, verify that the accelerometer has a clean, flat surface and is mounted properly.
   c. With the unit running, set up the vibration meter in a safe, secure location. Connect the transducer to the meter with the proper cables. Hold the magnetic tip of the transducer on top of the bearing, and measure the unit in mils of deflection. Record the measurement, then move the transducer to the side of the bearing, and record in mils of deflection. Record an axial reading in mils of deflection by holding the nonmagnetic, pointed transducer tip on the end of the shaft.
   d. Change the vibration meter to velocity (inches per second) measurements. Repeat and record the above measurements.
   e. Record the CPM or the RPM.
   f. Read each bearing on the motor, fan, and/or pump as required. Track and record vibration levels from the rotating component through the casing to the base.

4. **Reporting**
   a. The report must record the location and the system tested.
   b. Include horizontal-vertical-axial measurements for all tests.
   c. Verify that vibration limits follow specifications, or, if not specified, follow the “General Machinery Vibration Severity Chart” or “Vibration Acceleration General Severity Chart” from the AABC National Standards. Acceptable levels of vibration are normally “Smooth” to “Good.”
   d. Include in the report the Machinery Vibration Severity Chart, with conditions plotted.

5. Maximum vibration at any point listed above shall not exceed criteria listed in the ASHRAE Handbook, HVAC Systems and Application, Chapter 52 “Sound and Vibration Control”, Table 26 “Equipment Vibration Criteria”, unless otherwise specified. Reading shall be taken with vibration isolation blocked solid to the foundation.

6. The T&B Agency will submit the test data and equipment data to the Mechanical Engineer for review. The approved forms will be included in the T&B report.

D. **Controls Verification**
1. In conjunction with system balancing perform the following:
   a. Work with the temperature control contractor to ensure the system is operating within the design limitations, and gain a mutual understanding of intended control performance.
   b. Verify the integrity of valves and dampers in terms of tightness of close-off and full-open position. This includes dampers in multi-zone units.
   c. Check that all valves are properly installed in the piping system in relation to direction of flow and location.
   d. Verify the proper application of all normally open and normally closed valves.
   e. Check the locations of all thermostats and humidistats for potential erratic operation from outside influences such as sunlight, drafts or cold walls.
   f. Check the locations of all sensors to determine whether their position will allow them to sense only the intended temperatures, humidities, or pressures. Control Contractor will relocate as deemed necessary by the TAB Agency.
   g. Check the sequence of operation for any control mode is in accordance with approved shop drawings. Verify that only minimum simultaneous heating and cooling occurs. Observe that heating cannot take place until the cooling zone of valve is completely closed.
   h. Verify that all controller set points meet the design intent.
   i. Verify the operation of all interlock systems.
   j. Verify that controllers are calibrated and function as intended.
   k. Verify that controller setpoints are as specified.
   l. Verify the operation of lockout or interlock systems.
   m. Verify the operation of all valve and damper actuators.
   n. Verify that all controlled devices are properly installed and connected to the correct controller.
   o. Verify that all controlled devices travel freely and are in the position indicated by the controller: open, closed, or modulating.
   p. Perform all system verification to assure the safety of the system and its components.

2. Reporting
   a. The report shall include a summary of verifications performed, remaining deficiencies, and any variations from specified conditions.

3. A systematic check of the above requirements shall be included in the final TAB report.

3.10 FINAL ACCEPTANCE
A. At the time of final inspection, the T&B Agency shall recheck, in the presence of the Owner’s Representative, specific and random selections of data, i.e. water and air quantities, recorded in the Certified Report.

B. Points and areas for recheck shall be selected by the Owner’s Representative.

C. Measurement and test procedures shall be the same as approved for work forming basis of Certified Report.

D. Selections for recheck, specific plus random, will not normally exceed 25% of the total number tabulated in the report, except that special air systems may require a complete recheck for safety reasons.

E. If random tests elicit a measured flow deviation of 10% or more from that recorded in the Certified Report listings, by 10% or more of the selected recheck stations, the report shall be automatically rejected. In the event the report is rejected, all systems shall be readjusted and tested, new data recorded, new Certified Report submitted, and new inspection tests made, all at no additional cost to the Owner.

F. Following final acceptance of the Certified Report by the Owner’s Representative the settings of all valves, splitters, dampers, and other adjustment devices shall be permanently marked by the T&B Agency, so that adjustment can be restored if disturbed at any time. Devices shall not be marked until after final acceptance.

END OF SECTION
SECTION 23 09 23

CONTROLS FOR HVAC

PART 1 GENERAL

1.1 WORK INCLUDED

A. Related Documents: The General Provisions of the Contract, including General, Supplementary, and Special Conditions, and Division 01 - General Requirements, apply to work specified in this Section. Subcontractor must familiarize himself with the terms of the above documents.

1.2 DESCRIPTION

A. BAS Contractor:

1. The Building Automation System (BAS) is to be furnished and installed by a factory authorized Andover distributor with factory warranted Andover parts. The designated distributor for this work is EMCOR Mesa Energy Systems Inc (Contractor). Contact: Andy Bruch; andy_bruch@emcorgroup.com; (510) 909-9980

a. All bidders must be building automation contractors in the business of installing Direct Digital Controls (DDC) for a minimum of 3 years.

b. All bidders must have an office in the San Francisco Bay/Central Valley area.

c. All bidders must be a channel partner for “Andover Controls”.

d. All bidders must have a trained staff of application engineers who have been certified by Andover in administration, networking, configuration, programming and service of the automation system.

e. All installers must have a factory-trained technician on-site at all times during installation of the DDC controls.

2. Integration of the BAS system to the central BAS system shall be coordinated with the Facilities Manager at the work site.

B. Scope of Work

1. The BAS contractor shall review and study all HVAC drawings and the entire
specification to familiarize him with the equipment and system operation and to verify the quantities and types of valves, operators, alarms, etc. to be provided.

2. The Contractor shall furnish and install a complete building automation system including all necessary hardware and all operating and applications software necessary to perform the control sequences of operation as called for in this specification. Andover Controls only to match existing campus system architecture. At a minimum, provide controls for the following:
   a. Air handling units.
   b. Exhaust and supply fans.
   c. CAV/VAVs w/reheat.
   d. Power wiring to DDC devices CAV/VAV and BAS panels by Division 26.
   e. Lighting.

3. Provide services and manpower necessary for commissioning of system in coordination with the HVAC Contractor, Balancing Contractor and Owner’s representative.

4. All work performed under this section of the specifications will comply with all codes, laws and governing bodies. If the drawings and/or specifications are in conflict with governing codes, the Contractor shall submit a proposal with appropriate modifications to the project to meet code restrictions. If this specification and associated drawings exceed governing code requirements, the specification will govern.

C. Training: Provide a minimum of (40) hours of on-site training for (3) system operators. The training will be hands-on type, at the owner’s office. The training class will use the actual Operator’s Manual that will be submitted for this project. In addition, projects over $100,000 will include (2) weeks of classroom training for (1) individual at the Manufacturer’s sponsored training courses.

D. Portable handheld assist tools: Provide owner with one Roam I/O remote assist tool as indicated by Facilities at time of completion.

E. System Description:

1. The Building Automation System (BAS) shall consist of PC-based workstation (existing) and microcomputer controllers of modular design, providing distributed processing capability and allowing future expansion of both input/output points and processing/control functions:
   a. For this project the system shall consist of the following (new)
components:

1) Ethernet-based Network Controller.

2) Stand-alone Digital Control Units.

F. Ethernet-based Network Controller: The BAS Contractor shall furnish (1) Ethernet-based network controller. This controller will connect directly to the campus LAN over the existing Ethernet system. (1) Building network controller (as required) shall be assigned to an existing Infinet Loop.

G. Provide the necessary quantity and types of SDCUs to meet the requirements of the project for mechanical equipment control, including air handlers, return/exhaust fans, and terminal unit control. Each SDCU will operate completely standalone, containing all of the I/O and programs to control its associated equipment: i2 series and Infinet II.

H. Work by Others

1. The BAS Contractor shall cooperate with other contractors performing work on this project necessary to achieve a complete and neat installation. To that end, each contractor shall consult the drawings and specifications for all trades to determine the nature and extent of others' work.

2. The BAS Contractor shall furnish all control valves, sensor wells, flow meters and other similar equipment for installation by the Mechanical Contractor

3. The Electrical Contractor shall provide:

   a. All power wiring to VAV transformer disconnects. See floor plan for location and BAS panels.

I. Code Compliance

1. All wiring shall conform to the National Electrical Code.

2. Comply with FCC rules, Part 15 regarding Class A radiation for computing devices and low power communication equipment operating in commercial environments.


J. Submittals

1. All shop drawings shall be prepared in AutoCAD software. In addition to the drawings, the Contractor shall furnish a diskette containing the identical information. Drawings shall be B size or larger.

2. Shop drawings shall include a riser diagram depicting locations of all controllers
and workstations, with associated network wiring. Also included shall be individual schematics of each mechanical system showing all connected points, with reference to their associated controller. "Typical" will be allowed where appropriate.

3. Submittal data shall contain manufacturer's data on all hardware and software products required by the specification. Valve, damper, and airflow station schedules shall indicate size, configuration, and capacity of all equipment.

4. Software submittals shall contain narrative descriptions of sequences of operation, program listings, point lists, and a complete description of the graphics, reports, alarms and configuration to be furnished with the workstation software. Information shall be bound or in a three ring binder with an index and tabs.

5. Submit five (5) copies of submittal data and shop drawings to the Architect and (1) copy to Facilities for review, prior to ordering or fabrication of the equipment. Prior to submitting, the Contractor shall check all documents for accuracy.

6. The Engineer will make corrections, if required, and forward to Architect for distribution. The Contractor will then resubmit with the corrected or additional data. All corrections shall be made to the satisfaction of the Architect and Engineer and all submittals shall be fully approved before continuing with the installation.

K. System Startup & Commissioning

1. Each point in the system shall be tested for both hardware and software functionality. In addition, each mechanical and electrical system under control of the BAS will be tested against the appropriate sequence of operation. Successful completion of the system test shall constitute the beginning of the warranty period. A written report shall be submitted to the owner indicating that the installed system functions in accordance with the plans and specifications.

2. The BAS contractor shall commission and set in operating condition all major equipment and systems, such as the chilled water, hot water and all air handling systems, in the presence of the equipment manufacturer’s representatives, as applicable, and the Owner and Architect’s representatives.

3. The BAS Contractor shall provide all manpower and engineering services required to assist the HVAC Contractor and Balancing Contractor in testing, adjusting, and balancing all systems in the building. The BAS Contractor shall have a trained technician available, on request, during the balancing of the systems. The BAS Contractor shall coordinate all requirements to provide a complete air balance with the Balancing Contractor and shall include all labor and materials in their contract.
L. Training

1. The BAS Contractor shall provide both on-site and classroom training to the Owner’s representative and maintenance personnel. On-site training shall be per section 1.2 C and shall consists of “hands-on” instruction geared at the operation and maintenance of the systems. The curriculum shall include

   a. System overview.
   b. System software and operation.
   c. System access.
   d. Software features overview.
   e. Changing setpoints and other attributes.
   f. Scheduling.
   g. Editing programmed variables.
   h. Displaying color graphics.
   i. Running reports.
   j. Workstation maintenance.
   k. Application programming.
   l. Operational sequences including start-up, shutdown, adjusting and balancing.
   m. Equipment maintenance.

M. Operating and Maintenance Manuals

1. The operation and maintenance manuals shall contain all information necessary for the operation, maintenance, replacement, installation, and parts procurement for the entire BAS. This documentation shall include specific part numbers and software versions and dates. A complete list of recommended spare parts shall be included with the lead time and expected frequency of use of each part clearly identified.

2. Following project completion and testing, the BAS contractor will submit as-built drawings reflecting the exact installation of the system. The as-built documentation shall also include a copy of all application software both in written
form and on diskette.

N. Warranty: The BAS contractor shall warrant the system for 12 months after system acceptance and beneficial use by the owner. During the warranty period, the BAS contractor shall be responsible for all necessary revisions to the software as required to provide a complete and workable system consistent with the letter and intent of the Sequence of Operation section of the specification.

PART 2 PRODUCTS

2.1 SYSTEM ARCHITECTURE

A. General: The Building Automation System (BAS) shall consist of Network Control Units (NCUs), a family of Standalone Digital Control Units (SDCUs), Input/Output Unit Modules (IOU Modules), Operator Workstations (OWs), and (1) File Server to support system configurations where more than one operator workstation is required. The BAS shall provide control, alarm detection, scheduling, reporting and information management for the entire facility, and Wide Area Network (WAN) if applicable, from a single ODBC-compliant database.

B. Level 1 Network Description:

1. Level 1, the main backbone of the system, shall be an Ethernet LAN/WAN. Network Control Units, Operator Workstations, and the Central File Server shall connect directly to this network without the need for Gateway devices.

C. Level 2 Network Description:

1. Level 2 of the system shall consist of one or more field busses managed by the Network Control Units. The Level 2 field busses may consist of one or both of the following types:

   a. An RS485 token passing bus that supports up to 127 Standalone Digital Control Units (SDCUs) per communication port for operation of HVAC equipment and lighting, or

   b. An RS485 field bus that supports up to 32 devices from a family of plug-in, IOU modules. These IOU modules may be mounted within the NCU enclosure or remotely mounted via a single, twisted, shielded pair of wires.

D. BAS:

1. The BAS shall be capable of being segmented, through software, into multiple local area networks (LANs) distributed over a wide area network (WAN), sharing a single file server. This enables workstations to manage a single LAN (or building), and/or the entire system with all devices being assured of being updated and sharing the
most current database. In the case of a single workstation system, the workstation shall contain the entire database, with no need for a separate file server.

E. Standard Network Support

1. All NCUs, Workstation(s) and File Server shall be capable of residing directly on the owner’s Ethernet TCP/IP LAN/WAN with no required gateways. Furthermore, the NCU’s, Workstation(s) and File Server shall be capable of using standard, commercially available, off-the-shelf Ethernet infrastructure components such as routers, switches and hubs. With this design the owner may utilize the investment of an existing or new enterprise network or structured cabling system. This also allows the option of the maintenance of the LAN/WAN to be performed by the owner’s Information Systems Department, as all devices utilize standard TCP/IP components.

F. System Expansion

1. The BAS system shall be scalable and expandable at all levels of the system using the same software interface, and the same Level 1 and Level 2 controllers. Systems that require replacement of either the workstation software or field controllers in order to expand the system shall not be acceptable.

2. The BAS shall be expandable to include Security and Access Control functions at any time in the future, with no additional workstations, front-end software or Level 1 controllers required. Standalone Digital Control Units or IOU modules shall be able to be added to the existing Level 1 controller’s field bus (es), to perform security and card access applications. In this way, an owner’s existing investment in wiring infrastructure may be leveraged and the cost and inconvenience of adding new field bus wiring will be minimized.

3. Additionally, an integrated video badging option must be able to be included, with no additional workstations required. This photo ID option must share the same database as the BAS in order to eliminate the need for updating multiple databases.

4. The system shall use the same application programming language for all levels: Operator Workstation, Network Control Unit, Remote Site Control Unit and Standalone Digital Control Unit. Furthermore, this single programming language shall be used for all applications: environmental control, card access control, intrusion detection and security, lighting control, leak detection / underground storage tank monitoring, and digital data communication interfaces to third party microprocessor-based devices.

G. Support for Open Systems Protocols

1. The BAS design must include solutions for the integration of the following “open
systems’ protocols: BACnet, LonTalk™, MODBUS and digital data communication to third party microprocessors such as chiller controllers, fire panels and variable frequency drives (VFDs).

2. The system shall also provide the ability to program custom ASCII communication drivers that will reside in the NCU, for communication to third party systems and devices. These drivers will provide real time monitoring and control of the third party systems.

2.2 NETWORK CONTROL UNITS (NCUs)

A. General

1. Network Control Units shall be microprocessor based, multi-tasking, multi-user, and employ a real time operating system. Each NCU control panel shall consist of modular hardware including power supply, CPU board, and input/output modules. A sufficient number of NCUs shall be supplied to fully meet the requirements of this specification and the attached point list.

2. NCUs for telephone dialup sites shall be of the same design as the Ethernet control units but without the plug-in Ethernet network interface card (NIC), i.e., NCUs, which include a NIC, shall be interchangeable whether used on a LAN/WAN or a dialup site.

B. Webserver Functionality

1. All NCUs on the Ethernet TCP/IP LAN/WAN shall be capable, out-of-the box, to be set up as a Web Server. The NCU shall have the ability to store HTML code and “serve” pages to a web browser. This provides the ability for any computing device utilizing a TCP/IP Ethernet connection and capable of running a standard Internet browser (Microsoft Internet Explorer™, Netscape Navigator™, etc.) to access real-time data from the entire BAS via any NCUs.

2. Graphics and text-based web pages shall be constructed using standard HTML code. The interface shall allow the user to choose any of the standard text or graphics-based HTML editors for page creation. It shall also allow the operator to generate custom graphical pages and forms.

3. The WEB server interface shall be capable of password security, including validation of the requesting PC’s IP address. The WEB server interface shall allow the sharing of data or information between any controller, or process or network interface (BACnet, LonTalk and TCP/IP) that the BMS has knowledge of, regardless of where the point is connected on the BAS network or where it is acquired from.
4. The BAS network controller must act directly as the WEB server. It must directly
generate the HTML code to the requesting user (i.e. WEB browser), eliminating the
need for and reliance on any PC-based WEB server hardware or software. To
simplify graphic image space allocation, HTML graphic images, if desired, shall be
stored on any shared network device. The BAS WEB server shall have the ability to
acquire any necessary graphics using standard pathing syntax within the HTML
code mounted within the BAS WEB server. External WEB server hardware and
software are not acceptable.

C. Hardware Specifications

1. Memory: A minimum of 32 MB of RAM shall be provided for NCUs and shall
include a floating-point math co-processor.

D. Communication Ports

1. Each NCU shall provide communication to both the Workstation(s) and the field
busses. In addition, each NCU must have at least 3 other communications ports
that support a telephone modem, portable service tool, serial printer and
connection to third party controllers such as a chiller control panel. On a LAN/WAN
system the NCU shall be provided with a 10/100 baseT Mbps plug-in Ethernet
TCP/IP network interface card (NIC).

E. Input/Output (I/O):

1. Each NCU shall support the addition of the following types of inputs and outputs:
   a. Digital Inputs for status/alarm contacts.
   b. Counter Inputs for summing pulses from meters.
   c. Thermistor inputs for measuring temperatures in space, ducts and
      thermwells.
   d. Analog inputs for pressure, humidity, flow and position measurements.
   e. Digital Outputs for on/off equipment control.
   f. Analog Outputs for valve and damper position control, and capacity
      control of primary equipment.

F. Modular Expandability: The system shall employ a modular I/O design to allow easy
expansion. Input and output capacity is to be provided through plug-in modules of various
types or DIN-mountable IOU modules. It shall be possible to combine I/O modules as
desired to meet the I/O requirements for individual control applications.
G. Real Time Clock (RTC): Each NCU shall include a battery-backed, real time clock, accurate to 10 seconds per day. The RTC shall provide the following: time of day, day, month, year, and day of week. In normal operation the system clock will be based on the frequency of the AC power. The system shall automatically correct for daylight savings time and leap years and be Year 2000 compliant.

H. Power Supply: The power supply for the NCUs shall be auto sensing, 120-220VAC, 60/50 Hz power, with a tolerance of +/- 20%. Line voltage below the operating range of the system shall be considered outages. The controller shall contain over voltage surge protection, and require no additional AC power signal conditioning. Optionally, if indicated on the drawings, the power supply shall accept an input voltage of (~48 VDC).

