

Specifications

For

**Bob Cole Conservatory of Music
Phase 2**

California State University
Long Beach, California

Bid Set

October 27, 2011

Steinberg Project #11047.001

Steinberg Architects
523 West 6th Street, Suite 245
Los Angeles, CA 90014
 **213.629.0500**
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**BOB COLE CONSERVATORY OF MUSIC
PAVILION & PLAZA – PHASE 2
California State University, Long Beach, CA**

Specifications Signature Sheet

Architect - David Hart

STEINBERG ARCHITECTS

523 West 6th Street, Suite 245
Los Angeles, CA 90014



Civil Engineer -

KIMLEY-HORN and ASSOCIATES

765 The City Drive, Suite 400
Orange, CA 92868

IDENTIFICATION STAMP
DIV. OF THE STATE ARCHITECT

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Structural Engineer -

MHP STRUCTURAL ENGINEERS

4500 East Pacific Coast Highway, Suite 100
Long Beach, CA 90804

Landscape Architect -

SWA

811 West 7th Street, Suite 430
Los Angeles, CA 90017

Mechanical Engineer -

P2S

5000 East Spring Street, 8th Floor
Long Beach, CA 90815

Electrical Engineer -

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Plumbing Engineer -

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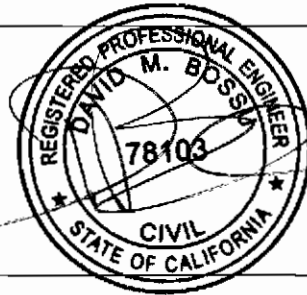
STEINBERG ARCHITECTS

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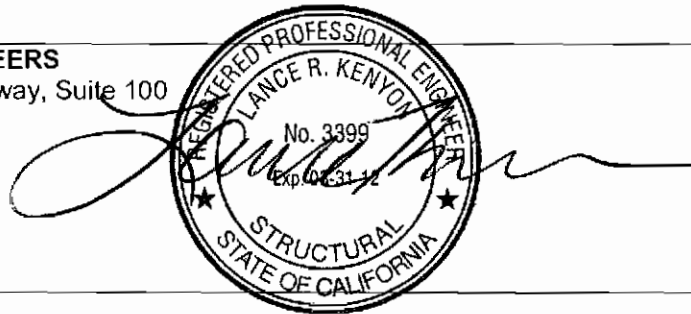
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Mechanical Engineer - Chris Miller

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Electrical Engineer - Aravind Batra

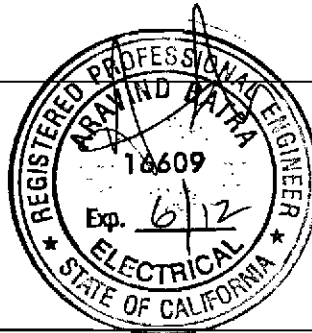
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Plumbing Engineer - Chris Miller

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00010
TABLE OF CONTENTS

00010	Stamp and Signature Page
	Table of Contents

DIVISION 1 – GENERAL REQUIREMENTS

From CSULB

DIVISION 2 – SITE CONSTRUCTION

02221	Demolition
02230	Site Clearing
02231	Tree Protection & Trimming
02310	Finish Grading
02320	Landscape Excavating & Backfilling
02370	Erosion Control
02300	Earthwork
02310	Finish Grading
02630	Storm Drainage
02751	Cement Concrete Pavement
02810	Landscape Irrigation
02870	Site & Street Furnishings
02910	Soil Preparation
02930	Exterior Plants
02935	Landscape Establishment

DIVISION 3 - CONCRETE

03310	Concrete Formwork
03200	Concrete Reinforcement
03300	Cast-in-Place Concrete
03355	Special Concrete Finishes

DIVISION 4 - CONCRETE

04813	Masonry Veneer

DIVISION 5 – METALS

05120	Structural Steel
05310	Steel Decking
05400	Cold Formed Steel Framing
05500	Metal Fabrications
05720	Handrails & Railings
05811	Seismic Joint Cover Assemblies

DIVISION 5 – WOOD

06100	Rough Carpentry
06200	Finish Carpentry
06411	Laminate Clad Wood Cabinetry
06652	Solid Surface Countertops

DIVISION 7 - THERMAL AND MOISTURE PROTECTION

07130	Membrane Waterproofing System
07190	Water Repellants
07213	Thermal Batt Insulation
07250	Weather Barrier
07540	Thermoplastic Membrane Roofing
07620	Sheet Metal Flashing & Trim
07650	Flexible Flashing
07840	Fire Stopping
07900	Joint Sealers