I. Automatic Restart After Power Failure: Upon restoration of power after an outage, the ECU shall automatically and without human intervention: update all monitored functions; resume operation based on current, synchronized time and status, and implement special start-up strategies as required.

J. Battery backup: Each NCU with the standard 120-220VAC power supply shall include a programmable DC power backup system rated for a minimum of 72 hours of battery backup to maintain all volatile memory or, a minimum of 2 hours of full UPS including modem power. This power backup system shall be configurable such that at the end of a settable timeframe (such as 1 hour) of running on full UPS, the unit will shut off full UPS and switch to memory retention-only mode for the remainder of the battery power. The system shall allow the simple addition of more batteries to extend the above minimum battery backup times. Each NCU with a control transformer shall include a minimum of 7 days of power failure backup of RAM memory.

K. Software Specifications

1. User Programming Language:
   a. The application software shall be user programmable. This includes all strategies, sequences of operation, control algorithms, parameters, and setpoints. The source program shall be English language-based and programmable by the user. The language shall be structured to allow for the easy configuration of control programs, schedules, alarms, reports, telecommunications, local displays, mathematical calculations, passwords, and histories. The language shall be self-documenting. Users shall be able to place comments anywhere in the body of a program. Program listings shall be configurable by the user in logical groupings.

2. Control Software:
   a. The NCU shall have the ability to perform the following pre-tested control algorithms:
1) Proportional, Integral plus Derivative Control (PID).
2) Self Tuning PID.
3) Two Position Control.
4) Digital Filter.
5) Ratio Calculator.
6) Equipment Cycling Protection.

3. Mathematical Functions
   a. Each controller shall be capable of performing basic mathematical functions (+, -, *, /), squares, square roots, exponential, logarithms, Boolean logic statements, or combinations of both. The controllers shall be capable of performing complex logical statements including operators such as >, <, =, and, or, exclusive or, etc. These must be able to be used in the same equations with the mathematical operators and nested up to five parentheses deep.

4. Energy Management Applications
   a. NCUs shall have the ability to perform any or all of the following energy management routines:
      1) Time of Day Scheduling.
      2) Calendar Based Scheduling.
      3) Holiday Scheduling.
      4) Temporary Schedule Overrides.
      5) Optimal Start.
      6) Optimal Stop.
      7) Night Setback Control.
      8) Enthalpy Switchover (Economizer).
      9) Peak Demand Limiting.
     10) Temperature Compensated Duty Cycling.
     11) CFM Tracking.
12) Heating/Cooling Interlock.
13) Hot/Cold Deck Reset.
14) Free Cooling.
15) Hot Water Reset.
16) Chilled Water Reset.

5. History Logging

a. Each controller shall be capable of logging any system variable over user defined time intervals ranging from 1 second to 1440 minutes. Any system variables (inputs, outputs, math calculations, flags, etc.) can be logged in history. A maximum of 32767 values can be stored in each log. Each log can record either the instantaneous, average, minimum or maximum value of the point. Logs can be automatic or manual. Logged data shall be downloadable to the Operator Workstation for long term archiving based upon user-defined time intervals, or manual command.

6. Alarm Management

a. For each system point, alarms can be created based on high/low limits or conditional expressions. All alarms will be tested each scan of the NCU and can result in the display of one or more alarm messages or reports.

b. Up to 8 alarms can be configured for each point in the controller.

c. Messages and reports can be sent to a local terminal, to the front-end workstation(s), or via modem to a remote-computing device.

d. Alarms will be generated based on their priority. A minimum of 255 priority levels shall be provided. If communication with the Operator Workstation is temporarily interrupted, the alarm will be buffered in the NCU. When communications return, the alarm will be transmitted to the Operator Workstation if the point is still in the alarm condition.

7. Reporting

a. The NCU shall be able to generate user-definable reports to a locally connected printer or terminal. The reports shall contain any combination of text and system variables. Report templates shall be able to be created by users in a word processing environment. Reports can be displayed based on any logical condition or through a user command.

2.3 STANDALONE DIGITAL CONTROL UNITS (SDCUs)
A. General

1. Standalone Digital Control Units shall provide control of HVAC and lighting. Each controller shall have its own control programs and will continue to operate in the event of a failure or communication loss to its associated NCU.

B. Memory

1. Control programs shall be stored in battery backed-up RAM and EPROM. Each controller shall have a minimum of 128K bytes of user RAM memory and 128K bytes of EPROM.

C. Communication Ports

1. SDCUs shall provide a communication port to the field bus. In addition, a port shall be provided for connection of a portable service tool to support local commissioning and parameter changes with or without the NCU online. It shall be possible from a service port on any SDCU to view, enable/disable, and modify values of any point or program on any controller on the local field bus, any NCU or any SDCU on a different field bus.

D. Input/Output

1. Each SDCU shall support the addition of the following types of inputs and outputs:
   a. Digital Inputs for status/alarm contacts.
   b. Counter Inputs for summing pulses from meters.
   c. Thermistor Inputs for measuring temperatures in space, ducts and thermowells.
   d. Analog inputs for pressure, humidity, flow and position measurements.
   e. Digital Outputs for on/off equipment control.
   f. Analog Outputs for valve and damper position control, and capacity control of primary equipment.

E. Expandability

1. Input and output capacity shall be expandable through the use of plug-in modules. A minimum of (2) modules shall be added to the base SDCU before additional power is required.

F. Networking
1. Each SDCU will be able to exchange information on a peer-to-peer basis with other Standalone Digital Control Units during each field bus scan. Each SDCU shall be capable of storing and referencing global variables (on the LAN) with or without any workstations online. Each SDCU shall be able to have its program viewed and/or enabled/disabled either locally through a portable service tool or through a workstation connected to an NCU.

G. Indicator Lamps

1. SDCUs will have as a minimum, LED indication of CPU status, and field bus status.

H. Real Time Clock (RTC)

1. An SDCU shall have a real time clock in either hardware or software. The accuracy shall be within 10 seconds per day. The RTC shall provide the following information: time of day, day, month, year, and day of week. Each SDCU shall receive a signal, every hour, over the network from the NCU, which synchronizes all SDCU real time clocks.

I. Automatic Restart after Power Failure

1. Upon restoration of power, the SDCU shall automatically and without human intervention, update all monitored functions, resume operation based on current, synchronized time and status, and implement special start-up strategies as required.

J. Battery Back Up

1. Each SDCU shall have at least 3 years of battery back up to maintain all volatile memory.

K. Alarm Management

1. For each system point, alarms can be created based on high/low limits or conditional expressions. All alarms will be tested each scan of the SDCU and can result in the display of one or more alarm messages or reports.

2. Up to 8 alarms can be configured for each point in the controller enabling the escalation of the alarm priority (urgency) based upon which alarm(s) is/are triggered.

3. Alarm messages can be sent to a local terminal or modem connected to an NCU or to the Operator’s Workstation(s).

4. Alarms will be generated based on their priority. A minimum of 255 priority levels shall be provided.
5. If communication with the NCU is temporarily interrupted, the alarm will be buffered in the SDCU. When communications return, the alarm will be transmitted to the NCU if the point is still in the alarm condition.

L. Air Handler Controllers (To be used on units with less than 40 points)

1. AHU Controllers shall be capable of meeting the requirements of the sequence of operation found in the Execution portion of this specification and for future expansion.

2. AHU Controllers shall support all the necessary point inputs and outputs as required by the sequence and operate in a standalone fashion.

3. AHU Controllers shall be fully user programmable to allow for modification of the application software.

4. An LCD display shall be optionally available for readout of point values and to allow operators to change setpoints and system parameters.

5. A manual override switch shall be provided for all digital and analog outputs on the AHU Controller. The position of the switch shall be monitored in software and available for operator displays and alarm notification.

M. VAV Terminal Unit Controllers

1. VAV Terminal Unit Controllers shall support, but not be limited to the control of the following configurations of VAV boxes to address current requirements as described in the Execution portion of this specification, and for future expansion:

   a. VAVR.

   b. Single Duct Cooling with Reheat (Hot Water).

2. VAV Controllers to be Andover i2866-V, i2865-V with LED smart stats.

3. VAV Controllers for single duct applications will come equipped with a built-in actuator for modulation of the air damper. The actuator shall have a minimum torque rating of 50 in.-lb., and contain an override mechanism for manual positioning of the damper during startup and service.

4. VAV Controllers shall contain an integral velocity sensor accurate to +/- 5% of the full range of the box’s CFM rating.

5. Each controller shall perform the sequence of operation described in Part 3 of this specification, and have the capability for time of day scheduling, occupancy mode control, after hours operation, lighting control, alarming, and trending.
6. VAV Controllers shall be able to communicate with any other Standalone Digital Control Unit on the same field bus with or without communication to the NCU managing the field bus. Systems that fail to provide this (true peer-to-peer) capability will be limited to a maximum of 32 VAV controllers per field bus.

N. Display Controllers

1. Display controllers are standalone, touch screen based operator interfaces. The controller shall be designed for flush mounting in a finished space, with a minimum display size of 9 x 9 inches.

2. Software shall be user programmable allowing for custom graphical images that simulate floor plans, menus, equipment schematics along with associated real time point values coming from any NCU on the network.

3. The touch screen display shall contain a minimum of 64 possible touch cells that permit user interaction for changing screens, modifying setpoints or operating equipment.

4. Systems that do not offer a display controller as specified must provide a panel mounted computer with touch screen capability as an alternative.

2.4 OPERATOR WORKSTATION REQUIREMENTS (existing LAN System) Workstation and Server are not added to this project. However, all controllers will be added to the existing Infinet and LAN system.

A. General

1. The BAS workstation software shall be configurable as either a single workstation system (with a local database) or multi-workstation system where the database is located on a central file server. The client software on multi-workstation system shall access the file server database program via an Ethernet TCP/IP network running at either 10MBPS or 100MBPS.

2. New Workstation shall be:

<table>
<thead>
<tr>
<th>PROCESSOR</th>
<th>Intel® Core™ i5 Processor 680 with VT (3.60GHz, 4M)</th>
</tr>
</thead>
<tbody>
<tr>
<td>OPERATING SYSTEM</td>
<td>Windows 7 Professional</td>
</tr>
<tr>
<td>WARRANTY &amp; SERVICE</td>
<td>3 Year ProSupport and 3 Year NBD Onsite Service</td>
</tr>
<tr>
<td>SYSTEMS MANAGEMENT MODE</td>
<td>Intel Core i7/i5 vPro Technology Enabled</td>
</tr>
<tr>
<td>MEMORY</td>
<td>4GB DDR3 Non-ECC SDRAM,1333MHz, (2 DIMM)</td>
</tr>
<tr>
<td><strong>HARD DRIVE</strong></td>
<td>500GB 2.5 SATA 3.0Gb/s and 16MB DataBurst Cache™</td>
</tr>
<tr>
<td>------------------------</td>
<td>--------------------------------------------------</td>
</tr>
<tr>
<td><strong>OPTICAL DRIVE</strong></td>
<td>16X DVD+/ RW SATA, Roxio Creator™ Cyberlink PowerDVD™</td>
</tr>
<tr>
<td><strong>VIDEO CARD</strong></td>
<td>Integrated Intel® Graphics Media Accelerator HD, DisplayPort/ VGA</td>
</tr>
<tr>
<td><strong>MONITOR</strong></td>
<td>Dell UltraSharp™ 2007FP 20in HAS Monitor, VGA/ DVI</td>
</tr>
<tr>
<td><strong>ENERGY SMART</strong></td>
<td>Dell Energy Smart Enable (ESMART)</td>
</tr>
<tr>
<td><strong>FILE SYSTEM</strong></td>
<td>NTFS File System for all Operating Systems</td>
</tr>
<tr>
<td><strong>SYSTEM DOCUMENTATION</strong></td>
<td>Resource DVD contains Diagnostics and Driver for Dell OptiPlex System</td>
</tr>
<tr>
<td><strong>KEYBOARD</strong></td>
<td>Dell Multimedia Pro Keyboard, English</td>
</tr>
<tr>
<td><strong>MOUSE</strong></td>
<td>Dell MS111 USB Optical Mouse</td>
</tr>
</tbody>
</table>

3. The application software shall be capable of communication to all Network Control Units and Standalone Digital Control Units, feature high-resolution color graphics, alarming, reporting, and be user configurable for all data collection and data presentation functions.

4. For multi-workstation systems, a minimum of 256 workstations shall be allowed on the Ethernet network along with the central file server. In this client/server configuration, any changes or additions made from one workstation will automatically appear on all other workstations without the requirement for manual copying of files. Multi-workstation systems with no central database will not be acceptable. Multi-workstation systems with distributed/tiered file servers and a central (master) database will be acceptable.

B. **Workstation Software**

1. **General Description:**
   a. The software architecture must be object-oriented in design, a true 32-bit application suite utilizing Microsoft’s OLE, COM, DCOM and ODBC technologies. These technologies make it easy to fully utilize the power of the operating system to share, among applications (and therefore to the users of those applications), the wealth of data available from the BAS.
b. The workstation functions shall include monitoring and programming of all DDC controllers. Monitoring consists of alarming, reporting, graphic displays, long-term data storage, automatic data collection, and operator-initiated control actions such as schedule and setpoint adjustments.

c. Programming of controllers shall be capable of being done either off-line or online from any operator workstation. All information will be available in graphic or text displays. Graphic displays will feature animation effects to enhance the presentation of the data, to alert operators of problems, and to facilitate location of information throughout the DDC system. All operator functions shall be selectable through a mouse.

C. System Database

1. The files server database engine must be Microsoft SQL Server (depending on version). This ODBC (Open Database Connectivity) compliant database engine allows for an owner to utilize “their” choice of database and due to its “open” architecture, allows an owner to write custom applications and/or reports which communicate directly with the database avoiding data transfer routines to update other applications. The system database shall contain all point configurations and programs in each of the controllers that have been assigned to the network. In addition, the database will contain all workstation files including alarm reports, text reports, historical data logs, schedules, and polling records.

2. New Workstation shall be:

<table>
<thead>
<tr>
<th>PRIMARY PROCESSOR</th>
<th>Intel® Xeon® E5620 2.4Ghz, 12M Cache, Turbo, HT, 1066MHz Max Mem</th>
</tr>
</thead>
<tbody>
<tr>
<td>MEMORY</td>
<td>8GB Memory (4x2GB), 1333MHz 1R LV UDIMMs for 1 Processor, Advanced ECC</td>
</tr>
<tr>
<td>SYSTEMS MANAGEMENT MODE</td>
<td>Intel Core i7/i5 vPro Technology Enabled</td>
</tr>
<tr>
<td>OPERATING SYSTEM</td>
<td>Windows Server 2008 R2, Standard Edition, x64, Includes 5 CALS</td>
</tr>
<tr>
<td>HARD DRIVE CONFIGURATION</td>
<td>RAID 1 for H700, PERC 6/i, H200 or SAS 6/IR Controllers</td>
</tr>
<tr>
<td>INTERNAL CONTROLLER</td>
<td>PERC H200 Integrated RAID Controller</td>
</tr>
<tr>
<td>HARD DRIVES</td>
<td>500GB 7.2K RPM SATA 2.5-in HotPlug Hard Drive</td>
</tr>
<tr>
<td>MICROSOFT SQL SERVER</td>
<td>Microsoft®SQL Server™2008R2 Workgroup w5 CALs,</td>
</tr>
<tr>
<td>NETWORK ADAPTER</td>
<td>OEM, NFI, w/ Media</td>
</tr>
<tr>
<td>-------------------------</td>
<td>------------------------</td>
</tr>
<tr>
<td>EMBEDDED MANAGEMENT</td>
<td>iDRAC6 Express</td>
</tr>
<tr>
<td>INTERNAL OPTICAL DRIVE</td>
<td>DVD+/-RW, SATA, Internal</td>
</tr>
<tr>
<td>SERVER ACCESSORIES</td>
<td>Keyboard and Optical Mouse, USB, Black, English, with 17 LCD Monitor</td>
</tr>
<tr>
<td>SYSTEM DOCUMENTATION</td>
<td>Electronic System Doc, OpenManage DVD Kit with Dell Management Console</td>
</tr>
<tr>
<td>HARDWARE SUPPORT SERVICES</td>
<td>3 Year ProSupport and Mission Critical 4HR 7x24 Onsite Pack</td>
</tr>
</tbody>
</table>

D. User Interface

1. The BAS workstation software shall allow the creation of a custom, browser-style interface linked to the user that has logged into the workstation software. This interface shall support the creation of "hot-spots" that the user may link to view/edit any object in the system or run any object editor or configuration tool contained in the software. Furthermore, this interface must be able to be configured to become a user’s “PC Desktop” – with all the links that a user needs to run other applications. This, along with the Windows NT user security capabilities, will enable a system administrator to setup workstation accounts that not only limit the capabilities of the user within the BAS software but may also limit what a user can do on the PC and/or LAN/WAN. This might be used to ensure, for example, that the user of an alarm monitoring workstation is unable to shut down the active alarm viewer and/or unable to load software onto the PC.

E. User Security

1. The software shall be designed so that each user of the software can have a unique username and password. This username/password combination shall be linked to a set of capabilities within the software, set by and editable only by, a system administrator. The sets of capabilities shall range from: View only, Acknowledge alarms, Enable/disable and change values, Program, and Administer. The system shall allow the above capabilities to be applied independently to each and every class of object in the system. The system must allow a minimum of 256 users to be configured per workstation. There shall be an inactivity timer adjustable in software that automatically logs off the current operator after the timer has expired.
F. Configuration Interface

1. The workstation software shall use a familiar Windows Explorer™-style interface for an operator or programmer to view and/or edit any object (controller, point, alarm, report, schedule, etc.) in the entire system. In addition, this interface shall present a “network map” of all controllers and their associated points, programs, graphics, alarms, and reports in an easy to understand structure. All object names shall be alphanumeric and use Windows long filename conventions. Object names shall not be required to be unique throughout the system. This allows consistency in point naming. For example, each VAV controller can have an input called Space Temperature and a setpoint called CFM Setpoint. The VAV controller name shall be unique such as VAV for LAB101. Systems requiring unique object names throughout the system will not be acceptable.

2. The configuration interface shall also include support for template objects. These template objects shall be used as building blocks for the creation of the BAS database. The types of template objects supported shall include all data point types (input, output, string variables, setpoints, etc.), alarm algorithms, alarm notification objects, reports, graphics displays, schedules, and programs. Groups of template object types shall be able to be set up as template subsystems and systems. The template system shall prompt for data entry if necessary. The template system shall maintain a link to all “child” objects created by each template. If a user wishes to make a change to a template object, the software shall ask the user if he/she wants to update all of child objects with the change. This template system shall facilitate configuration and programming consistency and afford the user a fast and simple method to make global changes to the BAS.

G. Color Graphic Displays

1. The system shall allow for the creation of user defined, color graphic displays for the viewing of mechanical and electrical systems, or building schematics. These graphics shall contain point information from the database including any attributes associated with the point (engineering units, etc.). In addition, operators shall be able to command equipment or change setpoints from a graphic through the use of the mouse. Requirements of the color graphic subsystem include:

   a. SVGA, bit-mapped displays. The user shall have the ability to import AutoCAD generated picture files as background displays.

   b. A built-in library of animated objects such as dampers, fans, pumps, buttons, knobs, gauges, ad graphs which can be “dropped” on a graphic through the use of a software configuration “wizard”. These objects shall enable operators to interact with the graphic displays in a manner that mimics their mechanical equivalents found on field installed control panels. Using the mouse, operators shall be able to adjust setpoints, start or stop equipment, modify PID loop parameters, or change schedules.
c. Status changes or alarm conditions must be able to be highlighted by objects changing screen location, size, color, and text, blinking or changing from one display to another.

d. Graphic panel objects shall be able to be configured with multiple “tabbed” pages allowing an operator to quickly view individual graphics of equipment, which make up a subsystem or system.

e. Ability to link graphic displays through user-defined objects; alarm testing, or the result of a mathematical expression.

f. Operators must be able to change from one graphic to another by selecting an object with a mouse - no menus will be required.

H. Alarm Management

1. The software shall be capable of accepting alarms directly from controllers, or generating alarms based on evaluation of data in controllers and comparing to limits or conditional equations configured through the software. Any alarm (regardless of its origination) will be integrated into the overall alarm management system and will appear in all standard alarm reports, be available for operator acknowledgment, and have the option for displaying graphics, or reports.

2. Alarm management features shall include:

   a. A minimum of 255 alarm notification levels. Each notification level will establish a unique set of parameters for controlling alarm display, acknowledgment, keyboard annunciation, alarm printout and record keeping.

   b. Automatic logging in the database of the alarm message, point name, point value, connected controller, timestamp, username and time of acknowledgement, username and time of alarm silence (soft acknowledgement)

   c. Automatic printing of the alarm information or alarm report to an alarm printer or report printer.

   d. Playing an audible beep or audio (wav) file on alarm initiation or return too normal.

   e. Sending an email or alphanumeric page to anyone listed in a workstation’s email account address list on either the initial occurrence of an alarm and/or if the alarm is repeated because an operator has not acknowledged the alarm within a userconfigurable timeframe. The ability to utilize email and alphanumeric paging of alarms shall be a standard feature of the software integrated with the operating system’s mail application interface.
(MAPI). No special software interfaces shall be required.

f. Individual alarms shall be able to be re-routed to a workstation or workstations at user-specified times and dates. For example, a critical high temp alarm can be configured to be routed to a Facilities Dept. workstation during normal working hours (7am-6pm, Mon-Fri) and to a Central Alarming workstation at all other times.

g. An active alarm viewer shall be included which can be customized for each user or user type to hide or display any alarm attributes.

h. The font type and color, and background color for each alarm notification level as seen in the active alarm viewer shall be customizable to allow easy identification of certain alarm types or alarm states.

i. The active alarm viewer can be configured such that an operator must type in text in an alarm entry and/or pick from a drop-down list of user actions for certain alarms. This ensures accountability (audit trail) for the response to critical alarms.

I. Scheduling

1. It shall be possible to configure and download from the workstation schedules for any of the controllers on the network.

2. Time of day schedules shall be in a calendar style and shall be programmable for a minimum of one year in advance. Each standard day of the week and user-defined day types shall be able to be associated with a color so that when the schedule is viewed it is very easy, at-a-glance, to determine the schedule for a particular day even from the yearly view. To change the schedule for a particular day, a user shall simply click on the day and then click on the day type.

3. Each schedule will appear on the screen viewable as the entire year, monthly, week and day. A simple mouse click shall allow switching between views. It shall also be possible to scroll from one month to the next and view or alter any of the schedule times.

4. Schedules will be assigned to specific controllers and stored in their local RAM memory. Any changes made at the workstation will be automatically updated to the corresponding schedule in the controller.

J. Programmer's Environment

1. The programmer's environment will include access to a superset of the same programming language supported in the controllers. Here the programmer will be able to configure application software off-line (if desired) for custom program development, write global control programs, system reports, wide area
networking data collection routines, and custom alarm management software. On the same screen as the program editor, the programming environment shall include dockable debug and watch bars for program debugging and viewing updated values and point attributes during programming. In addition a wizard tool shall be available for loading programs from a library file in the program editor.

K. Saving/Reloading

1. The workstation software shall have an application to save and restore field controller memory files. This application shall not be limited to saving and reloading an entire controller – it must also be able to save/reload individual objects in the controller: This allows off-line debugging of control programs, for example, and then reloading of just the modified information.

L. Data Logging

1. The workstation software shall have the capability to easily configure groups of data points with trend logs and display the trend log data. A group of data points shall be created by drag-and-drop method of the points into a folder. The trend log data shall be displayed through a simply menu selection. This data shall be able to be saved to file and/or printed.

M. Audit Trail

1. The workstation software shall automatically log and timestamp every operation that a user performs at a workstation, from logging on and off a workstation to changing a point value, modifying a program, enabling/disabling an object, viewing a graphic display, running a report, modifying a schedule, etc.

N. Fault Tolerant File Server Operation:

1. The system shall provide the option to provide fault tolerant operation in the event of the loss of the CPU, disk drives, or other hardware required to maintain the operational integrity of the system. Operational integrity includes all user interfaces, monitoring of alarm points and access points, and executing access control functions.

2. The switchover mechanism provided shall be automatic. Should the failure be caused by hardware, and then the system shall immediately switch to the Backup computer. Should the system failure be caused by software (instruction or data), the system shall not pass the faulted code to the Backup computer, otherwise the Backup shall fail in the same manner of the Primary computer.

3. Switchover to the Backup computer shall be initiated and effective (complete) in a manner and time frame that precludes the loss of event data, and shall be transparent to the system users, except for an advisory alarm message indicating
that the switchover has occurred.

4. When the system fails-over from the Primary to the Backup computer, no alarm or other event shall be lost, and the Backup computer shall take control of all system functions.

5. A single component failure in the system shall not cause the entire system to fail. All system users shall be informed of any detectable component failure via an alarm event. System users shall not be logged off as a result of a system failure or switchover.

6. The Primary computer shall provide continual indication that the Backup computer is unavailable until such time that the fault has been purged.

7. Full screen, laptop service tools shall communicate directly to all controllers. The laptop software shall enable users to monitor both instantaneous and historical point data, modify control parameters, and enable/disable any point or program in any controller on the network.

O. Temperature Sensors

1. All temperature devices shall use precision thermistors accurate to +/- 1 degree F over a range of -30 to 230 degrees F. Space temperature sensors shall be accurate to +/- .5 degrees F over a range of 40 to 100 degrees F.
   a. Zone Sensors- Andover Model Number: TTS-SD-LCD-1
   b. Duct Sensors- Andover TT-D Series, Veris TJ Series, or equivalent
   c. Well Sensors- Andover TT-I Series

2. Standard space sensors shall be available in an off white enclosure for mounting on a standard electrical box.

3. Where manual overrides are required, the sensor housing shall feature both an optional Sliding overrides for adjusting the space temperature setpoint, as well as a push button for selecting after hours operation.

4. Where a local display is specified, the sensor shall incorporate either an LED or LCD display for viewing the space temperature, setpoint and other operator selectable parameters. Using built in buttons, operators shall be able to adjust setpoints directly from the sensor.

5. Duct temperature sensors shall incorporate a thermistor bead embedded at the tip of a stainless steel tube. Probe style duct sensors are useable in air handling applications where the coil or duct area is less than 14 square feet.
6. Averaging sensors shall be employed in ducts, which are larger than 14 square feet. The averaging sensor tube must contain at least one thermistor for every 3 feet, with a minimum tube length of 12 feet.

7. Immersion sensors shall be employed for measurement of temperature in all chilled and hot water applications as well as refrigerant applications. Thermal wells shall be brass or stainless steel for non-corrosive fluids below 250 degrees F and 300 series stainless steel for all other applications.

8. A pneumatic signal shall not be allowed for sensing temperature.

P. Humidity Sensors

1. Humidity devices shall be accurate to +/- 5% at full scale for space and +/- 3% for duct and outside air applications. Provide Minco or Setra.

2. Provide a hand held field calibration tool that both reads the output of the sensor and contains a reference sensor for ongoing calibration.

Q. Pressure Sensors

1. Air pressure measurements in the range of 0 to 10" water column will be accurate to +/- 1 percent using a solid-state sensing element. Acceptable manufacturers include Setra and Dwyer.

2. Differential pressure measurements of liquids or gases shall be accurate to +/- 0.5% of range. The housing shall be Nema 4 rated. Acceptable manufacturers include Setra and Dwyer.

R. Current and KW Sensors

1. Current status switches shall be used to monitor fans, pumps, motors and electrical loads. Current switches shall be available in solid core models, and offer either a digital or an analog signal to the automation system. Acceptable manufacturer is Veris or approved equal.

2. Measurement of three-phase power shall be accomplished with a kW/kWh transducer. This device shall utilize direct current transformer inputs to calculate the instantaneous value (kW) and a pulsed output proportional to the energy usage (kWh). Provide Veris Model 6000 Power Transducer or approved equal.

S. Flow Sensors

1. Provide an insertion flowmeter for measurement of liquid; gas or steam flows in pipe sizes above 3 inches.

2. Install the flow meter on an isolation valve to permit removal without process
shutdown.

3. Sensors shall be manufactured by ONICON, Badger, or approved equal.

T. Electric/Pneumatic Transducers

1. Electric to pneumatic transducers shall operate from an analog signal. E/P transducers shall be rated for 0 - 20 psi operation and accurate to 2% of full scale. E/P transducers shall have a maximum air consumption of 100 SCIM.

2. E/P transducers may be installed at the end device (damper or valve), or mounted separately in a field interface panel, or in the control panel. All transducers will be calibrated. Panel mounted transducers shall be Mamac or approved equal.

U. Electric/Pneumatic Solenoid Valves

1. Electric solenoid operated pneumatic valves (EP’s) shall have a three-port operation: common, normally open and normally closed. They shall be rated for 50 psig when used for 25 psig or less applications, or rated for 150 psig when used for 100 psig or less applications. The coils shall be equipped with transient suppression devices to limit transients to 150 percent of the rated coil voltage.

2.5 CONTROL VALVES

A. Provide automatic control valves suitable for the specified controlled media (Hot and Chilled Water). Provide valves, which mate and are compatible with the material of the connected piping. Equip control valves with the actuators of required input power type and control signal type to accurately position the flow control element and provide sufficient force to achieve required leakage specification. Control valves to be DuraDrive or equivalent.

B. Contractor to size valve Cv so that differential pressure at rated flow is between 3 to 5 psig for Chilled Water and 2 to 3.5 psig for Hot Water.

C. Control valves shall meet the heating and cooling loads specified, and close off against the differential pressure conditions within the application. Valves should be sized to operate accurately and with stability from 10 to 100% of the maximum design flow.

D. Electric actuation should be provided on all terminal unit reheat applications.

E. The actuator shall be direct coupled over the shaft, enabling it to be mounted directly to the damper shaft without the need for connecting linkage. The actuator shall have electronic overload circuitry to prevent damage. For power-failure/safety applications, an internal mechanical, spring return mechanism shall be built into the actuator housing. Non-spring return actuators shall have an external manual gear release to allow positioning of the damper when the actuator is not powered. Actuators to be DuraDrive or equivalent.
2.6 SMOKE DETECTORS

A. Smoke detector to be furnished and wired by Division 26, installed by Division 23. Smoke Detector – Robertshaw Model Number: 2650-450

2.7 AIRFLOW MEASURING STATIONS

A. Provide a thermal anemometer using instrument grade self-heated thermistor sensors with thermistor temperature sensors.

B. The flow station shall operate over a range of 0 to 5,000 feet/min with an accuracy of +/- 2% over 500 feet/min and +/- 10 ft/min for reading less than 500 feet/min.

C. The output signal shall be linear with field selectable ranges including 0-5 VDC, 0-10VDC and 4-20 mA.

D. Furnish Ebtron Series GTx116 airflow stations or approved equal.

PART 3 EXECUTION

3.1 CONTRACTOR RESPONSIBILITIES

A. The BAS system is to be furnished and installed by an Andover approved Contractor. The Contractor shall certify all work as proper and complete. Under no circumstances shall the design; scheduling, coordination, programming, training, and warranty requirements for the project are delegated to a subcontractor.

B. Unless notified otherwise, entrance to building is restricted. No one will be permitted to enter the building unless their names have been cleared with the Owner or the Owner’s Representative.

C. All wiring shall be installed in accordance with all applicable electrical codes and shall comply with equipment manufacturer’s recommendations.

D. At the completion of the work, all equipment pertinent to this Section shall be checked and thoroughly cleaned, and all other areas shall be cleaned around equipment provided under this contract. Clean the exposed surfaces of tubing, hangers, and other exposed metal of grease, plaster, or other foreign materials.

3.2 WIRING, CONDUIT, TUBING AND CABLE

A. All wire shall be copper and meet the minimum wire size and insulation class listed below:
<table>
<thead>
<tr>
<th>Wire Class</th>
<th>Wire Size</th>
<th>Isolation Class</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power</td>
<td>12 Gauge</td>
<td>600 Volt</td>
</tr>
<tr>
<td>Class Two</td>
<td>14 Gauge Std.</td>
<td>600 Volt</td>
</tr>
<tr>
<td>Class Two</td>
<td>18 Gauge Std.</td>
<td>300 Volt</td>
</tr>
<tr>
<td>Class Two</td>
<td>18 Gauge Std.</td>
<td>300 volt</td>
</tr>
<tr>
<td>Communications</td>
<td>Per Mfr.</td>
<td>Per Mfr.</td>
</tr>
</tbody>
</table>

B. Power and Class One wiring may be run in the same conduit. Class Two and Three wiring and communications wiring may be run in the same conduit.

C. Where different wiring classes terminate within the same enclosure, maintain clearances and install barriers per the National Electric Code.

D. Where wiring is required to be installed in the conduit, EMT shall be used. Conduit shall be minimum 1/2 inch galvanized EMT. Setscrew fittings are acceptable for dry interior locations. Watertight compression fittings shall be used for exterior locations and interior locations subject to moisture. Provide conduit seal off fitting where exterior conduits enter the building or between areas of high temperature/moisture differential.

E. Where the space above the ceiling is a supply or return air plenum, the wiring shall be plenum rated cable. Plenum rated cable can be run without conduit above suspended ceilings. Cabling shall be installed in conduit systems in mechanical and electrical rooms.

F. Flexible metallic conduit (max. 3 feet) shall be used for connections to motors, actuators, controllers, and sensors mounted on vibration producing equipment. Liquid-tight flexible conduit shall be used in exterior locations and interior locations subject to moisture.

G. Junction boxes shall be provided at all cable splices, equipment termination, and transitions from EMT to flexible conduit. Interior dry location J-boxes shall be galvanized pressed steel, nominal four-inch square with blank cover. Exterior and damp location JH-boxes shall be cast alloy FS boxes with threaded hubs and gasketed covers.

H. Pneumatic tubing will be FR rated polyethylene instrumentation tubing, type M, hard copper tubing, or soft copper tubing. All pneumatic tubing will be sized for a maximum pressure drop of 2 PSI from the pressure-reducing valve to end device.

I. Coaxial cable shall conform to RG62 or RG59 rating. Provide plenum rated coaxial cable when running in return air plenums.

J. Fiber optic cable shall include the following sizes; 50/125, 62.5/125 or 100/140: Only glass fiber is acceptable, no plastic.

K. Fiber optic cable shall only be installed and terminated by an experienced contractor. The BAS contractor shall submit to the Engineer the name of the intended contractor of the fiber optic cable with his submittal documents.

3.3 HARDWARE INSTALLATION
A. Installation Practices for Wiring and Tubing

1. All controllers are to be mounted vertically and per the manufacturer’s installation documentation.

2. A true earth ground must be available in the building. Do not use a corroded or galvanized pipe, or structural steel.

3. Conduit in finished areas shall be concealed in furred spaces and wall construction. Exception: metallic surface raceway may be used in finished areas on masonry walls. All surface raceway in finished areas must be color matched to the existing finish within the limitations of standard manufactured colors.

4. Conduit, in non-finished areas where possible, shall be concealed in furred spaces and wall construction. Exposed conduit shall run parallel to or at right angles to the building structure.

5. Wires are to be kept a minimum of 3 inches from hot water, steam, or condensate piping.

6. Where sensor wires leave the conduit system, they are to be protected by a plastic insert.

7. Wire or pneumatic tubing will not be allowed to run across telephone equipment areas.

8. All wiring running down exposed fire rated walls to controls or control panels shall be run in EMT or completely enclosed in metal raceways.

9. All control wiring in concrete walls or floors shall run in rigid conduit.

B. Installation Practices for Field Devices

1. Well-mounted sensors shall include thermal conducting compound within the well to ensure good heat transfer to the sensor.

2. Actuators shall be firmly mounted to give positive movement, and linkage shall be adjusted to give smooth continuous movement throughout 100% of the stroke.

3. Waterline mounted sensors shall be removable without shutting down the system in which they are installed.

4. For duct static pressure sensors, the high-pressure port shall be connected to a metal static pressure probe inserted into the duct pointing upstream. The low-pressure port shall be left open to the plenum area at the point that the high-pressure port is tapped into the ductwork.
5. For building static pressure sensors, the high-pressure port shall be inserted into the space via a metal tube. Pipe the low-pressure port to the outside of the building.

C. Enclosures

1. For all I/O requiring field interface devices, these devices where practical shall be mounted in a field interface panel (FIP). The Contractor shall provide an enclosure, which protects the device(s) from dust, moisture, conceals integral wiring and moving parts.

2. FIPs shall contain power supplies for sensors, interface relays and contactors, safety circuits, and I/P transducers.

3. The FIP enclosure shall be of steel construction with baked enamel finish, NEMA 1 rated with a hinged door and keyed lock. The enclosure will be sized for twenty percent spare mounting space. All locks will be keyed identically.

4. All wiring to and from the FIP shall be to screw type terminals. Analog or communications wiring may use the FIP as a raceway without terminating. The use of wire nuts on control signal wires within the FIP is prohibited.

5. All outside mounted enclosures shall meet the NEMA-4 rating.

6. The tubing and wiring within all enclosures shall be run in plastic track. Wiring within controllers shall be wrapped and secured.

D. Identification

1. Identify all control wires with labeling tape or sleeves using words, letters, or numbers that can be exactly cross-referenced with as-built drawings.

2. Identify all pneumatic tubing with labeling tape or sleeves using words, letters, or numbers that can be exactly cross-referenced with as-built drawings.

3. All field enclosures, other than controllers, shall be identified with a Bakelite nameplate. The lettering shall be in white against a black or blue background.

4. Junction box covers shall be marked to indicate that they are a part of the BAS system.

5. All I/O field devices (except space sensors) that are not mounted within FIP's shall be identified with nameplates.

6. All I/O field devices inside FIP's shall be labeled.

E. Location
1. The location of sensors shall be per mechanical and architectural drawings.

2. Space humidity or temperature sensors shall be mounted away from machinery generating heat, direct light and diffuser air streams.

3. Outdoor air sensors shall be mounted on the north building face directly in the outside air. Install these sensors such that the effects of heat radiated from the building or sunlight is minimized.

4. Field enclosures shall be located immediately adjacent to the controller panel(s) to which it is being interfaced.

3.4 SOFTWARE INSTALLATION

A. The software design and implementation is to be facilitated only by an Andover approved Contractor. The Contractor shall provide all labor necessary to install, initialize, start-up and debug all system software as described in this section. This includes any operating system software or other third party software necessary for successful operation of the system.

B. The Contractor will provide all labor to configure those portions of the database that are required by the point’s list and sequence of operation.

C. Color Graphic Slides:

1. Unless otherwise directed by the owner, the Contractor shall provide color graphic displays matching the Campus Standards for each system and floor plan.

2. For each system or floor plan, the display shall contain the associated points identified in the point list and allow for setpoint changes as required by the owner.
   a. Animations and 3D Rendering.
   b. Animations to mimic all moving devised, status and operation.
   c. Animations set to maximum performance, compatible with Version 1.81.
   d. Individual slides; mechanical equipment, VAV/CAV boxes, pumps, motors, fans, dampers, thermostats, and valves.

D. Reports

1. The Contractor shall configure a minimum of 6 reports for the owner as listed below:
b. VAV Status Report.


E. Documentation

1. As built software documentation shall include the following:

   a. Descriptive point lists.

   b. Application program listing.

   c. Application programs with comments.

   d. Printouts of all reports.

   e. Alarm list.

   f. Printouts of all graphics.