DIVISION 8 – DOORS & WINDOWS

08110	Steel Doors & Frames
08212	Flush Wood Doors
08410	Aluminum Entrances & Storefronts
08710	Hardware
08800	Glazing
08911	Glazed Aluminum Curtain Wall

DIVISION 9 - FINISHES

09110	Non-Load Bearing Metal Framing
09115	Metal Channel Framing
09120	Suspended Ceiling Systems
09250	Gypsum Board
09251	Cementitious Backing Board
09253	Gypsum Sheathing
09300	Tile
09511	Acoustical Panel Ceiling
09513	Exterior Plank Ceiling
09543	Wood Ceiling System
09650	Resilient Sheet Flooring
09651	Resilient Base
09683	Carpet Tile
09721	Cork Wall Coverings
09820	Acoustical Insulation & Sealants
09900	Paints & Coatings
09960	Graffiti Resistant Coatings

DIVISION 10 - SPECIALTIES

10100	Visual Displays
10140	Signage
10441	Fire Extinguisher Cabinets
10451	Fire Extinguishers
10671	Metal Storage Units

DIVISION 11 - EQUIPEMENT

Not Used

DIVISION12 - FURNISHINGS

12241 Roller Window Shades

DIVISION 13 – SPECIAL CONSTRUCTION

Not Used

DIVISION 14 – CONVEYING SYSTEMS

Not Used

DIVISION 15 - MECHANICAL

15010 Basic Mechanical Requirements
15011 General Requirements for Equipment
15020 Mechanical Demolition
15060 Pipe and Pipe Fittings General
15061 Steel Pipe and Fittings
15077 Identification for HVAC Piping, Ductwork and Equipment
15088 HVAC Piping Insulation
15110 general Duty Valves for HVAC Piping
15120 Meters and Gages for HVAC Piping and Ductwork
15140 Hangers and Supports for HVAC Piping and Equipment
15171 VFD1
15290 Ductwork Insulation
15855 Air Handling Units
15890 Ductwork
15900 DDC Controls

DIVISION 16 - ELECTRICAL

16000 Common Electrical Requirements
16010 Electrical General Requirements
16050 Basic Materials and Methods
16060 Electrical Demolition
16110 Conduits and Raceways
16140 Wiring Devices
16170 Grounding
16180 Equipment Wiring Systems
16195 Electrical Identification
16402 Underground Electrical Work
16470 Panel boards
16150 Lighting
16515 Lighting Control System
16521 Exterior Lighting
16560 wireless Lighting controls
16561 Lighting Controls
16700 Fire Alarm System
16710 Telecom general Requirements
16715 Telecom Acceptance Testing
16720 Telecom Basic Materials and Methods
16725 Telecommunications Cable
16760 Telecom Grounding and Bonding
16995 Electrical Commissioning

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SECTION 01010
SUMMARY OF WORK, WORK SEQUENCE, AND SPECIAL CONDITIONS

1.00 GENERAL

1.01 SECTION INCLUDES

- A. General project description
- B. Work by others
- C. Access to the Site and Use of Premises
- D. University occupancy
- E. Review of existing conditions
- F. Hazardous materials procedure
- G. Codes, Ordinances, and regulatory requirements
- H. Use of University equipment
- I. Time of Completion, Delays in Completion, and Liquidated Damages
- J. Project staff
- K. Project Coordination and Site Survey Requirements
- L. Special Considerations
- M. Recommended Work Sequence

1.02 RELATED SECTIONS

- A. Contract General Conditions
- B. Technical Specifications

1.03 GENERAL PROJECT DESCRIPTION

- A. The work shall conform to the contract drawings and to the specifications, which form a part of this package.
- B. Demolish and Renovate existing building overhang, New Building Addition, Terraced Seating (plaza, seating, ramp, landscape), Main Walk (paving, planters, landscape), Miscellaneous site improvements - lighting, signage, bench seating, bike storage, storage, benches.

1.04 WORK BY OTHERS

- A. The University reserves the right to let other contracts in accordance with the General Conditions of the Contract.
- B. The Contractor shall coordinate and cooperate with other contractors and shall execute the work of this contract in a timely manner so as to cause no delay in the work of other contracts. Where excavations and installations to be performed and provided under this contract are in common, in

conjunction with, or in connection with the work of another contract, the Contractor shall afford the other contractors ample opportunity to execute their work.

C. COMMISSIONING

1. This project will have selected building systems commissioned. The equipment and systems to be commissioned are specified in Section 01810. The commissioning process, which the Contractor is responsible to execute, is defined in Division 1.
2. The University will provide the services of a qualified Commissioning Authority. The responsibilities of the Commissioning Authority are defined in Section 01810.

1.05 ACCESS TO THE SITE AND USE OF PREMISES

A. Limit use of site and premises to allow:

1. University occupancy of adjacent buildings and spaces
2. Work by Others and Work by the University
3. Use of adjacent site and premises by students and faculty
4. Unimpeded access by fire fighting or rescue equipment
5. Exiting from existing facilities for life safety
6. Accessibility to adjacent buildings, walkways, roadways, and spaces for the disabled
7. Access for trash disposal
8. Loading / Receiving area access

B. The contractor shall be responsible to ensure that ADA access is maintained to surrounding buildings. The contractor shall prepare and provide a fencing plan that incorporates ADA accessibility to adjacent buildings at all times during construction.

C. The contractor must be sensitive to and recognize the possibility of encountering cultural artifacts when performing excavations and site work. Contractor shall exercise extreme discretion and caution when performing excavation and site work activities. The Contractor is required to notify the University in writing a minimum of ten (10) working days prior to any activities which include, but are not limited to, digging, trenching, or excavation work. The campus' consulting archaeologist and Native American monitor are required to oversee all trenching and excavation work in progress and inspect all spoils prior to removal from site. No spoils are to be removed until the campus' consulting archaeologist and Native American monitor have certified to University that the inspections have occurred.

D. In accordance with University policy, the Contractor shall be assessed a refundable deposit of \$50.00 per change key and \$100.00 for maintenance or building masters issued for use in conjunction with the Contract. The deposit can be made in the form of cash, cashier's check, Company check, or personal check. Deposit must be made prior to any keys being issued by the University. The deposit will be refunded upon completion of the project and the receipt of the keys to the University. If Contractor fails to return a key, the deposit for that key will be forfeited, and a lost key fine will be charged for the actual cost of labor and material for re-keying campus University locks, up to \$5,000 per building.

- E. Contractor shall be responsible for the full and complete costs associated with replacing and/or repairing all damage to on-campus roads, sidewalks, landscape, hardscape, etc., used by construction vehicles coming to the job. At the start of the project, a video of the existing conditions shall be made by the Contractor with the Inspector of Record in attendance during taping. Contractor shall provide one (1) copy of the pre-construction survey videotape to the University within fourteen (14) calendar days after completion of taping. The videotape shall act as the official record for verification of existing conditions prior to the start of construction.
- F. Placement of Trash Bins, Recycling Bins, Storage Bins and Storage of Materials
1. Site for trash bins, recycling bins, storage bins, and/or staging areas are to be within the limits of work designated on the plans. Failure to comply will result in the University removing the equipment under its own forces at the expense of the contractor.
 2. Contractor is responsible for restoring site / facility to original condition.
- G. The Contractor is required to observe all campus driving and access restrictions. Each driver must have a valid California driver's license. Contractor must avoid driving on inner campus during class breaks ten (10) minutes to the hour. Contractor shall access campus interiors for specific service-related needs (i.e., unloading or emergency response only). Contractor is required to obtain an access permit for each vehicle that must access campus interiors. A limited number of access permits are available through the Facilities Management department. Each vehicle used by the Contractor to access any area on campus must have a sign on the side of each vehicle that identifies the contractor or subcontractor for which the driver is employed.
- H. Contractor must never exceed posted speed limits and must use discretion when a slower speed may be more appropriate due to congestion. Contractor must use caution at pedestrian crossings (i.e., intersections, crosswalks, and other unmarked areas where frequent crossing occurs). Contractor must ensure that the pedestrian has the right of way. Contractor must park vehicles so as to not block traffic crosswalks, disabled access routes, fire lanes, building entrances, fire hydrants, and walkways. Vehicle access is prohibited on the elevated pedestrian walkways. Driving on lawns and landscaped areas is prohibited.
- I. Contractor shall be required to maintain fire equipment access through established fire lanes at all times and shall provide trench plates, etc., as necessary to ensure access for fire equipment. Contractor shall be required to maintain access for all truck deliveries, trash removal, etc.
- J. The Contractor's employees (including sub-contractors, material suppliers, manufacturer's representatives, etc.) must purchase a parking permit and are restricted to park only in Parking Lots 12, Parking Structures 2 and 3. Contractor will be responsible to become familiar with these parking lot locations and provide transportation for the labor forces as needed. Parking in any other parking lot or area within the campus will result in the vehicle being cited and / or towed at the owner's expense. The current parking rates consist of the following but may change without notice. For more information, contact the Office of Parking and Transportation Services at (562) 985-4146. Parking and Transportation Services will only accept checks.
1. Daily - \$5.00 – available at permit dispensers located throughout the campus.
 2. Monthly - \$28.50
 3. Annual - \$342.00 – available at the Office of Parking and Transportation Services.
 4. Storage of trailer or bin in one designated parking stall - \$20 per day
 5. Use of more than one stall as a lay-down yard – rate determined by Parking Office review.
- K. The University has adopted a strict policy prohibiting sexual or racial harassment of any kind on campus. The Contractor shall be responsible for cautioning and reminding the Contractor's employees, including subcontractors, materials suppliers and others, to refrain from initiating verbal or physical conduct of a sexual or racial nature. The Contractor shall be responsible for their employee's actions and communications, including those of the subcontractors, material suppliers and others, while working on campus. Failure on the Contractors part to inform their