3.5 COMMISSIONING AND SYSTEM STARTUP

A. Point to Point Checkout

1. Each I/O device (both field mounted as well as those located in FIPs) shall be inspected and verified for proper installation and functionality. A checkout sheet itemizing each device shall be filled out, dated and approved by the Facilities Manager for submission to the owner’s representative.

B. Controller and Workstation Checkout

1. A field checkout of all controllers and front-end equipment (computers, printers, modems, etc.) shall be conducted to verify proper operation of both hardware and software. A checkout sheet itemizing each device and a description of the associated tests shall be prepared and submitted to the owner or owner’s representative by the completion of the project.

C. System Acceptance Testing

1. All application software shall be verified and compared against the sequences of operation. Control loops shall be exercised by inducing a setpoint shift of at least 10% and observing whether the system successfully returns the process variable to setpoint. Record all test results and attach to the Test Results Sheet.

2. Test each alarm in the system and validate that the system generates the
appropriate alarm message, that the message appears at all prescribed destinations (workstations or printers), and that any other related actions occur as defined (i.e. graphic panels are invoked, reports are generated, etc.). Submit a Test Results Sheet to the owner.

3. Perform an operational test of each unique graphic display and report to verify that the item exists, that the appearance and content are correct, and that any special features work as intended. Submit a Test Results Sheet to the owner.

4. Perform an operational test of each third party interface that has been included as part of the automation system. Verify that all points are properly polled, that alarms have been configured, and that any associated graphics and reports have been completed. If the interface involves a file transfer over Ethernet, test any logic that controls the transmission of the file, and verify the content of the specified information.

END OF SECTION
SECTION 26 05 00
BASIC ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Work included in this Section: All materials, labor, equipment, services, and incidentals necessary to install the Electrical Work as shown on the drawings and as specified hereinafter, including, but not limited to the following:

1. Branch circuit wiring, wiring devices and connections to all equipment requiring electrical service.

2. Lighting fixtures completely lamped, including switches, raceways and wiring.

3. Emergency egress/exit illumination system.

4. Fire Alarm system.

5. Mechanical equipment power connections, and motor starters where noted.

6. Low voltage lighting control system and programming.

7. All required incidental work, such as roof flashing, electrical testing, title 24 acceptance testing, and temporary power.

8. Any other electrical work as might reasonably be implied as required, even though not specifically mentioned herein or shown on the drawings.

9. It is the intent of the drawings and specifications that systems be complete and, except as otherwise noted, be ready for operation.

1.2 RELATED WORK

A. Division 1 - General Requirements

B. Division 9 - Finishes

C. Division 23 - Mechanical

1.3 INCORPORATED DOCUMENTS

A. Requirements of the General Conditions, Supplementary Conditions, and Division 1 Sections apply to all work in this Section, unless modified herein.
B. Published specifications, standard tests or recommended methods of trade, industry or
government organizations apply to work of this Section where cited by abbreviations
noted below, unless modified herein.

1. 2013 California Code of Regulations.

2. 2013 California Building Standards Administrative Code, Part 1, Title 24, C.C.R.

3. 2013 California Building Code (CBC), Part 2, Title 24, C.C.R. (Based on 2012

4. 2013 California Electrical Code (CEC), Part 3, Title 24, C.C.R. (Based on 2011
   National Electrical Code with 2013 California Amendments).

5. 2013 California Mechanical Code (CMC), Part 4, Title 24, C.C.R. (Based on 2012
   Uniform Mechanical Code with 2013 California Amendments).

6. 2013 California Plumbing Code (CPC), Part 5, Title 24, C.C.R. (Based on 2012
   Uniform Plumbing Code with 2013 California Amendments).

7. California Energy Code, Part 6, Title 24, C.C.R.

8. 2013 California Fire Code (CFC), Part 9, Title 24, C.C.R. (Based on 2012

9. American Society of Civil Engineers 7-10 (ASCE/SEI), Minimum Design Loads for
   Buildings and Other Structures.

10. Underwriters' Laboratories, Inc. (UL).

11. Local Utility Company regulations.

C. All State and Municipal Codes and Ordinances.

1.4 CONDITIONS AT SITE:

A. Visit to site is required of all bidders prior to submission of bid. All will be held to have
   familiarized themselves with all discernible conditions and no extra payment will be
   allowed for work required because of these conditions, whether specifically mentioned
   or not.

B. Lines of other services that are damaged as a result of this work shall promptly be
   repaired at no expense to the Owner to the complete satisfaction of the Owner.

1.5 QUALITY ASSURANCE

A. Conformance:

1. All work shall conform to the applicable requirements of Article 1.3 above.
2. The Contractor shall notify the Architect, prior to submission of bid, about any part of the design, which fails to comply with abovementioned requirements.

3. If after contract is awarded, minor changes and additions are required by aforementioned authorities, even though such work is not shown on drawings or covered in the specifications, they shall be included at Contractor's expense.

B. Coordination:

1. The Contractor shall become familiar with the conditions at the job site, and with the drawings and specifications and plan the installation of the electrical work to conform with the existing conditions and that shown and specified so as to provide the best possible assembly of the combined work of all trades.

2. The Contractor shall work out in advance all "tight" conditions, involving all trades and if found necessary, supplementary drawings shall be prepared by this Contractor, for the Architect's approval, before work proceeds in these areas. No additional costs will be considered for work, which must be relocated due to conflicts with the work of other trades.

3. The Contractor shall coordinate and verify all backbox, device, lighting fixture, or equipment mounting requirements with the devices or equipment to be installed, prior to rough in.

1.6 SUBMITTALS

A. Product Data:

1. Comply with the provisions of Section 01 33 00 - Submittals.

2. Within 15 days after award of the Contract, submit:

   a. Complete electrical, lighting, and signal systems material list of all items proposed to be furnished and installed under this Division. Provide manufacturers data sheets for all devices, raceways, fixtures, equipment, and related products to be used for the Division 26, 27, and 28 work.

   b. Manufacturers' specifications and other data required demonstrating compliance with the specified requirements.

   c. Manufacturers' recommended installation procedures which, when approved by the Architect, shall become the basis for inspecting and accepting or rejecting actual installation procedures used on the work.

3. Shop Drawings: Furnish shop drawings and/or equipment cuts for the following:

   a. Light fixtures including lamps and ballasts
b. Fire alarm system

c. Disconnect switches

d. Motor starters

e. Low voltage lighting control system

f. Mechanical and Plumbing equipment. The Electrical Contractor shall review the Mechanical and Plumbing Submittals, and verify the voltage, wire size and overcurrent protection required. Also provide the Electrical Engineer with a copy of the submittals for their review.

4. Test Reports:


b. Field Tests: Performance tests as specified for specific equipment.

c. Megger Tests: As specified under TESTING.

d. When series rated circuit breakers are used, provide a letter from the manufacturer of the equipment confirming that U.L. series rating exists for all protective devices. State the available fault current from the Utility Company and indicate that the overcurrent devices exceed the available fault current at the respective point of protection.

e. Special Seismic Certification documentation as per CBC Section 1616A and ASCE/SEI 7-10 requirements for all equipment defined as 'critical’ with an importance factor of 1.5 in Paragraph 1.10.M.3 of this Section.

f. Manufacturer's Seismic Certification or Project-Specific Design of Supports and Attachments for all other equipment and fixtures as per CBC Section 1616A and ASCE/SEI 7-10 requirements.

5. Maintenance and Operating Manuals:

a. Systems Description: Description of operating procedures.

b. Controls: Diagrams and description of operation of each system.

c. Equipment: Manufacturer’s brochures, ratings, certified shop drawings, maintenance data, and parts lists with part numbers. Mark each sheet with equipment identification number and actual installed condition.

d. Materials and Accessories: Manufacturer's brochures, parts lists with part numbers, and maintenance data where applicable. Mark each sheet with identification number of system and location of installation.
e. The Maintenance and Operation Manual shall be presented in a three ring binder that has tabbed sections as stated below. Provide all information in each section as stated below.

1) 26 51 01:
   (a) Insert the approved submittals for the light fixtures.
   (b) Highlight the lamp type that was installed for each light fixture.
   (c) Provide the names, address and telephone numbers of the manufacturer and the closest manufacturer’s representative for each light fixture.

2) 26 51 01:
   (a) Insert the approved submittals for the motion sensing light control equipment.
   (b) Insert all operating instructions.
   (c) Provide the names, address and telephone number of the manufacturer and the closest manufacturer’s representative of the equipment.
   (d) Include the manufacturer's recommended maintenance of the equipment.

3) 27 00 00:
   (a) Insert the approved submittals for the telephone/data system.
   (b) Provide the names, address and telephone number of the manufacturer and the closest manufacturer's representative of the equipment.
   (c) Include the manufacturer's recommended maintenance of the equipment.

4) 28 31 01:
   (a) Complete the “Record Of Completion” entirely.
   (b) Provide the names, address and telephone number of the manufacturer and the closest manufacturer's representative of the equipment.
(c) Include the manufacturer's recommended maintenance of the equipment.

(d) Insert an abbreviated data sheet that states how to test, reset and silence the fire alarm system.

5) 26 08 00:

(a) Insert all feeder system testing results.

6. Record Documents: "As-builts": As specified under Paragraph 3.2 of this Section.

1.7 DELIVERY, STORAGE AND HANDLING

A. Protection: Use all means necessary to protect the materials of this Section before, during, and after installation and to protect the work and materials of all trades.

B. Delivery and Storage: Deliver all materials to the job site in their original containers with all labels intact and legible at time of use. Store in strict accordance with approved manufacturers' recommendations.

C. Replacements: In the event of damage, immediately make all repairs and replacements necessary to the approval of the Architect and at no additional cost to the Owner.

D. This Contractor shall personally, or through an authorized representative, check all materials upon receipt at job site for conformance with approved shop drawings and/or plans and specifications.

1.8 SCHEDULING/SEQUENCING

A. Place orders for all equipment in time to prevent any delay in construction schedule or completion of project. If any materials or equipment are not ordered in time, additional charges made by equipment manufacturers to complete their equipment in time to meet the construction schedule, together with any special handling charges, shall be borne by this Contractor.

B. The Contractor shall coordinate production and delivery schedule for all Owner-supplied equipment with the equipment suppliers to ensure that all Owner-supplied equipment is delivered to site in coordination with the construction schedule and in such a manner as to cause no delays in completion of the Contract as scheduled.

1.9 REQUIREMENTS

A. The contract drawings indicate the extent and general arrangements of the conduit wiring systems, etc. If any departures from the contract drawings are deemed necessary by the Contractor, details of such departures and the reasons therefore shall...
be submitted as soon as practicable, and within thirty-five (35) days after award of the electrical contract.

B. Unless material list and data is received as a complete and all inclusive submittal within the stipulated time all items shall be provided as specified, with no deviations permitted.

C. Any and all additional costs incurred by the substitution of electrical material or equipment, or installation thereof, whether architectural, structural, plumbing, mechanical or electrical, shall be borne by the Contractor under this Section.

D. Burden of proof of equality of any substitution for a specified product is the responsibility of this Contractor.

E. Where required by Architect to ascertain equality of substitute product, Contractor may be requested to provide the specified item and the submitted substitution for comparison, at no additional cost to the Owner.

1.10 SEISMIC CERTIFICATION AND INSTALLATION OF EQUIPMENT

A. See Architectural and Structural Drawings and Specifications for description of Occupancy Group and Seismic Design Category applicable to this project.

B. Provide Special Seismic Certification per CBC Section 1616A and ASCE/SEI 7-10 for all equipment and components defined as critical with an importance factor 1.5 in Paragraph 1.10.M.3 of this Section.

C. Special Seismic Certification shall require either certification through approved analytical method or approved shake table testing in accordance with Section 13.2.5 of ASCE/SEI 7-10 or experience data in accordance with Section 13.2.6 of ASCE/SEI 7-10.

D. Manufacturer's Seismic Certification or Project-Specific Design of Supports and Attachments for all other equipment and fixtures as per CBC Section 1616A and ASCE/SEI 7-10 requirements.

E. Provide seismic restraints per applicable code and as specified or indicated. Design restraints to prevent permanent displacement in any direction caused by lateral motion, overturning, or uplift.

F. Rigidly Supported Equipment, Conduits, and Raceways.

G. Components supported by chains or simply suspended from above are not required to meet lateral seismic force requirements and seismic relative displacement requirements provided that they cannot be damaged or cannot damage any other component when subject to seismic motion. They must have ductile or articulating connections to the structure at the point of attachment.

H. Electrical Cabinets:
1. Electrical cabinet design shall conform to National Electrical Manufacturers Association (NEMA) 250 and NEMA ICS6 standards. Cutouts in the lower shear panel that do not appear to have been made by the manufacturer and significantly reduce the strength of the cabinet are not permitted unless analysis demonstrates that the remaining strength is sufficient.

2. A latch or fastener to prevent opening during an earthquake event and damaging the cabinet and internal components shall secure all doors.

3. Slide-out components in electrical control panels, etc., shall have a latching mechanism to hold contents in place.

4. Attached cabling shall have adequate slack or flexibility between the cabinets and surrounding structure supporting the conduit to preclude severing of the cabling due to differential seismic displacements.

I. The design load shall include the effects of loading on the equipment imposed by attached utility or service lines that are also attached to separate structures.

J. The attachment of additional external items is not permitted unless such items have either been provided by the Manufacturer, or analysis shows that their effects are supported by design.

K. Conduit and their connections shall be constructed of ductile materials unless otherwise approved by the Architect. Conduits and their connections constructed of non-ductile materials (e.g., cast iron, no-hub pipe and plastic) shall have brace lengths reduced to one-half that allowed for ductile material.

1. All trapeze assemblies supporting conduit shall be braced to resist CBC design forces considering the total weight of the elements on the trapeze.

2. Seismic restraint spacing shall be in accordance with hanger spacing.

L. Critical Equipment:

1. Design with importance factor of 1.5.

2. Provide Special Seismic Certification for all equipment and components and their installation per CBC and ASCE/SEI requirements.

3. Critical Equipment shall include the following:
   a. Fire Alarm system equipment.
   b. Lighting System Inverter (where applies).

M. Seismic Design Submittals: For all Critical Equipment included in paragraph 26.05 00.1.10.M.3.
1. The Manufacturer of each item of critical equipment shall arrange for the testing or analysis by an approved agency of each component and assembly and its mounting system or anchorage.

2. The Manufacturer shall submit a Certificate of Compliance for each item for approval by the Architect and by the Authority Having Jurisdiction.

3. Based on Manufacturer's approved submittal, Contractor shall retain the services of a State of California registered Structural Engineer to prepare final installation details and drawings for equipment supports and attachments.

4. Submit drawings of the equipment showing dimensions, support equipment, connections, and the proper anchorage locations.

5. Equipment weight and weight distribution (e.g., center of gravity in elevation and plan).

6. Thickness of sheet metal bases.

7. Seismic Vibration Isolation Devices: Manufacturer's product information indicating class and type. Indicate load ratings as published manufacturer's data or shop drawings. Indicate proper orientation of devices on plan.

8. Inertia bases and support frames.

9. Specific details of restraints including anchor bolts and welds and maximum load at each location.

N. Independent Supports: An independent means of secure support shall be provided for all wiring methods in non-fire-rated assemblies. Where independent support wires are used, they shall be distinguishable by color, tagging, or other effective means.

1.11 DESCRIPTION OF WORK

A. This project involves the renovation of an existing building. As such, the project scope for this contractor will include all associated electrical, lighting, and signal system upgrades and demolition/removal work at the existing site. The intent is that all systems will be complete and functional at the completion of this contract and that all old systems, equipment, feeders, circuits, wiring, and related devices (no longer used) be completely and neatly removed. Where discrepancies between the drawings and existing conditions are noted, the project manager shall be notified immediately for resolution.

B. As with every renovation project, the electrical work will include (and require) exploration and other field work on a daily basis to complete the new designed equipment and connections within the constraints of the existing building and existing site conditions.
C. The contractor shall include as part of the base bid, sufficient labor hours to provide such exploration and field work throughout the duration of the project. Change orders for misc. coordination of existing conditions will not be approved unless specific and latent conditions are uncovered that warrant such additional compensation or require additional work not shown on the plans or implied by the designed conditions.

D. New raceways and wiring to new and renovated equipment are to be installed unless otherwise noted. Where raceways are installed in accessible concealed locations (i.e. unfinished spaces or electrical / mechanical / attic spaces), EMT with wire shall be used. Where new wiring is required to be routed through existing walls and ceilings that can not easily be accessible for new conduit, MC cable or flex conduit and wiring may be installed, fished through and secured in each space as required by code. Non-metallic sheathed cable shall not be utilized on this project.

E. All new raceways shall be installed concealed and all new equipment installed flush, unless otherwise noted on the plans or in these specifications.

1.12 GUARANTEE

A. This Contractor shall guarantee that all work executed under this Section will be free from defects of materials and workmanship for a period of one (1) year or as per the General Conditions of this project, whichever is longer. Dates shall be from the date of final acceptance of the building. The contractor shall further guarantee that he will, at his own expense, repair and replace all such defective work, and all other work damaged thereby, which becomes defective during the term of the guarantee. Such repair or replacement shall be guaranteed for one (1) year from the date of repair or replacement.

1.13 PERMITS AND INSPECTIONS

A. This Contractor shall arrange for and obtain all required inspections.

B. Do not allow or cause any of the work to be covered or enclosed until it has been tested and/or inspected.

1.14 IDENTIFICATION

A. Switchboards, feeder circuit breakers in switchboards, panels, disconnect switches, motor starters, transformers, motor disconnect switches, cabinets, and other apparatus used for the operation of, or control of circuits, appliances or equipment, shall be properly identified by means of engraved laminated plastic descriptive nameplates mounted on apparatus using stainless steel screws. Nameplates shall have white letters with black background and be submitted to the Architect for approval. Cardholders in any form are not acceptable.

B. Provide p-touch style labeling of circuit designations for all receptacles on the project.
C. Each branch circuit of panel boards to have a permanently fixed number with load
directory, mounted under celluloid on inside of cabinet door, showing circuit numbers
and typewritten description of equipment supplied by breakers.

D. Provide label on all motors: "Caution. Automatic equipment. May start at any time."

E. Provide silk-screened or engraved identification labels on all switch box covers
identifying specific loads that are not readily apparent to the user, including
electroshades, projection screens, exhaust fans, etc. Submit proposed labels to
Architect for approval prior to manufacture of labels.

F. Provide identification of all pull boxes, junction boxes, and conduit stub-ups on the
project as outlined below:

1. For Power Feeders:
   a. Stencil cover with identifying circuit number.
   b. Lettering 1" high.
   c. Color of lettering black.
   d. Place lettering on cover in neat manner; run parallel to long sides of
      box.

2. For branch circuits, grounding, communication, signal, and control systems
   boxes and blank conduit stub-outs:
   a. Paint inside back of each j-box, front of each cover, and ends of each
      blank conduit stub-out with identifying system color as listed below:
      1) 277/480-volt Orange
      2) 120/208-volt Blue
      3) Ground system Green
      4) Fire Alarm Red
      5) Lighting control Orange/White

PART 2 - PRODUCTS

2.1 GENERAL

A. Refer to applicable Division 26, 27, and 28 Sections for complete products
   specifications.
2.2 MATERIALS

A. Materials of the same type or classification, used for the same purpose, shall be the product of the same manufacturer.

2.3 ACCEPTABLE MANUFACTURERS

A. Materials shall be of make mentioned elsewhere in this specification. All materials shall be the best of their several kinds, perfectly new and approved by the Underwriters' Laboratories.

B. Where material, equipment, apparatus or other products are specified by manufacturer, brand name, type or catalog number, such designation is to establish standards of desired quality, style and utility and shall be the basis of the bid. Materials so specified shall be furnished under the contract unless changed by written approval of the Architect. Where two or more designations are listed, choice shall be optional with this Contractor, but this Contractor must submit his choice for final approval.