employees concerning the University policy prohibiting sexual and racial harassment and discrimination will be due cause by the University to request the Contractor to stop work and to remove the Contractor's employee from the project site. Any damages and cost accrued by such work stoppage shall be borne at the sole expense of the Contractor and at no additional cost to the University.

- L. The University has adopted the policy of a Smoke-Free environment. Contractor shall not allow employees or subcontractors, visitors, manufacturer's representatives, etc., to smoke in new or existing buildings and / or buildings under construction or within twenty (20) feet of an entrance to a University building, near the fresh air supply or near operable windows.
- M. The University requires that the Contractor observed all posted regulations for accessing campus facilities. This includes the requirement that no food and drink is allowed at any time within University facilities unless designated otherwise.
- N. The Contractor shall comply with University policy pertaining to a drug-free workplace. The Contractor shall adhere to this policy at all times.
- O. Provide signs adequate to direct visitors to the job site. The University shall approve all signage prior to fabrication and installation by the General Contractor. Do not allow posting of unauthorized signs.
- P. Contractor must provide a project sign at the East and South areas of the site, visible to the street in accordance with Article 4.23 of the Contract General Conditions. This shall be fabricated and installed within 14 days after the NTP is issued. The University shall approve all signage prior to fabrication and installation by the contractor.
- Q. Contractor must provide and post pedestrian and vehicular detour signs and disabled accessible route signs as required providing clear direction around any obstruction caused by construction. The University shall approve all signage prior to fabrication and installation by the contractor. All walkways in the vicinity of the building are accessible paths of travel that need to be maintained.

In addition, the Contractor shall note the locations of existing disabled access route signs, which indicate the established disabled accessible path of travel. The established disabled accessible path of travel must remain open, free of any obstructions, and accessible at all times.

- R. The contractor must maintain disabled access routes at all times around the work areas. Contractor shall provide ramping for bridges and trench plates at all times as required for wheelchair and visually impaired persons. Trench plates in pedestrian travel routes shall be installed as necessary, and in such a manner, to ensure smooth transition for wheelchair travel.
- S. The Contractor must maintain all utilities affected by the construction of this project in an operable and functioning condition (including irrigation systems) to all buildings, facilities, parking lots, and services on the campus. All costs for providing temporary utilities must be included in the base bid.

If any utility is interrupted which affects any occupied facility, the Contractor must provide a temporary connection to the affected utility / facility / area within the time frame noted below with due diligence, at no additional cost to the University. The Contractor is not allowed to shutdown valves or take other measures to secure utilities except in extreme life threatening situations. The Contractor must **immediately** notify Facilities Management at (562) 985-4357 between the hours of 7:00 a.m. and 5:00 p.m. or University Police at (562) 985-4101 between the hours of 5:00 p.m. and 7:00 a.m. of any utility interruption.

If the contractor does not perform repairs with due diligence within the noted time frames, the University will enforce the terms and conditions of the General Conditions for Contractor's failure to perform work in a timely manner.