2.4 POSTED OPERATING INSTRUCTIONS

A. Furnish approved operating instructions for systems and equipment where indicated in the technical sections for use by operation and maintenance personnel. The operating instructions shall include wiring diagrams, control diagrams, and control sequence for each principal system and equipment. Print or engrave operating instructions and frame under glass or in approved laminated plastic. Post instructions as directed. Attach or post operating instructions adjacent to each principal system and equipment including startup, proper adjustment, operating, lubrication, shutdown, safety precautions, procedure in the event of equipment failure, and other items of instruction as recommended by the manufacturer of each system or equipment. Provide weather-resistant materials or weatherproof enclosures for operating instruction exposed to the weather. Operating instruction shall not fade when exposed to sunlight and shall be secured to prevent easy removal or peeling.

2.5 CATALOGED PRODUCTS/SERVICE AVAILABILITY

A. Materials and equipment shall be current products by manufacturers regularly engaged in the production of such products. Products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year period shall include applications of equipment and materials under similar circumstances and of similar size. The 2-year period shall be satisfactorily completed by a product for sale on the commercial market through advertisements, manufacturers' catalogs, or brochures. Products having less than a 2-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6,000 hours, exclusive of the manufacturers' factory or laboratory tests, is furnished. The equipment items shall be supported by service organizations which are reasonable convenient to the equipment installation in order to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.
PART 3 - EXECUTION

3.1 INSPECTION

A. Examine the areas and conditions under which the work of this Section will be installed. Correct conditions detrimental to the proper and timely completion of the Work. Do not proceed until unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Drawings:

1. The general arrangement and location of wiring and equipment is shown on the electrical drawings and shall be installed in accordance therewith, except for minor changes required by conflict with the work of other trades.

2. The Contractor shall coordinate and verify all backbox, device, lighting fixture, or equipment mounting requirements with the devices or equipment to be installed, prior to rough in.

3. Drawings indicate the circuit and panel which supplies each device or fixture. Provide and install conduit and conductors to make all connections from panel to nearest device and from first device to additional devices on same circuit. Conduit size and fill shall satisfy NEC requirements. Two or three different phases supplied by a 3-phase panel may share a single neutral only if circuit positions are adjacent in the panel. Do not exceed 4 #12 or 3 #10 conductors in a ½" conduit, 7 #12 or 5 #10 in a 3/4" conduit, and 11 #12 or 9 #10 in a 1" conduit, unless otherwise noted. Provide common handle-tie on breakers for multi-wire branch circuits (with common neutral), per NEC. If more than three current carrying conductors are installed in one conduit, conductor size shall be increased as required per NEC. Do not share neutrals for branch circuit runs to electronic equipment or where noted on the drawings.

4. Drawings indicate the location of all light switches. Where fixtures in a room are controlled by more than one switch, the same lower case letter is drawn adjacent to a switch and each fixture controlled by that switch. Where no lower case letter is adjacent to a switch, all fixtures in the room are controlled by that switch. Provide and install conduit and wire from fixture to switch and between fixtures as required to accomplish switching shown. Do not route branch circuit wiring for light fixtures through switch boxes.

5. Drawings indicate location of all signal outlet boxes. Provide and install conduit system as required as required and complete system wiring, unless otherwise noted.

6. Control wiring is generally not shown on the plans. Contractor shall refer to control diagrams and provide and install all wiring and raceways required to make all interconnections.
7. All branch circuit wiring No. 12 or No. 10 as noted, all control wiring No. 14, except as noted next to "slash marks" on drawings, or as noted under "Wire," as specified herein.

8. All dimensions, together with locations of doors, partitions, etc. are to be taken from the Architectural Drawings, verified at site by this Contractor.

9. Maintain "as-built" records at all times, showing the exact location of concealed conduits and feeders installed under this contract, and actual numbering of each circuit. Upon completion of work and before acceptance can be considered, this Contractor must forward to the Architect, updated CAD plans, corrected to show the electrical work as actually installed.

10. Branch circuit conductors shall be #12 minimum and #10 minimum for runs longer than 150 feet.

B. Measurements: Before ordering any material or closing in any work, verify all measurements on the job. Any differences found between dimensions on the drawings and actual measurements shall be brought to the Architect's attention for consideration before proceeding.

3.3 FIELD QUALITY CONTROL

A. All workmanship shall be first class and carried out in a manner satisfactory to and approved by the Architect.

B. This Contractor shall personally, or through an authorized and competent representative, constantly supervise the work and so far as possible keep the same foreman and workmen on the job throughout.

3.4 COORDINATION

A. In electrical rooms, where electrical equipment is located at walls with brace framing, provide and install steel channel supports for mounting of electrical equipment away from wall to avoid conflict with brace framing. Steel channel supports shall be unistrut or equal, and shall include all channels, bases, fittings, etc., as required for a complete installation.

B. In electrical rooms, Contractor is responsible for installation of electrical equipment within the space provided. Contractor shall provide ¼" scale plans of electrical room layouts, and elevations of steel channel supports (where used or required) of electrical equipment for review and approval prior to any installation or rough-in.

3.5 INSTALLATION/APPLICATION/ERECTION

A. All electrical raceways and devices shall be installed concealed (for raceways) and/or flush mounted (for devices), unless otherwise noted. Provide cut-in boxes and "fish" flexible MC or flex conduit and wire through existing walls to remain, unless shown
otherwise on plans. Cut and patch to facilitate such installation to match adjacent and original finish.

B. All cutting, repairing and structural reinforcing for the installation of this work shall be done by the General Contractor in conformance with the Architect’s requirements.

3.6 EMERGENCY POWER SOURCES

A. All emergency source circuits shall be installed in separate raceways (from normal power), per 2014 NEC 700.10(B), or the applicable code at the time of permitting.

3.7 TEMPORARY LIGHTING AND POWER

A. Provide and install temporary lighting and power systems for the duration of construction, of adequate size to accommodate the required lighting and power loads. Coordinate with other trades to insure adequate sizing.

B. Provide distribution equipment as required to support all construction activities.

3.8 FIRE STOPPING AND FIRE RATED PENETRATIONS

A. All electrical equipment mounted in, on, or through fire rated construction shall be installed to maintain the fire rating of the construction.

B. Provide fire rated pads (or other suitable assembly) around all electrical junction boxes in fire rated walls/ceilings/floors to maintain the fire rating.

C. Provide fire rated construction around all recessed light fixtures and/or panel board / cabinets mounted flush in fire rated walls to maintain the fire rating. Coordinate depth of construction with other trades to avoid conflicts.

D. Conduit sleeves shall be provided as a means of routing cables through fire-rated walls or floors. Openings in sleeves and conduits used for system cables and those which remain (empty) spare shall be sealed with an approved fireproof, removable sagging material. Sleeves which pass vertically from floor to floor shall be sealed in a similar manner using an approved re-enterable system. Additional penetrations through rated assemblies necessary for passage of tel/data wiring shall be made using an approved method and permanently sealed after installation of cables.

3.9 ADJUSTING AND CLEANING

A. All electrical equipment, including existing equipment not "finish painted" under other sections, shall be touched up where finished surface is marred or damaged.

B. All equipment, lighting fixtures, etc., shall be left in clean condition, with all shipping and otherwise unnecessary labels removed there from.
3.10 SCHEDULES

A. Coordination: Coordinate installation of electrical items with the schedule for other work to prevent unnecessary delays in the total Work.

3.11 WARNING SIGN MOUNTING

A. Provide the number of signs required to be readable from each accessible side, but space the signs a maximum of 30 feet apart.

3.12 PAINTING OF EQUIPMENT

A. Factory Applied: Electrical equipment shall have factory-applied painting systems which shall, as a minimum, meet the requirements of NEMA ICS 6 corrosion-resistance test, except equipment specified to meet requirements of ANSI C37.20 shall have a finish as specified in ANSI C37.20.

B. Field Applied: Paint electrical equipment as required to match finish or meet safety criteria. Painting shall be as specified in the respective equipment section.

3.13 TESTS

A. Testing and inspection: See Section 26 08 00 - Testing.

END OF SECTION
SECTION 26 08 00

TESTING

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Work Included in This Section: All materials, labor, equipment, services, and incidentals necessary to perform the testing and inspection of the electrical work, including but not limited to the general systems noted below:

1. Grounding System.

2. Lighting System.

3. Distribution System.


5. Lighting control system.

6. Title 24 Acceptance Testing

B. Any other electrical work as might reasonably be implied as required, even though not specifically mentioned herein or shown on the drawings.

C. All work shall comply with Sections 26 05 00 and 26 27 00.

D. In addition to the general system tests and inspections indicated above, the Contractor shall retain the services of a recognized corporately and financially independent testing firm (Emerson Network Power or equal) for the purpose of performing the following inspections and tests. The testing firm shall provide all material, equipment, labor, and technical supervision to perform such tests and inspections:

1. System Grounding.

E. The purpose of these tests is to assure that all tested electrical equipment is operational and within industry and manufacturer's tolerances and is installed in accordance with design specifications.

1.2 APPLICABLE CODES, STANDARDS, AND REFERENCES

A. All inspections and tests shall be in accordance with the International Electrical Testing Association - Acceptance Testing Specifications ATS-2013 (referred to herein as NETA ATS-2013).

1.3 QUALIFICATIONS

A. Qualifications of the Testing Firm shall be as listed in NETA ATS-2013.
PART 2 - PRODUCTS

2.1 THIS ARTICLE DOES NOT APPLY TO TESTING.

PART 3 - EXECUTION

3.1 GENERAL

A. Final test and inspection to be conducted in presence of the Authority having Jurisdiction (AHJ) or Inspector of Record (IOR). Test shall be conducted at the expense of, and managed by, the Contractor, at a mutually agreed time. Submit written test report of all tests, with test result values and overall outcome.

B. All portions of the electrical installation shall be inspected and tested to ensure safety to building occupants, operating personnel, conformity to code authorities and Contract Documents, and for proper system operation.

3.2 INSPECTIONS AND TESTS

A. Tests: Field tests shall be performed and reports submitted, as per Section 26 05 00, Part 1.

1. Final Inspection Certificates: Prior to final payment approval, deliver to the Owner, with a copy to the Architect, signed certificates of final inspection by the appropriate local authority having jurisdiction.

B. Grounding System:

1. All ground connections shall be checked and the entire system shall be checked for continuity. The resistance of grounding electrodes in the system shall be measured using a 3 point fall-of-potential method. The maximum ground resistance shall be three ohms. If the measured ground resistance exceeds three ohms, install an additional ground rod, bonded and interconnected with the grounding electrode system.

2. Ground tests shall meet or exceed the requirements of the National Electric Code.

C. Lighting Systems:

1. The interior and exterior lighting systems shall be checked for proper local controls and operation of entire installation, including the operation of the low voltage lighting control system.

D. Power Distribution System:

1. Test panel boards for grounds and shorts with mains disconnected from feeders, branch circuits connected and circuit breakers closed, all fixtures in
2. Check verification of color coding, tagging, numbering, and splice make-up.

3. Verify that all conductors associated with each circuit are in same conduit.

4. Demonstrate that all lights, jacks, switches, outlets, and equipment operate satisfactorily and as called for.

5. Test proper functioning of the ground fault protective system(s).

6. Perform megger tests of all distribution system feeders prior to energizing. All Cables failing megger tests or with evidence of damage shall be removed and replaced in their entirety (no splices), at no cost to the Owner. Damaged cables may not be field repaired without specific approval of the Architect.

E. Fire Alarm System: Verify that all equipment, components, and devices function as specified. Refer to Section 28 3101 for additional testing requirements.

F. Lighting Control System: Verify that all equipment, components, and devices function as specified. Refer to Section 26 5101 for additional testing requirements.

G. Title 24 Acceptance Testing: Contractor shall complete the requirements for Title 24 Acceptance Testing, as per CA Title 24, Part 6.

1. Perform testing requirements as per Title 24 Lighting Acceptance requirements. Testing shall include construction inspection of installed controls, occupancy / motion sensor testing, manual daylighting controls testing, automatic time switch controls testing, and demand response system interface, as applicable.

2. Complete and submit all required forms for complete Acceptance Testing.

3. Obtain required review and approval of Acceptance Forms to allow final certificate of occupancy to be granted.

END OF SECTION
SECTION 26 27 00
BASIC ELECTRICAL MATERIALS AND METHODS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Work included in this Section: All materials, labor, equipment, services, and incidentals necessary to install the electrical work as shown on the drawings and as specified hereinafter, including but not limited to the work listed below:

1. Raceways, feeders, branch circuit wiring, wiring devices, safety switches and connections to all equipment requiring electric service.

B. Any other electrical work as might reasonably be implied as required, even though not specifically mentioned herein or shown on the drawings.

C. All work shall comply with Section 26 05 00.

1.2 RELATED WORK

A. Division 09 - Finishes

B. Division 23 - Motors and Mechanical Equipment Installation

1.3 SUBMITTALS

A. Comply with the provisions of Section 26 05 00.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Refer to Section 26 05 00, Basic Electrical Requirements, Part 2 - Products.

B. List of Equipment Manufacturers:

Conduit and Conduit Fittings


Wire and Cable (600V)
American Wire Company, General Wire and Cable Corporation, Okonite Company, Rome Cable Corporation, Cerrowire, American Insulated Wire, AFC Cable Systems, Essex, Simplex Wire and Cable Company, Southwire.

Solderless Lugs and Grounding Connections


Pull Boxes, Gutters, Special Cabinets


Outlet Boxes


Steel City Electric Company, Hubbell Inc, RCI, Walker.

Wiring Devices

Leviton, Arrow-Hart, Cooper, Hubbell, Lutron, Bryant.

Conduit Racks, Hangers


Safety Switches (Disconnect and Fusible)

Fuses
Bussman Manufacturing Company, Chase-Shawmut Company.

Firestopping
3M, Nelson.

2.2 MATERIALS

A. Raceways: Only the raceways specified below shall be utilized on this project. Substitutions shall be pre-approved in writing. All bare conduit ends (stub-ups or stub-outs) shall be provided with bushed ends or manufactured insulated throat connectors:

1. Rigid Type - hot dip galvanized or sherardized steel, use on all exterior locations, below grade or in concrete slab, and to 18" on either side of structural expansion joints in floor slabs, with completely watertight, threaded fittings throughout. Compression fittings are not acceptable.
   a. All rigid steel conduit couplings and elbows in soil or concrete or under membrane to be ½ lap wrapped with Scotch #50 tape and threaded ends coated with T&B #S.C.40 rust inhibitor prior to installation of couplings.
   b. ½ lap wrapp all rigid steel conduit stub-ups from slab or grade to 6" above finished grade level with Scotch #50 tape.

2. Intermediate metal conduit may be used in all exposed interior locations, except that electrical metallic tubing may be used in some locations as noted below. Utilize steel compression type fittings for all exposed conduit runs, unless otherwise noted. Cast fittings are unacceptable.

3. Electrical metallic tubing shall be used exposed in interior electrical and mechanical rooms, in interior unfinished spaces, and in interior concealed and furred spaces, made up with steel watertight or steel set screw type fittings and couplings. EMT shall not be used in under-building crawl spaces or other areas subject to moisture. Set screws shall have hardened points. Cast fittings are unacceptable.

4. Use flexible conduit for all motor, transformer and recessed fixture connections, minimum ¼"; "Seal tite" type used outdoors and in all wet locations, provide with code size (minimum No. 12) bare ground wire in all flexible conduit.
5. All conduit cuts (factory or field cut) shall be perfectly square to the length of the conduit and cut ends shall be reamed with a reaming tool to provide a smooth edge to the passing conductors and to remove all burs and scrapes. Use of a hand file is not acceptable.

6. All electrical raceways shall be installed concealed, unless otherwise noted. Cut and patch to facilitate such installation to match adjacent and original finish. All exposed conduits, where required, shall be installed parallel to building members.

7. All emergency source circuits shall be installed in separate raceways (from normal power), per 2014 NEC 700.10(B), or the applicable code at the time of permitting.

8. Where existing conditions preclude the installation of EMT in existing walls to remain, provide and install cut-in type boxes and "fish" flexible MC or flex conduit and wire through existing walls to remain, unless shown otherwise on plans.

9. Fasten conduits securely to boxes with locknuts and bushings to provide good electrical continuity.

10. Provide chrome escutcheon plates at all exposed wall, ceiling and floor conduit penetrations.

11. Support individual suspended conduits with heavy malleable strap or rod hangers; supports for ½ inch or 3/4 inch conduit placed on maximum 7-foot centers; maximum 10-foot centers on conduits 1 inch or larger.

12. Support multiple conduit runs from Kindorf B907 channels with C-105 and C-106 straps.

13. Conduit bends - long radius.

14. Flash conduits through roof, using approved roof jack; coordinate with General Contractor.

15. To facilitate pulling of feeder conductors, install junction boxes as shown or required.

16. All empty conduits on the project shall be provided with a nylon pull rope to allow pulling of future conductors intended for the specific raceway. Provide plastic wire-tie style nameplate tags on each end of pull rope with printed identification of conduit use and the location of the opposite end of the rope. Pull ropes for telephone and cable tv service conduits shall meet the respective utility company requirements.
17. Where conduits pass through structural expansion joints in floor slab, rigid galvanized conduit shall be used 18" on either side of joint, complete with Appleton expansion couplings and bonding jumpers, or equal. All above grade expansion joint crossings shall also utilize expansion joint couplings or flex conduit transitions as required for each particular installation. Installed condition shall allow for a minimum deflection of raceway and wire (in any direction) equal to the structural expansion joint dimension (building to building). No solid conduits shall be allowed to cross expansion joints without proper provisions for building and seismic movement.

18. Minimum cover of conduits in ground outside of building - 36 inches, unless otherwise noted.

19. Provide and install exterior wall conduit seals and cable seals in the locations listed below. Coordinate installation and scheduling with other trades:
   a. Conduit seals through exterior wall or slab (below grade): O.Z. Gedney series "FSK" in new cast in concrete locations, series "CSM" in cored locations.
   b. Conduit seals through exterior wall or slab (above grade): O.Z. Gedney series "CSMI."
   c. Cable seals at first interior conduit termination after entry through exterior wall or slab: O.Z. Gedney series "CSBI." Coordinate quantity of conductors at each location.

B. Outlet Boxes and Junction Boxes. Verify all backbox requirements with devices to be installed prior to rough-in.
   1. One piece steel knockout type drawn boxes, unless otherwise noted, sized as required for conditions at each outlet or as noted.
   2. Flush-mounted boxes equipped with galvanized steel raised covers for device mounting flush with finished surface. Provide extension rings as required on all acoustical or additional wall treatment areas to bring top of cover flush with finished surface (coordinate with architectural drawings). Devices shall be capable of being tightly mounted to boxes without distorting or bending device or mounting hardware.
   3. Boxes for fixture outlets: 4-inch octagon or larger as required, or as noted.
   4. Switch and receptacle outlets - not smaller than 4-inch-square in furred walls, with raised cover for single device; ganged where required.
   5. Outlet and switch boxes for wet locations, cast aluminum FS or FD type with cast aluminum gasketed spring lid cover. Weatherproof "Bell" type boxes are not acceptable.
6. All connectors from conduit to junction or outlet boxes shall have insulated throats. Connectors shall be manufactured with insulated throats as integral part. Insertable insulated throats are unacceptable.

7. Conduit Bodies: Malleable iron type, with lubricated spring steel clips over edge of conduit body, O-2/Gedney type EW, or equal.

C. Wire and Cable (line voltage and signal systems):

1. 600-volt class where used for or run with line voltage power wiring, insulation color coded, minimum No. 12 awg for power branch circuits, No. 14 for power control circuits, and wiring size and type as directed by signal system manufacturer for each signal system.

2. All conductors shall be copper.

3. Size and insulation type:
   a. Standard locations: #12 to #1 AWG: THWN for wet locations and THHN for dry locations. #1/0 through #4/0 AWG: XHHW (55 Mils). 250MCM and larger: XHHW (65 Mils). All wire sizes used shall be based on a 75 degree insulation rating, unless specifically used with 90 degree rated breakers and devices.
   b. All wiring (power and signal) installed underground between buildings, or in wet or damp locations, shall be outside listed and rated for wet locations.
   c. High temperature and non-standard locations: Provide wire type and insulation category suitable for area of use as defined in NEC table 310-13.

4. Conductors No. 8 and larger and as otherwise noted on drawings shall be stranded. Conductors No. 10 and smaller shall be solid.

5. Install all wiring branch circuits and feeders (low voltage and line voltage) in conduit unless noted otherwise in the drawings. Contractor shall mandrel all feeders and pass a "sock" (or utilize other suitable means) through each raceway prior to pull to remove all water and construction debris. All raceways shall be completely clear of any obstructions or debris and all cut ends shall be reamed, prior to pull. Utilize pulling compound on all runs to insure minimum friction and pulling tension.

6. Megger test all feeders prior to energizing. See section 26 08 00 for additional information.

7. Approximately balance branch circuits about the neutral conductors in panels.
8. Connections to devices from "thru-feed" branch circuit conductors to be made with pigtails, with no interruption of the branch circuit conductors.

9. Neutral conductor identified by white outer braid, with different tracers of "EZ" numbering tags used where more than one neutral conductor is contained in a single raceway.

10. Neatly arrange and "marlin" wires in panels and distribution panelboards with "T and B Ty-rap" or approved equal plastic type strapping.

11. All wire and cable shall bear the Underwriters' Label, brought to the job in unbroken packages; wire color-coded as follows:

<table>
<thead>
<tr>
<th>Voltage</th>
<th>Phasing</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>120/208W</td>
<td>3PH4W</td>
<td>Black</td>
<td>Red</td>
<td>Blue</td>
<td></td>
</tr>
<tr>
<td>White</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2083PH</td>
<td>3W</td>
<td>Black</td>
<td>Red</td>
<td>Blue</td>
<td>--</td>
</tr>
</tbody>
</table>

12. The equipment grounding conductor shall be insulated copper; where it is insulated, the insulation shall be colored green.

13. Label each wire of each electrical system in each pull box, junction box, outlet box, terminal cabinet, and panelboard in which it appears with "EZ" numbering tags indicating the connected circuit numbers.

14. Properly identify the "high leg" of 4-wire delta connected systems (in each accessible location) as required by NEC 110.15 and 230-56.

15. Provide permanently affixed adhesive labels with machine printed lettering (min. 1/8" high) at junction boxes serving fixtures that are supplied by (2) electrical sources (i.e. normal and emergency lighting). Label to read "CAUTION - This light fixture is powered by (2) separate sources. The normal power source breaker and the emergency power source breaker must be turned off before servicing this light fixture."

16. Install feeder cables in one continuous section unless splices are approved by Architect. Exercise care in pulling to avoid damage or disarrangement of conductors, using approved grips. No cable shall be bent to smaller radius than the spool on which it was delivered from the manufacturer. Color code feeder cables at terminals. Provide identifying linen tags in each pullbox.

17. Metal-clad cable, (MC) may be used in lieu of conduit and wire at concealed locations for final branch runs to devices on same circuit only. MC cable may not be used for multi-circuit branch circuit homeruns or feeders. Provide conduit and wire homeruns and feeders.
a. The conductors shall be soft drawn annealed copper, solid or stranded as stated above. Insulation shall be type THHN. Conductors shall be cabled with fillers, taped wrapped with overall seamless corrugated aluminum sheath.

b. Cables shall be 3 or 4 conductor type with parity sized ground wire.

D. Switches: Model numbers are Hubbell, color to be selected by architect, unless otherwise noted. All switches to utilize screw terminals for wire connections - no plug-in terminations:

1. Single Pole - No. HBL1221
2. Two Pole - No. HBL1222
3. Three Way - No. HBL1223
4. Momentary contact - No. HBL1557
5. Momentary contact Keyed - No. HBL1556L
6. Keyed, - No. HBL1221L
7. Pilot Light (on with load on) - Hubbell No. 1221-PLC
8. Motor Rated Double Pole (30A) - Hubbell No. 7832
10. Low voltage Data line switches - Refer to lighting control system (for compatability)

E. Receptacles: Mounting straps and contacts shall be one piece design, constructed of minimum 0.050" solid brass. Base shall be high strength, heat resistant, glass reinforced nylon. Device shall accept up to #10 wire, side or back wired with screw terminals - no plug-in terminations. Hubbell, Leviton, Pass & Seymour, or equal. Color to be selected by architect, unless otherwise noted. Numbers listed below are Hubbell:

1. 15A 3PG 125 volt duplex - No. HBL5262
2. 20A 3PG 125 volt duplex - No. HBL5362
3. 20A 3PG 125 volt ground fault interrupter receptacle; GFI receptacles shall conform to the 2006 UL requirements to a) interrupt power to the unit in the event of internal failure, or b) provide an audible or visual indication of internal failure of the GFI; No. GF20 or equal. Through wiring to downstream GFI designated receptacles is not acceptable.
4. GFI Module (blank face), no indicator light, 20A – No. GF2BF20 or equal.
5. All receptacles located in exterior or wet locations shall be corrosion resistant with UV stabilized body.

F. Plates: Leviton, or equal, except as noted:

1. For flush outlet boxes, for switches, and receptacles: stainless steel, color to be selected by architect, unless otherwise noted.

2. Plates for surface-mounted outlets: stainless steel unless otherwise noted.

3. Weatherproof duplex receptacle plates for exterior locations with ground fault interrupter receptacles in type FS or FD boxes – Hubbell #WPFS26 or compatible equal. Verify cover compatibility with box type and device installed.

4. Weatherproof "in-use" cover, vertical or horizontal mount, for exterior with GFCI receptacles. Die-cast metal alloy, TayMac MX series or equal with openings to match installed devices.

5. Locking plates for duplex receptacles where noted; Pass & Seymour #WP26-L (non weather proof).

6. Locking plates for duplex exterior GFCI receptacles (or in wet or damp locations); Heavy duty cast aluminum flush cover with locking latch and key, Pass & Seymour #4600 with appropriate mounting plate for type of device installed. Coordinate backbox requirements and finished wall trim-out with wall installer prior to rough-in to insure an adequate and neat trim appearance upon completion.

G. Equipment Disconnects: All disconnects shall be located to allow proper code required clearance in each area. Locations shown on drawings are diagrammatic only. The contractor shall coordinate exact locations in the field (with other trades) prior to rough-in to insure proper clearances.

1. Motor Disconnect Switches and Safety Switches: General Electric Company Heavy Duty Type "THD", cover interlocked with operating handle so that cover cannot be opened with switch in closed position and switch cannot be closed with cover in open position. 240V or 480V rating, single or multi-pole as required or as noted on drawings, in Nema 1 enclosure indoors or Nema 3R enclosure outdoors unless otherwise noted. Provide dual element motor circuit fuses sized as recommended by equipment manufacturer (for final equipment actually installed).

2. Code required disconnects: Provide a local disconnect in addition to the branch circuit protection device for all equipment as required by code (whether shown or not). Disconnects shall consist of a motor rated switch (or disconnect) for all motor loads less than 3/4HP or other suitable disconnect sized to match branch circuit conductors and load current of equipment, with number of poles as required.
H. Lugs and Connectors: Thomas and Betts "lock-tite", for No. 4 and larger wire; 3M "Scotchloc" fixed spring screw-on type wire connectors with insulator for No. 6 and smaller wire.

1. All splices shall be made up with screw-on type connectors - no plug-in or push-in style connectors acceptable. Wires shall be solidly twisted together with electricians pliers before screw-on connector is installed to ensure a proper connection in the event of wire nut failure. No exceptions.

2. Connectors listed or labeled for “no wire twisting required” are not an acceptable substitute for actual wire twisting.

3. Utilize porcelain type connectors in all high temperature environments (above 105 degrees Celsius).

I. Splice Insulation: "Scotch" electrical tape with vinyl plastic backing or rubber tape with protective friction tape for interior work.

1. Splices in electrical cables of 600 volt insulation class in underground system duct shall be made only in accessible locations such as pullboxes, light pole handholes, etc., using a compression connector on the conductor and by insulating and waterproofing (for exterior and underground locations) by one of the following methods:

   a. Cast type splice insulation shall be provided by means of a molded casting process employing a thermosetting epoxy resin insulating material which shall be applied by a gravity poured method or by a pressure injected method. The component materials of the resin insulation shall be in a packaged form ready for convenient mixing after removing from the package. Do not allow the cables to be removed until after the splicing material has completely set.

   b. Gravity poured method shall employ materials and equipment contained in an approved commercial splicing kit which includes a mold suitable for the cables to be applied. When the mold is in place around the joined conductors, the resin mix shall be prepared and poured into the mold. Do not allow cables to be moved until after the splicing materials have completely set.

J. Identification: Refer to Section 26 05 00.

K. Firestoppping: as manufactured by 3M Fire Protection Products or equal.

1. Fire-rated and smoke barrier construction: Maintain barrier and structural floor fire and smoke resistance ratings including resistance to cold smoke at all penetrations, connections with other surfaces or types of construction, at separations required to permit building movement and sound vibration absorption, an at other construction gaps.
2. Systems or devices listed in the UL Fire Resistance Directory under categories XHCR and XHEZ may be used, providing that it conforms to the construction type, penetration type, annular space requirements and fire rating involved in each separate instance, and that the system be symmetrical for wall penetrations. Systems or devices must be asbestos free.

PART 3 - EXECUTION

3.1 REFER TO BASIC ELECTRICAL REQUIREMENTS - SECTION 26 05 00 FOR WORK UNDER THIS SECTION.

3.2 TESTS

A. Testing and Inspection: See Section 26 08 00 - Testing.

END OF SECTION
SECTION 26 51 01
LIGHTING

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Luminaires (i.e., lighting fixtures). Refer to the Luminaire Schedule, and provide a complete and working Building Lighting System. Catalog numbers in the Luminaire Schedule are basic luminaire types. Additional features, accessories and options herein specified, described, or scheduled are to be included for all luminaires provided.

B. Lamps. Provide all lamps for all luminaires of size and type as recommended by the luminaire manufacturer and as scheduled, or specified herein.

C. Provide lamps for all existing luminaires to remain (to be re-lamped).

D. Ballasts and power supplies, including standard and dimmed fluorescent, HID, and LED.

E. Lighting controls, including occupancy sensors.

F. Exit and Emergency Egress lighting where indicated and where required.

G. Supports for outlet boxes and luminaires, including seismic restraint slack wires for recessed luminaires in suspended ceilings per code and backing in walls as required to keep luminaires secure and level.

1.2 INCORPORATED DOCUMENTS

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

B. Section 26 05 00 and 26 27 00 apply to all work in this section.

C. Division 03: Concrete (Bases for pole-mounted luminaires as noted in Luminaire Schedule).

D. Division 09: Painting and Finishes (cutting of holes in finished surfaces for recessed luminaires).

1.3 RELATED WORK

A. Ceiling Access panels where required for access to equipment, outlets, transformers, etc., located above suspended ceilings, sheet rock or plaster ceilings. Coordinate with the Architect and other trades.

1.4 SUBMITTALS

A. Submit under provisions of Section 01 33 00 and 26 05 00.
B. The Contractor shall furnish (6) six sets of submittals for review by the project team unless otherwise noted in these specifications. The submittals shall include the following information:

1. Product Index: The following information shall be included in the product index.

   a. Luminaire Type. The index shall call out each luminaire type per the Luminaire Schedule in the Contract Documents.

   b. Manufacturer's Catalog Number. Outstanding information required to make a complete catalog number shall be clearly identified in the index.

   c. Lamp Data. Provide the Manufacturer's name and Catalog Number for each lamp including wattage, color temperature, and color rendering index.

   d. LED Data. Provide the Manufacturer's name for each LED array including wattage, color temperature, lumen output, and color rendering index.

   e. Comments. The index shall include a column for comments. The comments column shall include extraneous information required for clarity.

2. Manufacturer's literature for every luminaire listed on the Luminaire Schedule.

   a. Catalog Information:

      1) Luminaire Data Sheet: The manufacturer's cut sheet shall include the following:

         (a) Photometrics: Candlepower distribution curve or table with horizontal readings at 0, 22.5, 45, and 90 degrees and vertical readings from 0 to 180 degrees in 5 degree increments in accordance with the Illuminating Engineering Society published test procedures.

         (b) Catalog Number Nomenclature

         (c) Coefficient of Utilization Tables

         (d) Luminaire Line Drawing

         (e) Ballast or power supply (each type)

3. Data sheets for electronic ballasts and power supplies. Indicate luminaire types on applicable ballast/power supply data sheets.

4. Data sheets for wallbox controls and other products specified in this section.
5. **Shop Drawings:**

   a. Provide shop drawings of suspension details for luminaires recessed in, mounted on, or suspended from hung ceilings. Details shall clearly illustrate proposed methods for supporting luminaires independent of the suspended ceiling system.

   b. Detailed shop drawings of all cove or box mounted luminaires containing the following information:
      1) Exact field measured length (clear inside dimension) of cove pocket or box.
      2) Exact luminaire length and arrangement of luminaires in cove or box.

   c. Detailed shop drawings of pendant mounted luminaires constructed with linear metal housings containing the following information.
      1) Support mechanism, including swivel canopies.
      2) Trim details.
      3) Closure piece details.
      4) Pattern configurations.

   d. Provide shop drawings for the following luminaire types:
      1) Indicate specific luminaire types that require shop drawings.

6. **Samples:**

   a. Provide samples of luminaire trim where "Finish as selected by Architect" is indicated on the Luminaire Schedule. Submit two finish samples, 75 mm x 75 mm (3" x 3") minimum, of all custom color, decorative metal, or anodized aluminum finishes. Samples must be approved in writing by the Architect prior to ordering.

   b. Submit sample of custom luminaires: complete and operational, equipped with 120V, 6 foot cord and 3 prong grounded plug. Luminaire shall be fabricated and finished as specified, full size, using specified materials & equipment. Submit one luminaire to Owner's representative for review prior to production.

   c. Indicate specific luminaire types that require shop drawings.

7. **Schedule of spare lamps.**
a. Provide a schedule indicating the type and quantity of spare lamps to be provided to the Client at project closeout.

b. Refer to article 3.06 below for specific lamp information.

c. Refer to Section 01 60 00 - Product Requirements.

C. For Any Luminaires Substituted For Those Specified:

1. Refer to section 01 60 00 - Product Requirements, for all substitution procedures.

2. Provide independent testing laboratories, Inc., or equal, photometric test report for each Luminaire type and lamp combination listed on the Luminaire Schedule. Test reports shall be based on Illuminating Engineering Society published test procedures and shall contain polar coordinate candlepower distribution curves in five lateral planes for luminaires with asymmetric distributions and luminaire luminance data for vertical angles above 45 degrees from nadir. Test results shall indicate luminaire efficiency for the lamp and aperture assembly specified. Luminaires with efficiencies more than 2% below the values of specified luminaires are not acceptable and will be rejected.

3. Prior approval does not guarantee final approval by the electrical engineer. The contractor shall be completely responsible for providing luminaires that meet or exceed the quality/performance of the specified products in their entirety. All deviations in quality/performance of the specified products must be listed and individually signed off by the engineer.

4. The Owner reserves the right to reject a proposed substitution based on his agent’s professional judgment as to the utility, visual appropriateness, or finish of substitutions.

1.5 OCCUPANCY SENSORS

A. Equipment Qualification

1. Wall switch products must be capable of withstanding the effects of inrush current. Submittals shall clearly indicate the method used.

2. Contractor’s work to include all labor, materials, tools, appliances, control hardware, sensor, wire, junction boxes and equipment necessary for and incidental to the delivery, installation and furnishing of a completely operational occupancy sensor lighting control system, as described herein.

3. Contractor/Supplier shall examine all general specification provisions and drawings for related electrical work required as work under Division 26.
4. Contractor shall coordinate all work described in this section with all other applicable plans and specifications, including but not limited to wiring, conduit, luminaires, HVAC systems and building management systems.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site and store in unopened cartons in protected location. Inspect products immediately and report all damage accordingly.

1.7 GUARANTEE AND WARRANTIES

A. All work performed under this section must be guaranteed to be free of defects in products or workmanship for one year after date of acceptance by Owner, unless noted otherwise in General Conditions.

B. Warranties:

1. Electronic ballasts and power supplies must be warranted against failure for at least five years after date of substantial completion.

PART 2 - PRODUCTS

2.1 GENERAL

A. Provide luminaires as indicated in Luminaire Schedule; if conflict exists between Luminaire Schedule and Specifications, the more stringent requirement shall take precedence.

B. Provide luminaires new and complete with mounting accessories, junction boxes, trims, and lamps.

C. Provide products with UL labels appropriate to intended installation conditions, or with labels from other testing laboratories whose results are acceptable to local inspector, showing compliance with UL standards. Labels must be concealed from normal viewing angles.

D. All products of same type by same manufacturer.

2.2 SOLID STATE LUMINAIRES

A. Housing, where applicable:

1. Steel bonderized or equal rust protected, or aluminum, rigid construction. Minimum gauge thickness shall be as follows:

   a. Interior locations: No. 20-gauge steel, No. 16-gauge aluminum.

B. Finish:
C. Baked enamel finish (except when otherwise specified).

1. Concealed interior surfaces (this applies to interior hardware, circuit boards, etc.) matte black.

2. Concealed exterior surfaces: matte black.

3. Visible surfaces: color and texture as specified below for each luminaire type or as selected.

4. Exterior luminaire finish: refer to "Exterior Luminaire Finishes".

D. Light Emitting Diode (LED) requirements:

1. Correlated color temperature (CCT) for phosphor-coated white LEDs must have one of the following designated CCT's and fall within the following binning standards.
   a. 2700K defined as 2725 +/- 145K
   b. 3000K defined as 3045 +/- 175K
   c. 3500K defined as 3465 +/- 245K
   d. 4000K defined as 3985 +/- 275K
   e. 4500K defined as 4503 +/- 243K
   f. 5000K defined as 5028 +/- 283K
   g. 5700K defined as 5665 +/- 355K
   h. 6500K defined as 6530 +/- 510K

2. Color spatial uniformity shall be limited to variations in chromaticity for different directions (i.e. changes in viewing angle) within 0.004 from the weighted average point on the CIE 1976 (u',v') diagram.

3. Color maintenance shall be limited to a maximum change in chromaticity of 0.007 on the CIE 1976 (u',v') diagram over the lifetime of the product.
   a. Color rendering index to be determined using ANSI C78.377-2008 and applicable IESNA standards.
   b. Laboratory tests must be produced using specific module(s)/array(s) and power supply combination that will be used in production.
   c. Manufacturers must provide a test report from a laboratory accredited by NVLAP or one of its MRA signatories.
4. Lumen depreciation
   a. Lumen depreciation to be measured using IESNA LM-80-08 standard for IES approved method of measuring lumen maintenance of LED light sources.
   b. Phosphor coated white LED module(s)/array(s) shall deliver at least 70% of initial lumens for a minimum of 35,000 hours when installed in-situ and operated at 100% output and the maximum specified operating temperature.
   c. Colored LED module(s)/array(s) shall deliver at least 50% of initial lumens for a minimum of 35,000 hours when installed in-situ and operated at 100% output and the maximum specified operating temperature.