Fire Alarm System:	By the end of same work day or post fire watch.
Security Alarm System:	By end of same work day
Radio Communication System:	By end of same work day
Telecommunications System – Voice and Data including payphones, fiber backbone, copper network, etc.	Within 4 hours of occurrence
Energy Management Control System:	Within 4 hours of occurrence
University Master Clock System:	Within 8 hours of occurrence
Exterior Lighting / Street Lighting:	By end of same work day
Building Power:	Within 4 hours of occurrence
Potable Water:	Within 6 hours of occurrence, depending on impact of loss of water as determined by the University.
Gas:	Within 4 hours of occurrence
Sewer:	Within 6 hours of occurrence, depending on impact of loss of water as determined by the University.
Storm Drain:	Within 48 hours of occurrence
Irrigation (including reclaimed water):	Within 48 hours of occurrence - provide alternate methods of irrigation if needed during outages to prevent damage to landscape.

1.06 UNIVERSITY OCCUPANCY

- A. The University will occupy the buildings, walkways, roadways, and parking areas adjacent to this project during the entire period of construction for the conduct of normal operations.
- B. Cooperate with University to minimize conflict and to facilitate University's operations as noted in these specifications and plans. Contractor to follow project phasing schedule.
- C. Schedule the Work to accommodate these requirements.

1.07 REVIEW OF EXISTING CONDITIONS

- A. Record drawings are available for review by the Contractor at the Physical Planning and Construction Management Office at the Facilities Management Building located at 1331 Palo

Verde Ave., Long Beach, CA. Hours are normally 9:00 a.m. – 12:00 p.m. and 1:00 p.m. – 4:00 p.m., Monday through Friday. Copies can be requested after Award of Contract and at the Contractor's expense. Request for copies should be made in writing a minimum of seven (7) working days in advance of the Contractor's need for these documents.

- B. Before commencing work, the Contractor shall review the as-built drawings for the areas in question to determine probable locations of utilities and other structures that will impact construction.

1.08 HAZARDOUS MATERIALS PROCEDURES

- A. The Contractor is made aware that in buildings or portions thereof constructed prior to 1972 or thereabout, there is a serious possibility when it is altered or renovated that some existing construction materials may contain asbestos or other materials considered hazardous.
- B. During the course of performing this contract the Contractor suspects asbestos or other hazardous materials are present in the area of work, the Contractor shall immediately stop work in the affected area and notify the University.

1.09 CODES, ORDINANCES AND REGULATORY REQUIREMENTS

- A. Comply with all ordinances, laws, and regulations applicable to the Work. Contractor shall be fully responsible for any results of carelessness or violations in this respect and shall hold the State of California, the Trustees of the California State University, the University, the Architect, and the officers, employees, representatives, and agents of each of them, harmless from any damage arising there from. Nothing in the Specifications or Drawings shall be construed to permit Work not in complete conformance with any Federal, State, or local code or ordinance.
- B. During the entire construction period, it shall be the sole responsibility of the Contractor to maintain conditions at the project site to meet the requirements of the Federal Occupational Safety and Health Administration (OSHA). This provision shall cover the Contractor's employees and all other persons working upon or visiting the site. To this end, the Contractor shall inform themselves and Contractor's representatives of the Federal OSHA standards.
- C. Obtain copies of the applicable regulations and keep at the project site for use of all parties.
- D. Contractor shall provide an Injury and Illness Prevention Plan (IIPP). All requirements of Title 8 – Cal-OSHA are to be adhered to. The contractor and its subcontractors are to submit an IIPP for the University's review prior to the start of construction. The IIPP is a written program describing the policies used by an employer to provide a safe and healthy workplace for their employees. The IIPP is required to include, but is not limited to, the following information (per Title 8, CCR 3203):
 - 1. Identify the person responsible for implementing the plan by name.
 - 2. Include a system for ensuring employee compliance with the plan.
 - 3. Include a system for communicating health and safety information to employees.
 - 4. Include a procedure for correction of unsafe conditions.

5. Include a procedure for investigating injuries and illnesses.

6. Include procedures for identifying and evaluating workplace hazards, including inspections of work site; when the program is first established, whenever new substances, processes, or equipment changes occur; and whenever the employer is made aware of a new or unrecognized hazard.

1.10 CONSTRUCTION PHASES - DELAYS IN COMPLETION - LIQUIDATED DAMAGES

A. The time period for completion of the OVERALL project shall be two hundred and forty-five (245) calendar days from the date of the Notice to Proceed. Liquidated damages shall be \$2,500.00 for each calendar day completion is delayed beyond the time prescribed for the overall project.

1.11 USE OF UNIVERSITY EQUIPMENT

A. The Contractor will not be allowed the use of University equipment such as work tools, disposal bins, trash carts, or the like.

B. The Contractor shall furnish all equipment necessary for completion of work as outlined in the contract documents.

1.12 PROJECT STAFF

A. Contractor shall employ a competent project staff, including but not limited to a Project Manager and Project Superintendent. The General Contractor's Project Superintendent shall be in full-time attendance at the project site during the progress of the work. The project staff shall represent the Contractor, and all communications given to the project staff shall be as binding as if given to the Contractor. Contractor shall provide a management organizational chart and a list of personnel comprising the project staff at time of contract award. All references to the Superintendent elsewhere in the Contract Documents shall mean the Superintendent and Superintendent's staff.

B. With the exception of the Project Manager, the project staff shall be in attendance at the project site full time and / or at all times that any work is taking place on the project site, unless the work is stopped due to a general strike or conditions beyond the control of the Contractor, or until termination of the contract is accordance wit the Contract Document. The project staff must be fully capable for this project and must be acceptable to the University. Failure to provide appropriate documentation of qualifications and suitable experience shall be sufficient reason for the University to disqualify and disallow such person for the required position of Project Manager or Project Superintendent on this project.

C. Failure to maintain a Superintendent on the project site at all times the work is in progress, including second and third shift, weekends, after-hours, holidays, etc., and including when work is being performed by subcontractor(s), shall be considered a material breach of the contract, entitling the University to terminate the contract, or alternatively, to issue a Stop Work Order until the Superintendent is on the project site. If, by virtue of issuance of said Stop Order, Contractor fails to complete the project within the time required by Contract, the University will not be held liable for any cost associated with the Contractor's delay.

1.13 PROJECT COORDINATION AND SITE SURVEY REQUIREMENTS

- A. Coordinate the work and do not delegate responsibility for coordination to any subcontractor or manufacturer.
- B. Anticipate the interrelationship of all subcontractors and manufacturers and their relationship with the work.
- C. Resolve differences or disputes between the subcontractors concerning coordination, interference, or extent of work between sections.
- D. Coordinate the work of subcontractors so that portions of the work are performed in a manner that minimizes interference with the progress of the work.
- E. Do not obstruct spaces and installations until they have been inspected and approved and required certificates of inspection issued.
- F. Do not obstruct spaces and installations that are required to be clear by Applicable Code Requirements.
- G. Remove and replace all work that does not comply with Contract Documents. Repair or replace any other work or property damaged by these operations at no additional cost to the University.
- H. Perform a survey of the project site, and record conditions in and adjacent to the project site including but not limited to all pathways and travel ways around the project. Contractor and Inspector of Record shall attend the pre-construction survey. At the start of the project, a video of the existing conditions shall be made by the Contractor with the Inspector of Record in attendance during taping. The Contractor shall provide one (1) copy of the pre-construction survey videotape to the University within fourteen (14) calendar days after completion of taping. Contractor shall provide one (1) copy of the pre-construction survey videotape to the University within fourteen (14) calendar days after completion of taping. The videotape shall act as the official record for verification of existing conditions prior to the start of construction.

1.14 SPECIAL CONSIDERATIONS

- A. All work must be scheduled around the University's commencement activities. The dates of the ceremonies are as follows:

May 23, 24 and 25th, 2011

At no time during these dates may the General Contractor schedule any deliveries, noise-making activities, or any other work that is visible / audible from the Commencement site (Central Quad area between the Liberal Arts buildings and the Fine Arts buildings). General Contractor and Subcontractors shall refrain from any activities that will, may or have the possibility of disrupting the Commencement activities. The General Contractor is required to work with the University a minimum of six (6) weeks in advance of the Commencement activities to determine which General Contractor-related activities will be allowed to be scheduled during these days.

The General Contractor's overall contract time period for this project shall include these work restriction periods; no additional days will be added to the Contract time due to these work restrictions.

- B. Prior to any coring, drilling or saw cutting of concrete or masonry construction all existing reinforcing steel shall be positively located as necessary to prevent damage to the existing reinforcing steel during the coring, drilling or saw cutting procedure. The General Contractor shall employ an appropriate method such as x-ray or pachometer survey to positively locate the

reinforcing steel. In no instance shall the extent of the drilled or cored hole be closer to any existing reinforcing than 1-½ inches. The General Contractor shall notify the Structural Engineer of Record prior to proceeding with any coring, drilling or saw cutting where the existing placement of reinforcing interferes with the intended location. Coring or drilling shall not commence until the Structural Engineer of Record has adequately reviewed and dispositioned any such interference.