5. Acceptable LED manufacturers:
   a. Cree
   b. Nichia
   c. Osram Opto Semiconductors
   d. Philips Lumileds
   e. Soraa
   f. Xicato

E. Luminaire Efficacy:
   1. Luminaire efficiency shall be measured using IESNA LM-79-08 standard for electrical and photometric measurements of solid state lighting products.
   2. Manufacturer shall provide published luminaire efficacy, which is defined as luminaire light output divided by luminaire input power measured in a 25 degree Celsius environment. Efficacy shall include power supply, thermal, optical, and luminaire losses.

F. Thermal Management:
   1. Solid state luminaire shall not exceed LED manufacturer’s maximum junction temperature requirements when operated in-situ at luminaire manufacturer’s maximum ambient operating temperature and 100% light output.
   2. Solid state luminaires shall be thermally protected using one of more of the following thermal management techniques:
a. Metal core board
b. Gap pad
c. Internal monitoring firmware

3. Solid state luminaire housing shall be designed to transfer heat from the LED board to the outside environment.

G. Power Supplies/Drivers:

1. Power supply shall have a power factor of 0.90 or greater for primary application

2. Power supply input current shall have Total Harmonic Distortion (THD) of less than 20%.

3. Power supply shall have a minimum operating temperature of minus 20 degrees Celsius or below when used in luminaires intended for outdoor applications.

4. Power supply output operating frequency to be equal to or greater than 120 Hz.

5. Power supply shall operate with sustained input variations of +/- 10% (voltage and frequency) with no damage to the driver.

6. Power supply shall tolerate sustained open circuit and short circuit output conditions without damage and without need for external fuses or trip devices.

7. Power supply output shall be regulated to +/- 5% across published load range.

8. Power supply shall have a Class A sound rating.

9. Power supply outputs shall have current limiting protection.

10. Power supply shall operate LEDs at constant and regulated current levels. LEDs shall not be overdriven beyond the diode manufacturer’s specified nominal voltage and current.

H. System Installation

1. Hardwired connections to solid state luminaires shall be reverse polarity protected and provide high voltage protection in the event connections are reversed or shorted during the installation process.

2. All solid state luminaires (100% of each lot) shall undergo a minimum eight-hour burn-in test during manufacturing. In addition to requirements identified in Section 1.04 STANDARDS, solid state lighting installations shall be
UL Listed as a low-voltage lighting system including, but not limited to, luminaire, power supply, controller, keypad, and wiring.

I. Warranty
   1. Luminaires, drivers, and controllers for solid state lighting systems shall be covered by a five-year warranty against defects in workmanship or material. Warranty shall include in-warranty service program providing for payment of authorized labor charges incurred in replacement of inoperative in-warranty equipment.

2.3 LUMINAIRE CONSTRUCTION
   A. Sheet metal: materials and thicknesses shall be 20 gauge (0.7 mm or 0.027") min., free of dents, scratches, oil-can, or other defects.
   B. Painted luminaires: exposed weld marks, joints, and seams shall be filled and sanded smooth before finishing.
   C. All edges cleaned and dressed to remove sharp edges or burrs.
   D. Extrusions: 1/10" min. wall thickness, smooth and free of tooling lines, with cast end plates that exactly match extrusion profiles.
   E. Castings: smooth, free of pits, scales, gate marks, or blemishes.
   F. Spinnings shall have 1/32" min. thickness, smooth, free of spinning lines or blow-back, with clean edges.
   G. Welds: Follow recommendations of American Welding Society. All welds continuous and free of spatter, residue, or warping.
   H. No light leaks visible in finished room. Ensure that downlight housings mounted in wood slat ceilings are not visible from below. Field paint exterior of housing with high temperature paint if necessary.
   I. Exposed end plates and joiners, with concealed fasteners.
   J. End-to-end mounted luminaires: Verify row configurations and provide joiners, aligning splines, and trims to suit.
   K. Hardware:
      1. Steel or aluminum interior luminaires: cadmium-plated hardware.
      2. Steel or aluminum exterior luminaires: stainless steel hardware.
      4. Copper alloy luminaires: brass hardware.
L. Raceways: Where used for through wiring, luminaires must be approved for use as raceways.

2.4 RECESSED LUMINAIRES

A. Point-source luminaires: provide pre-wired junction box and thermal protection, and provide slack wires to structure at two diagonal corners.

B. Troffer luminaires: provide hold-down clip at each luminaire corner, and slack wires to structure as detailed on the drawings. The detail will take precedence.

C. Verify ceiling construction details and provide luminaire housings and trims to suit.

D. Non-accessible ceilings: Provide access to junction boxes, ballasts, transformers, and battery packs through luminaire apertures; no access panels in ceiling.

E. Mounting frames: To prevent rusting, provide galvanized steel or cast aluminum frames for installation in damp locations or in plaster ceilings.

F. Adjustable luminaires shall be provided with rotation and tilt locking devices.

2.5 TRIMS

A. Trims must fit tightly and be held in by gravity, spring clips, or mechanical fasteners. Trims must not drop out under normal conditions or seismic forces which do not exceed the design criteria of the building.

B. Aluminum parabolic cones shall be smooth, properly shaped, with Alzak finish in colors as indicated.
   1. No hot spots or lamp images visible at angles shallower than lamp shielding angle.
   2. Self-flange cones must bend parallel to ceiling and cover ceiling hole without additional trim ring. Unpainted flange, shall have the same finish as cone interior.
   3. Cones and louvers for fluorescent luminaires must have permanent anti-iridescence treatment.

C. Lenses, diffusers, and patterned glass: glass or virgin acrylic as noted, with patterns as noted.
   1. Finished thickness 2 mm (1/10") min. unless noted otherwise.
   2. Linear runs over 1200 mm (4'-0") long shall be in equal-length pieces.
   3. Lenses for tungsten halogen luminaires shall be tempered borosilicate glass.
4. Lamp enclosures for metal halide lamps shall be glass or acrylic and must be capable of retaining lamp fragments in the event of non-passive lamp failure.

5. Glass UV filters for individual accent luminaires, where indicated, shall be 3 mm (1/8") borosilicate glass filters with dichroic coating, 2% max. light transmission @ 400nm, 80% min. transmission @ >425nm, Bausch & Lomb "Optivex" or equal by Balzers.

6. Acceptable Manufacturers:
   b. Glass lenses and patterned glass: Balzers, Bausch & Lomb, Gray.

2.6 FINISHES

A. Steel Reflectors: Unless otherwise specified, the reflector surface finish shall be of synthetic white enamel or polyester powder coating. Finish shall show no indication of chipping, cracking, flaking or any other sign of loss of adhesion. The initial reflection factor shall be not less than 88 percent averaging 5 randomly selected points on the reflector. After 100 hours of exposure to the radiation of a glass enclosed carbon arc lamp, such as a Fade-O-Meters, the reflectance of the exposed portion shall not be less than 5 percent and finish shall show no appreciable color change. The carbon arc lamp shall be operated at appreciable color change. The carbon arc lamp shall be operated at 13 plus or minus 0.5 amperes at 140 volts. The reflector shall be placed ten inches from the arc and the lamp so ventilated that the temperature of the exposed portion does not exceed 105 degrees F.

B. Aluminum Reflectors: Reflecting surfaces shall be provided with either a specular or diffuse finish as indicated. Reflection factors shall be not less than 83 percent for specular reflecting surfaces. Each reflecting surface shall be protected by dense coating of oxide weighing not less than 5.0 milligrams per square inch, applied by an anodic process. The reflector shall be given a sealing treatment that will prevent staining of the reflecting surface when subjected to a stain test. All aluminum reflectors & louvers shall be a low iridescent equivalent to that provided by Coil Anodizers.

C. Non-Reflecting Surfaces: Unless otherwise specified, the finish on all non-reflecting exterior surfaces shall be aluminum oxide or aluminum; white, gray or aluminum paint on steel; nickel or chromium plating on copper alloy. Fastening devices shall be nickel, chromium, cadmium or zinc plated. All painted surfaces shall be free of tears, star marks, blisters, pinholes, chipping and any other defects that may impair appearance or serviceability.

2.7 LAMPS

A. Unless otherwise noted, lamps described in the Luminaire Schedule and in these Specifications shall be manufactured by General Electric, Osram/Sylvania, North American Philips, Venture, or approved equal.
B. Each type of lamp by only one manufacturer to maintain color consistency.

C. Relamp luminaires or replace LED boards and drivers at no cost to owner if lamps exhibit excessive lamp to lamp color variation or burn out within 90 days of substantial completion date.

D. Incandescent:

1. All incandescent lamps and tungsten-halogen lamps shall be extended life or 2,000 hour life whenever such designs are available. Par lamps: no diodes.

E. Fluorescent:

1. Long fluorescent lamps shall either be 265ma full wattage, T8; 3500 deg. K color temperature; min. CRI 82; 2ft., 3ft. & 4ft. lamps or, 170ma full wattage for standard output T5 lamps, and 460ma full wattage for high output T5 lamps, 3500 deg. K color temperature; min. CRI 85; 3ft, and 4ft lamps only. Provide TCLP compliant reduced mercury content lamps whenever such lamps are available.

2. Compact fluorescent lamps shall be 3500 deg. K color temperature, min. CRI 82, twin-tube or quad tube as noted or as required for each luminaire. Provide TCLP compliant reduced mercury content lamps whenever such lamps are available.

3. Long compact fluorescent (Biax) lamps shall be 3500 deg. K color temperature, min. CRI 82, twin tube, single ended 4-pin. Provide TCLP compliant reduced mercury content lamps whenever such lamps are available.

4. “Burn-in” all fluorescent lamps on dimmed circuits for at least 100hrs. prior to dimming.

F. LED:

1. LED quantity and wattage as specified for each LED luminaire.

2. 3500 deg. K color temperature, unless otherwise noted.

2.8 LAMPHOLDERS

A. Incandescent and HID shall be porcelain, size to accommodate specified lamps.

B. Fluorescent lampholders shall have plastic bodies with copper contacts. For horizontally-mounted lamps over 8’’ long, provide additional plastic clip to support glass end of lamp.

1. Provide rapid start lampholders in luminaires for all dimmed linear fluorescent lamps.
2.9 BALLASTS DRIVERS AND TRANSFORMERS

A. General:

1. Verify input voltages and match to branch circuit voltages.

2. Provide ballasts with best-made sound ratings for each type and mount securely to prevent vibration.
   a. Replace excessively noisy ballasts or transformers at no cost to Owner.

3. Remote ballasts or transformers: Provide suitable enclosures and mounting hardware, and install in accessible, ventilated locations.
   a. Secondary wiring: provide number and size of conductors as required, with 3% max. voltage drop between transformer and last lamp.
   b. Keep ballasts or transformers at least 300 mm (12") apart and do not stack vertically.

4. Ballasts must contain no PCB’s and be labeled accordingly.

B. Fluorescent Ballasts:

1. Ballasts must meet applicable energy-conservation standards.

2. Interwiring (for electronic ballasts):
   a. In linear luminaires or continuous rows of individual luminaires, provide tandem wiring to operate each row of lamps independently. Provide three-lamp and four-lamp ballasts where possible, two-lamp ballasts only where needed to finish a row.
   b. In individual one-lamp luminaire, provide two-lamp ballasts and master-slave interwiring between pairs of luminaires where possible.
   c. In individual two-lamp luminaires, provide two-lamp ballasts and interwiring between pairs of luminaires to operate one lamp in each luminaire on each ballast.
   d. In individual three-lamp or four-lamp luminaires, provide two-lamp ballasts and interwiring between pairs of luminaires to operate all outer lamps independently of all inner lamps.
   e. In master/slave three-lamp or four-lamp luminaires, provide one two-lamp ballast and one four-lamp ballast and master-slave interwiring between pairs of luminaires with and interwiring between pairs of luminaires to operate all outer lamps independently of all inner lamps.
3. Electronic ballasts for long fluorescent lamps 97% min. power factor, “A” sound-rated, with UL Class P thermal protection, 85% min. ballast factor with specified types and numbers of lamps. Ballasts must operate specified lamps within lamp manufacturer’s specifications and have no effect on rated lamp life when run more than 10 hours per start.
   a. Programmed Start operation, with starting voltage and filament current in compliance with ANSI C78-1.
   b. Parallel-wired.
   c. Provide interwiring and number of lamps per ballast as described under “Interwiring” above. Follow manufacturer’s recommendations for maximum whip length.
   d. Light variation 10% max. with +/- 10% input voltage variation.
   e. Electromagnetic radiation must not exceed FCC Part 18 regulations.
   g. End of life protection to guard against lamp delamination.
   h. Harmonic distortion: Total harmonic distortion (ratio of total harmonic RMS current to fundamental RMS current) must be less than 20% or as required to meet local utility requirements, whichever is lower.

4. Preheat ballasts for short compact fluorescent lamps shall be electronic where noted, with 95% min. power factor; HPF ballast where electronic type are not specified and where HPF will fit luminaire.

5. Acceptable Manufacturers:
   b. Short compact fluorescent: Advance, Robertson, Universal

6. Fluorescent Dimming Ballasts for small packaged dimming systems:
   a. Fluorescent Dimming Ballasts shall be electronic type, providing 100% - 1% dimming range for long fluorescent lamps and 100% - 5% for high wattage biaxial and compact fluorescent lamps.
   b. Ballasts must be capable of starting lamps at the low-end of the dimming range with no visible flicker or “racing”.
   c. Acceptable Manufacturers:
1) Lutron Hi-Lume electronic type, no substitutions.

7. Fluorescent Dimming Ballasts for Daylight Harvesting Systems:
   a. Electrical Requirements
      1) Ballast THD shall be less than 10% for the main lamp design (as indicated on the datasheet).
      2) Lamp Current Crest Factor shall not exceed 1.7 for the main lamp design.
      3) Ballast Power Factor must be greater than 98% for the main lamp design.
      4) Ballast output for any lamp combination shall not be between 30kHz and 42kHz.
      5) Ballast must operate between ±10% of rated input voltage, 50/60Hz.
   b. Mechanical Requirements
      1) Ballast shall be able to dim a fluorescent lamp from 100-10% of nominal light output. Dimming shall be available to 5% on some models.
      2) Ballast shall be able to start the lamp at any level without having to start at the high level first and without visible flicker or “racooning”.
      3) Ballast input power (ANSI watts) shall be able to be reduced to less than 20% of nominal.
      4) Ballast shall be controlled via a 0 to 10V signal transmitted over Class 1 or Class 2 low voltage leads.
   c. Acceptable Manufacturers:

8. LED Drivers:
   a. High power factor, thermally-protected.
   b. Compatible with LED lamps being used.
c. Capable of dimming LED source without perceptible flicker or stroboscopic effects.


2.10 EMERGENCY LIGHTING AND EXIT SIGNS

A. Emergency lighting:

1. Provide lighting for paths of egress as required by code.

B. Description of Systems:

1. Auxiliary battery pack/ballasts mounted integral to luminaires shall be Bodine B50 or approved equal. Provide no less than 1400 lumen output for lamps on emergency ballast for a minimum of 90 minutes.

2.11 OCCUPANCY SENSORS

A. General

1. Wall switch sensors shall be capable of detection of occupancy at desktop level up to 300 square feet, and gross motion up to 1000 square feet.

2. Wall switch sensors shall accommodate loads from 0 to 800 watts at 120 volts; 0 to 1200 watts at 277 volts and shall have 180° coverage capability.

3. Wall switch products shall utilize Zero Crossing Circuitry which increases relay life, protects from the effects of inrush current, and increases sensor’s longevity.

4. Wall switch sensors shall have no leakage current to load, in manual or in Auto/Off mode for safety purposes and shall have voltage drop protection.

5. Where specified, wall switch sensors shall provide a field selectable option to convert sensor operation from automatic-ON to manual-ON.

6. Where specified, vandal resistant wall switch sensors shall utilize a hard lens with a minimum 1.0mm thickness. Products utilizing a soft lens will not be considered.

7. Passive infrared sensors shall utilize Pulse Count Processing and Digital Signature Analysis to respond only to those signals caused by human motion.

8. Passive infrared sensors shall utilize mixed signal ASIC which provides high immunity to false triggering from RFI (hand-held radios) and EMI (electrical noise on the line), superior performance, and greater reliability.
9. Passive infrared sensors shall have a multiple segmented Lodif Fresnel lens, in a multiple-tier configuration, with grooves-in to eliminate dust and residue build-up.

10. Where specified, passive infrared and dual technology sensors shall offer daylighting footcandle adjustment control and be able to accommodate dual level lighting.

11. Dual technology sensors shall be corner mounted to avoid detection outside the controlled area when doors are left open.

12. Dual technology sensors shall consist of passive infrared and ultrasonic technologies for occupancy detection. Products that react to noise or ambient sound shall not be considered.

13. Ultrasonic sensors shall utilize Advanced Signal Processing to adjust the detection threshold dynamically to compensate for constantly changing levels of activity and air flow throughout controlled space.

14. Ultrasonic operating frequency shall be crystal controlled at 25 kHz within ± 0.005% tolerance, 32 kHz within ± 0.002% tolerance, or 40 kHz ± 0.002% tolerance to assure reliable performance and eliminate sensor cross-talk. Sensors using multiple frequencies are not acceptable.

15. All sensors shall be capable of operating normally with electronic ballasts, PL lamp systems and rated motor loads.

16. Coverage of sensors shall remain constant after sensitivity control has been set. No automatic reduction shall occur in coverage due to the cycling of air conditioner or heating fans.

17. All sensors shall have readily accessible, user adjustable settings for time delay and sensitivity. Settings shall be located on the sensor (not the control unit) and shall be recessed to limit tampering.

18. In the event of failure, a bypass manual override shall be provided on each sensor. When bypass is utilized, lighting shall remain on constantly or control shall divert to a wall switch until sensor is replaced. This control shall be recessed to prevent tampering.

19. All sensors shall provide an LED as a visual means of indication at all times to verify that motion is being detected during both testing and normal operation.

20. Where specified, sensor shall have an internal additional isolated relay with Normally Open, Normally Closed and Common outputs for use with HVAC control, Data Logging and other control options. Sensors utilizing separate components or specially modified units to achieve this function are not acceptable.
21. All sensors shall have UL rated, 94V-0 plastic enclosures.

B. Circuit Control Hardware - CU

1. Control Units - For ease of mounting, installation and future service, control unit(s) shall be able to externally mount through a 1/2" knock-out on a standard electrical enclosure and be an integrated, self-contained unit consisting internally of an isolated load switching control relay and a transformer to provide low-voltage power. Control unit shall provide power to a minimum of two (2) sensors.

2. Relay Contacts shall have ratings of:
   a. 13A - 120 VAC Tungsten
   b. 20A - 120 VAC Ballast
   c. 20A - 277 VAC Ballast

3. Control wiring between sensors and controls units shall be Class II, 18-24 AWG, stranded U.L. Classified, PVC insulated or TEF/OLN jacketed cable suitable for use in plenums, where applicable.

4. Minimum acceptable wire gauge from the circuit control hardware relays shall be #14 AWG.

C. Acceptable Manufacturers

1. The Watt Stopper, or Pre-Approved Equal: For pre-approval, provide all the information listed under “submittals” a minimum of ten (10) working days prior to initial bid date.

2. The listing of any manufacturer as "acceptable" does not imply automatic approval. It is the sole responsibility of the electrical contractor to ensure that any price quotations received and submittals made are for sensors that meet or exceed the specifications included herein.

3. Products
   a. All products shall be Watt Stopper product numbers:
      2) Wall sensors: WI-200, WS-120/277, WA-100, WD-170, WD-180, WD-270, WD-280

PART 3 - EXECUTION

3.1 PREPARATION

A. Architectural Reflected Ceiling Plans shall govern exact location and mounting conditions for all luminaires. Subcontractor shall be responsible for coordination of luminaire mounting and compatibility with ceiling construction and other trades.