- C. General Contractor must ensure that all landscape and hardscape areas campus-wide, are protected against damage, including, but not limited to, tire marks / ruts, fluid drips / stains, etc. General Contractor shall be responsible for full and complete costs associated with all repairs / cleaning, site restoration, etc., as required to return site to original condition. General Contractor shall clean / make all repairs, etc., within seventy-two (72) hours after receiving written notification from the University that such repairs are required.
- D. General Contractor shall be required to maintain fire equipment access through established fire lanes at all times and shall provide trench plates, etc., as necessary to ensure access for fire equipment. General Contractor shall be required to maintain access for all truck deliveries, trash removal, etc.
- E. The General Contractor will be held responsible for and be required to make restitution, at their own expense, for all damage to persons or property caused by the General Contractor or Subcontractor, or the agents, or employees of either during the progress of the Work until its Final Acceptance.
- F. The General Contractor shall time the construction activities so as to not interfere with peak hour traffic and minimize obstruction of through traffic lanes adjacent to the site. As required, a flag person shall be retained to maintain safety adjacent to existing roadways.
- G. Unless noted on the General Contractor's approved construction schedule, General Contractor must submit written notice to the Construction Administrator a minimum of 72-hours in advance, requesting authorization to perform work on Saturday, Sunday or recognized Local, State or Federal holiday. General Contractor must obtain written authorization from the Construction Administrator prior to commencing work on Saturday, Sunday or recognized holiday.
- H. Work adjacent to or within occupied portions of the building shall not disrupt University operations. At the end of every shift, furniture or other items moved by the Contractor as necessary to access work area shall be moved back into original position and shall be cleaned and / or restored to original condition. Contractor materials and equipment shall be removed and stored, all debris and refuse removed, and area cleaned, including removal of all dust generated by construction activities. It is the Contractor's responsibility to move all site furnishings, furniture including contents, accessories, equipment, and other miscellaneous items as required in all areas affected by work to be performed under this contract. It is the Contractor's responsibility to disconnect and reconnect all other miscellaneous equipment as required in all areas affected by work to be performed under this contract. All furniture, equipment, and miscellaneous items shall be protected in such a manner as to prohibit any damage due to weather, dust, construction activities, etc. The Contractor shall be responsible for any damage incurred to the furniture, equipment, or miscellaneous items while performing work. If the University determines that the Contractor's activities are interrupting University operations in occupied areas, the Contractor shall work with the University to determine alternate methods or times for completing work. Work using alternate methods and / or times shall be completed at no additional cost to the University.
- I. The Contractor will be held responsible for and be required to make restitution, at their own expense, for all damage to persons or property caused by the Contractor or subcontractor, or the agents, or employees of either during the progress of the Work until its Final Acceptance.

1.15 RECOMMENDED WORK SEQUENCE

- A. The Contractor shall provide the University with a work plan that ensures that the project will be completed within the required time of completion.
- B. Construct work in stages to accommodate the University's operation. All activities shall be coordinated a minimum of three (3) weeks in advance with the University unless noted otherwise in these specifications.

2.00 PRODUCTS

- A. All building materials used in the construction of this project shall not contain asbestos and all coatings shall be lead free.

3.00 EXECUTION

Not Used

END OF SECTION

SECTION 01019
CONTRACT CONSIDERATIONS

1.00 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Schedule of values.
2. Application for payment.

B. Related Work:

1. Documents affecting work of this Section include, but are not limited to, General Conditions, Supplementary General Conditions, Special Conditions, and sections in Division 1 of these specifications.

1.02 SCHEDULE OF VALUES

- A. As a preliminary submittal, submit a printed schedule on The California State University form provided by the University.
- B. Submit Schedule of Values in duplicate within twenty-one (21) calendar days after date of commencement of work given in Notice To Proceed.
- C. Format: Utilize the Table of Contents of this Project Manual. Identify each line item with number and title of the specification section. Identify site mobilization, bonds, insurance, and similar items.
- D. Include separately a direct amount of Contractor's overhead and profit.
- E. Revise schedule to list approved Change Orders, with each Application For Payment.
- F. See Article 8.00 in General Conditions for additional requirements.

1.03 APPLICATION FOR PAYMENT

- A. Submit six copies of each application on The California State University form provided by the University.
- B. Content and Format: Utilize Schedule of Values for listing items in Application For Payment.
- C. See Article 8.00 in General Conditions for additional requirements.

2.00 PRODUCTS

Not used.

3.00 EXECUTION

Not used.

END OF SECTION

SECTION 01035
ALTERATION PROJECT PROCEDURES

1.00 GENERAL

1.00 SUMMARY

A. Section Includes:

1. General description and requirements.
2. Sequence and schedule.
3. Alterations, cutting, and protection.
4. Noise control.