B. Coordinate work with other trades. Location of lighting has priority over location of new framing (except major structural members), ducts, diffusers, sprinklers, speakers, smoke detectors, and other obstructions.

C. If obstructions are encountered which prevent installation of luminaires according to drawings, notify Architect immediately and do not proceed until conflict has been resolved.

D. Coordinate the location of luminaires in mechanical or unfinished spaces. Locations shown on Drawings may be adjusted by the Contractor to suit conditions. Install luminaires to avoid obstructions and maximize light output, 2100 mm (7'-0") min. mounting height.

E. Coordinate the location of any exposed conduit used to feed luminaires with the Architect prior to installation.

3.2 INSTALLATION

A. General:

1. Subcontractor shall be responsible for handling and installation of luminaires including all supports, hangers and hardware necessary for a complete installation. Luminaires shall be clean, plumb, level in straight lines, without distortion. Luminaires must be installed so they do not shift during relamping or adjustment. Remedy any light leaks which may develop after installation of recessed or enclosed luminaires.

2. Install luminaires at locations and heights as indicated, in accordance with luminaire manufacturer's written instructions, applicable requirements of NEC, NECA's "Standard of Installation", NEMA standards, and with recognized industry practices to ensure that luminaires fulfill requirements.

3. Point-source luminaires shall be located as dimensioned, or in center of tile or on tile joint as drawn; 6 mm (1/4") max. off-center tolerance.

4. Linear luminaires shall have 3 mm (1/8") max. horizontal or vertical alignment variation in any 5 m (16-ft.) portion of run.
5. Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for equipment connectors. Where manufacturer's torqueing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL Stds. 486 A and B, and the National Electrical Code.

6. Clean luminaires of dirt and construction debris upon completion of installation. Clean fingerprints and smudges from lenses.

7. Remove and replace luminaires that may have been damaged during construction at no additional cost to the Owner.

8. Protect installed luminaires from damage during remainder of construction period.

9. Provide equipment grounding connections for luminaires as indicated. Tighten connections to comply with tightening torques specified in UL 486 A to assure permanent and effective grounds.

10. Install luminaires, lamps, lenses, etc., after building is enclosed, weather tight and environmental conditions are nominally the same as expected for the complete spaces. All lamps, glassware, reflectors and refractors shall be clean and free of chips, cracks and scratches.

11. Lamps installed for use as temporary lighting prior to approval shall be replaced with new lamps. Replace all burn outs with specified lamp prior to project closeout.

12. All wall mounted luminaires and all ceiling mounted surface luminaires including exit lights shall be fed through a luminaire Stud/Hickey/Nipple assembly and with provisions to prevent luminaire turning.

13. Installation of exit signs shall be coordinated with other trades to ensure signs are visible as intended.

14. All junction box cover plates for the lighting branch circuit system shall be clearly marked with a permanent ink felt pen identifying the branch circuit and control relay (panel number, circuit number, lighting control cabinet designation and control relay number) contained in the box.

15. Provide permanently affixed adhesive labels with machine printed lettering (min. 1/8" high) at junction boxes serving luminaires that are supplied by (2) electrical sources (i.e. normal and emergency lighting). Label to read "CAUTION - This luminaire is powered by (2) separate sources. The normal power source breaker and the emergency power source breaker must be turned off before servicing this luminaire."

B. Recessed Luminaires:
1. The contractor shall be responsible to verify the fire rating of the ceiling system within which the luminaires are to be mounted. Where luminaires are installed in fire rated ceilings (and as required by code), provide fire rated enclosures around and over luminaires to maintain ceiling fire rating. No additional cost shall be allowed for failure to include such enclosures and installation in the bid.

2. Holes for Recessed Point-Source Luminaires: Cut holes to follow luminaire housings exactly so no gaps will be visible after trims are installed.

3. Install bottom of housing aligned with finished ceiling.

4. Keep ceiling insulation at least 75 mm (3") away from luminaires.

5. A-lamp downlights shall be installed with adjustable lampholders at proper heights for specified lamps.

6. Install trims after painting of spaces. Install trims tightly, with no gaps or light leaks.

7. Seismic restraints: Provide and install slack wires and hold-down clips per code.

8. Lamp Orientation:
   a. In situations where luminaires with horizontal lamps are aligned with each other, orient the lamps such that the axis of the lamps are in the same direction.

C. Ceiling-Mounted:

1. Provide support for outlet boxes and suspension points so luminaires can be installed securely, including seismic supports per code.
   a. Luminaire weight less than 25 kg (50 lb.) at each suspension point: hang from strap or stud on outlet box, or at non-feed points, provide 1/4"-20 stud projecting 20 mm (3/4") below ceiling.
   b. Luminaire weight 25 kg (50 lb.) or more at each suspension point: hang directly from structure, either independent of outlet box or from stud extending through outlet box to structure.

D. Wall-Mounted Luminaires:

1. Mounting heights shown on Drawings are measured from finished floor to centerline of outlet box or recessed housing, unless otherwise noted.

2. Verify luminaire weights and provide backing in wall as required. Luminaires must not droop or tilt away from wall.

3. Wet locations: install sealant between luminaire and outlet box.
4. In circulation areas, wall-mounted luminaires must not project more than 100 mm (4") from wall if mounted above 685 mm (27") and below 2030 mm (80").

E. Re-Lamping Existing Luminaires:

1. Provide new lamps for all existing luminaires to remain.

2. Field verify exact lamp type, color temperature, wattage, and style, to provide proper replacements for each lamp in existing luminaires to remain.

3. Clean all existing lenses to remain.

3.3 LIGHTING CONTROLS

A. Lighting controls to include occupancy sensors.

B. Occupancy sensors shall initially be set as follows:

1. Maximum sensitivity.

2. Time delay for 15 minutes.


4. Automatic off operation.

5. Aim all adjustable sensors to properly cover room areas.

3.4 DELIVERY, STORAGE, & HANDLING:

A. Deliver luminaires in factory-fabricated containers or wrappings, which properly protect luminaires from damage. Inspect luminaires immediately upon delivery to ensure correct shipment without damage.

B. Store luminaires in original packaging. Store inside well-ventilated area protected from weather, moisture, soiling, extreme temperatures, humidity, laid flat and blocked off ground.

C. Handle luminaires carefully to prevent damage, breaking, and scoring of finishes. Do not install damaged units or components; replace with new. Protection wrapping on louvered (parabolic) luminaires shall not be removed until luminaires are ready for operation.

3.5 SEQUENCING AND SCHEDULING:

A. General:

1. Coordinate with other work including wires/cables, electrical boxes and fittings, and raceways, to properly interface installation of luminaires with other work.
2. Sequence lighting installation with other work to minimize possibility of damage and soiling during remainder of construction.

B. Install controls so that all operable parts are at 48 inches (1220 mm) maximum height.

3.6 PROJECT CLOSEOUT

A. Clean luminaires and remove plaster and paint spatters.

B. Clean fingerprints and dust from downlight reflectors. Refer to manufacturer’s instructions.

C. Verify that luminaires and controls are working at time of final acceptance by Owner.
   1. Relamp as required.

D. Test emergency lighting system for 90 minutes in presence of Owner’s representative, check each luminaire for proper operation at end of 90-minute test, then recharge for 24 hours and briefly test each luminaire again for proper operation.

E. Install and aim adjustable lighting as directed by Architect.
   1. Provide personnel, lifts, ladders, and walkie-talkies as required.
   2. Aiming will occur at night, outside of normal working hours, at times as approved by the Architect.

F. Spare Lamps:
   1. Provide the following spare lamps to the Client for their use after project closeout. Deliver to the jobsite and store lamps as directed by the Client in a clean, dry, and protected environment.
      a. All lamp types:
         1) Provide 5% of the total quantity of each individual lamp type on the project.
         2) Provide an additional 5% of the total quantity of each T5 type lamp on the project.

G. Prepare two copies of a Lighting Systems Maintenance Manual consisting of the following in a hardcover binder. Deliver to Architect. After review, Architect will deliver one copy to Owner.
   1. One complete set of approved submittals, including product data and shop drawings.
2. List of lamps used in Project, cross-referenced to luminaire types, with specific manufacturer's names and ordering codes.

3. Relamping instructions for lamps that require special precautions (tungsten halogen, metal halide, etc.).

4. Luminaire cleaning instructions, including chemicals to be used or avoided.

5. Instructions for code-required testing and maintenance of emergency lighting system.

6. Identification of lighting products that contain hazardous materials or that require special disposal techniques (large quantities of fluorescent lamps, etc.)

END OF SECTION
SECTION 28 31 01
FIRE ALARM SYSTEM

GENERAL

1.1 DESCRIPTION:

A. This project shall include the furnishing, installation, connection, programming, commissioning, and testing of minimal expansion of an existing conventional, manual fire alarm system.

B. Alarms/troubles at each building shall activate the local notification devices (or report troubles) at the respective building panel only and report the alarms/troubles to the Main FACP, but shall not activate other building notification devices.

1.2 SCOPE:

A. This specification outlines the requirements for a conventional system. The system and components shall be supplied by one manufacturer of established reputation and experience who shall have produced similar apparatus for a period of at least five (5) years and who shall be able to refer to similar installations in public buildings rendering satisfactory service.

B. The work described in this specification consists of all labor, materials, equipment and services necessary and required to complete and test the manual fire alarm system. Any material not specifically mentioned in this specification or not shown on drawings but required for proper performance and operation shall be furnished, installed, and connected complete.

C. The work shall include all required programming to allow network operation between each control panel, for central monitoring from the Main FACP.

1.3 REQUIREMENTS:

A. This installation shall be made in accordance with the drawings, specification and the following:

   1. National Electrical Code Article 760
   2. NFPA Standard 72
   3. Local Codes and Authorities Having Jurisdiction
   4. ADA requirements and regulations.

1.4 RELATED WORK:

A. Division 26: Basic materials and methods
B. Division 21: Fire protection systems
C. Division 23: HVAC systems

1.5 FIRE DETECTION SYSTEM DESCRIPTION:

A. Provide notification and other devices as per specifications and indicated on drawings.
B. Indicate alarms, supervisory, and trouble signals on the main fire alarm control panel.
C. Transmit alarm signals to off-site reporting agency via a digital communicator at each building panel, with specific building address ID.
D. The fire alarm system shall function as follows when any workflow switch or manual station initiating device operates:

1. Operate required audible/visual and visual devices as shown on the Drawings.
2. Automatically notify off-site reporting agency.
3. Indicate at the control panel alphanumeric display the number and location of the alarmed device.
4. Light an indicating lamp on the smoke detector initiating the alarm.
5. Light an indicating lamp on the remote annunciator indicating the location alarmed as well as the type of device alarmed (area smoke detector, duct detector, manual pull station, workflow switch, ansl system panel, valve supervisory switch, etc.).

E. Provide additional system features and capacities as indicated in Part 2 of this Section of the Specifications.

1.6 GUARANTY:

A. All work performed and all material and equipment furnished under this contract shall be free from defects and shall remain so for a period of at least one (1) year from the date of acceptance.

1.7 SUBMITTALS:

A. Submit fire alarm shop drawings and product data sheets in accordance with Division 01 and Section 26 05 00.
B. This Contractor shall submit the completed Fire Alarm Shop Drawings, with associated equipment cut sheets and CSFM listings, to the local Fire Department and submit for a seperate Fire Alarm System Permit as required by the local authority. Final Fire Alarm System approval (by the AHJ) and Permit shall be based on the shop drawings.
submitted and completed by the Contractor. The design drawings are for overall system requirements and layout only.

C. Shop Drawings shall indicate the following: building floor plan, location and type of devices, conduit and wire quantities, power requirements, complete wiring point-to-point diagrams, details, and locations of fire alarm and remote annunciator panels. Submittal shall include a system 1-line riser diagram with all devices and equipment and interconnections shown.

D. Submit manufacturer's installation instructions including back-box requirements for each piece of equipment.

E. Submit manufacturer's operating instructions and maintenance data.

F. Submit voltage drop and battery calculations.

1.8 APPLICABLE PUBLICATIONS:

The publications listed below form a part of this specification.

A. National Fire Protection Association (NFPA) - USA:
   No. 70- National Electrical Code (NEC)
   No. 72 - National Fire Alarm Code
   No. 101 Life Safety Code

B. Underwriters Laboratories Inc. (UL) - USA:
   No. 464 Audible Signaling Appliances
   No. 1971 Visual Signaling Appliances
   No. 38 Manually Actuated Signaling Boxes
   No. 346 Waterflow Indicators for Fire Protective Signaling Systems

C. Local and State Building Codes.

D. All requirements of the Authority Having Jurisdiction (AHJ).

1.9 APPROVALS:

A. The control panel and all peripherals shall have proper listing and/or approval from Underwriters Laboratory (UL) and be California State Fire Marshall listed and approved.
PRODUCTS

2.1 EQUIPMENT AND MATERIAL, GENERAL:

A. All equipment and components shall be new, and the manufacturer's current model.

B. The system shall be UL 864 (9th Edition) listed.

C. Acceptable System Manufacturers: ADT, Gentex to match existing.

D. The system design is based on the products listed on the Fire Alarm Equipment List and has been approved by DSA as such. Deviations from the approved design (for manufacturer or device layouts) may be allowed with approval by the engineer, however, it shall be the Contractors responsibility to redesign and resubmit the plans to DSA for re-approval.

E. All equipment and components shall be installed in strict compliance with manufacturers' recommendations.

F. All Equipment shall be attached to and ceiling/floor assemblies and shall be held firmly in place. (e.g., detectors shall not be supported solely by suspended ceilings). Fasteners and supports shall be adequate to support the required load.

2.2 CONDUIT, BOXES, AND WIRE:

A. All conduit and wire shall comply with section 26 27 00 of these specifications.

B. Conduit:

1. Conduit shall be in accordance with The National Electrical Code (NEC), local and state requirements.

2. Conduit fill shall not exceed 40 percent of interior cross sectional area where three or more cables are contained within a single conduit.

3. Cable must be separated from any open conductors of Power, or Class 1 circuits, and shall not be placed in any conduit, junction box or raceway containing these conductors, as per NEC Article 760-29.

4. Conduit shall be 3/4 inch minimum.

C. Wire:

1. All fire alarm system wiring shall be new and installed in conduit.

2. Wiring shall be in accordance with local, state and national codes (e.g., NEC Article 760). Number and size of conductors shall be as recommended by the fire alarm system manufacturer, but not less than 16 AWG for initiating device circuits and signaling line circuits, and 12 AWG for Notification device circuits.
D. Terminal Boxes, Junction Boxes and Cabinets:

1. All boxes and cabinets shall be UL listed for their use and purpose.

2.3 INITIATION DEVICES:

A. Manual Stations, (conventional) shall be single action and semi-flush or surface mounted as indicated on the drawings.

1. The manual station shall be equipped with terminal strip and pressure style screw terminals for the connection of field wiring.

2.4 BATTERIES

A. Batteries shall be 12 volt, sealed Gell-Cell type, with combined Amp-Hour ratings as required by code.

B. Battery shall have a minimum sufficient capacity to power the fire alarm system for not less than twenty-four hours in standby mode, plus 5 minutes of full system alarm upon a normal AC power failure.

C. The batteries are to be completely maintenance free, no liquids required. Fluid level checks, refilling, spills and leakage shall not be required.

2.5 NOTIFICATION DEVICES:

A. Horn/Strobe combinations shall be provided as indicated on drawings. The horn / strobe combination shall be Wheelock or equal, ADA and UL 1971 compliant (candela values as required) - White finish.

B. Strobe Lights shall be provided as indicated on drawings. The strobe lights shall be wall mounted at +80" AFF or 6" below the ceiling level, whichever is lower, Wheelock or equal, ADA and UL 1971 compliant (candela values as required) - White finish.

C. Refer to Part 3 below for required synchronization of strobes when located in the same field of view.

EXECUTION

3.1 INSTALLATION:

A. Installation shall be performed by current factory-authorized contractor of the specified system.

B. Installation shall be in accordance with the NEC, NFPA 72, local and state codes, as shown on the drawings, and as recommended by the major equipment manufacturer.

C. All conduit, junction boxes, conduit supports and hangers shall be concealed in finished areas and may be exposed in unfinished areas. Smoke detectors shall not be installed.
prior to the system programming and test period. If construction is ongoing during this period, measures shall be taken to protect smoke detectors from contamination and physical damage.

D. All fire detection and alarm system devices, control panels and remote annunciators shall be flush mounted when located in finished areas and may be surface mounted when located in unfinished areas.

E. Provide identification labeling on all devices to identify loop and device number/address. Labeling shall consist of min. 3/8" black lettering on white background P-Touch style adhesive labels with machine printing, Helvetica font or similar.

F. At the final inspection a factory trained representative of the manufacturer of the major equipment shall perform the tests in Section 3.2 TESTS.

G. WIRING:

1. All circuits shall be in conduit, minimum 3/4".

2. Notification circuits shall be 12 AWG minimum for strobes, but not to exceed manufacturers wire capacity for modules. Control power circuits shall be 14 AWG minimum or as required.

3. When (3) or more visual notification devices are located within the same field of view and are less than 55 feet apart (within the field of view), all devices within that field of view shall be synchronized to provide the same flash rate and frequency. Provide all required sync modules and compatible strobe devices to provide a synchronized output.

3.2 TESTING:

A. Provide the service of a competent, factory trained engineer or technician authorized by the manufacturer of the fire alarm equipment to technically supervise and participate during all of the adjustments and tests for the system. Each building shall be separately tested as completed and the entire networked system tested just prior to project completion. Include contractor pre-test for each building prior to the final AHJ testing to insure a suitable final test result.

1. Before energizing the cables and wires, check for correct connections and test for short circuits, ground faults, continuity, and insulation.

2. Close each sprinkler system flow valve and verify proper supervisory alarm at the respective FACP and/or annunciator.

3. Verify activation of all flow switches.

4. Open initiating device circuits and verify that the trouble signal actuates at the respective FACP and/or annunciator.
5. Open and short all notification appliance circuits and verify that trouble signals actuate at the respective FACP and/or annunciator.

6. Ground circuits and verify response of trouble signals at the respective FACP and/or annunciator.

7. Check presence and audibility of tone at all alarm notification devices.

8. Check installation, supervision, and operation.

9. Verify that each initiating device alarm is properly received and processed by the respective FACP and annunciator (Walk Test).

10. Conduct tests from each FACP to verify trouble indications for common mode failures, such as alternating current power failure.

B. Test reports shall include, but not be limited to:

1. A complete list of equipment installed indicating proper operations as listed above.

3.3 FINAL INSPECTION:

A. Final acceptance will require the contractor to deliver to the Owner the following;

1. Three (3) copies of the operating instructions and system maintenance manuals.

2. Three (3) set of record drawings.

3. Three (3) copies of the final test reports.

4. Three (3) copies indicating the name and phone number of person to contact in the event of equipment failure, and date when system warranty will be terminate.

5. Three (3) sets of data sheets for each piece of equipment supplied.

B. The fire alarm system subcontractor or manufacturer shall offer for the owners consideration at the time of system submittal a priced inspection, maintenance, testing and repair contract in full compliance with the requirements of NFPA 72.

1. The services offered under this contract shall be performed at no charge during the first year after system acceptance and the owner shall have the option of renewing for single or multiple years, up to five years, at the price quoted in bid.
2. The contractor performing the contract services shall be qualified and listed to maintain ongoing certification of the completed system to the UL for specific installed system listing.

3.4 WARRANTY

A. The fire detection system shall be warranted for a period of one year from date of acceptance. The warranty shall cover parts, labor, and travel to and from the site.

3.5 INSTRUCTION:

A. Provide complete instruction manuals and training to the building personnel. "Hands-on" demonstrations of the operation of all system components and the entire system shall be provided.

END OF SECTION