B. Related Work:

1. Documents affecting the work of this section include, but are not necessarily limited to, General Conditions, Supplementary General Conditions, Special Conditions, and sections in Division 1 of these specifications.

1.02 GENERAL DESCRIPTION AND REQUIREMENTS

- A. Coordinate the work of trades and schedule elements of alterations and renovation work by procedures and methods to expedite completion of the work.
- B. In addition to demolition specifically shown, cut, move or remove items as necessary to provide access or to allow alterations and new work to proceed. Include such items as:
1. Repair or removal of hazardous or unsanitary conditions.
 2. Removal of abandoned items and items serving no useful purpose, such as abandoned piping, conduit and wiring.
 3. Removal of unsuitable or extraneous materials not marked for salvage, such as abandoned furnishings and equipment, and debris such as rotted wood, rusted metals and deteriorated concrete.
 4. Cleaning of surfaces and removal of surface finishes as needed to install new work and finishes.
- C. Patch, repair and refinish existing items to remain, to the specified condition for each material, with a smooth and clean transition to adjacent new items of construction.

1.03 ALTERATIONS, CUTTING AND PROTECTION

- A. Assign the work of moving, removal, cutting and patching, to trades qualified to perform the work in a manner to minimize the possibility of damage to each type of work, and provide means of returning surfaces to appearance of new work.
- B. Perform cutting and removal work with minimal disruption and in a manner to avoid damage to adjacent work.
- C. Cut finish surfaces such as masonry, tile, plaster or metals, by methods which terminate surfaces in a straight line at a natural point of division.
- D. Perform cutting and patching as specified in Section 01045.

- E. Protect existing finishes, equipment, and adjacent construction which is scheduled to remain, from damage.
 - 1. Maintain existing interior work above 60 degrees F.
 - 2. Provide heat and humidity control as needed to prevent damage to remaining work and to new work.

1.04 NOISE CONTROL

- A. The Contractor shall carry on all work in a manner which will produce the least amount of noise during class time and/or University functions. Contractor shall instruct all workers in noise control procedures.
- B. The University reserves the right to determine if work being performed by the Contractor is creating disruption to classes and/or University functions and, if so, to arrange with the Contractor alternate times or methods for completing the work in question, at no cost to the University.
- C. All work shall be scheduled as necessary to comply with the City of Long Beach Noise Ordinance. For work performed between the hours of 10:00 p.m. and 7:00 a.m., the noise level cannot exceed 45 decibels. For work performed between the hours of 7:00 a.m. and 10:00 p.m., the noise level cannot exceed 50 decibels.
- D. The maximum noise level within 1,000 feet of any classroom, laboratory, residence, business, adjacent buildings or other populated areas for trenchers, pavers, graders and trucks cannot exceed 90 decibels at 50 feet as measured under the noisiest operating conditions. For all other equipment, noise levels cannot exceed 85 decibels at 50 feet.
- E. Equip jack hammers with exhaust mufflers and steel muffling sleeves. Use quiet type air compressors such as "whisperized" compressor. Close compressor hoods while equipment is in operation. Use electrically powered rather than gasoline or diesel powered fork-lifts. Provide portable barriers around jack hammering. Barriers are to be constructed of ¾ inch plywood lined with 1 inch thick fiberglass on work side at a minimum.
- F. Keep noisy equipment as far as possible from noise-sensitive site boundaries. Do not leave machines idling. Use electric power in lieu of internal combustion engine power wherever possible. Maintain equipment properly to reduce noise from excessive vibration, faulty mufflers or other sources. Provide all engineers with properly functioning mufflers.
- G. Contractor shall include on Initial Contract Schedule all unusual noise-producing activities. Schedule noisy operations so as to minimize their duration at any given location, to minimize disruption to the adjoining users, and schedule such work at times mutually agreeable. Should deviations from the Initial Contract Schedule occur, the Contractor shall notify the University a minimum of five days prior to beginning such unusual noise-producing activities.
- H. Do not play radios, tape recorders, televisions, or other similar items at the job site.

2.00 PRODUCTS

2.01 PRODUCTS FOR PATCHING, EXTENDING AND MATCHING

- A. Provide same products or types of construction as that in existing structure, as needed to patch, extend or match existing.
- B. Generally the Contract Documents will not define products or standards of workmanship present in existing construction; determine products by inspection and necessary testing, and determine quality of workmanship by using existing as a sample for comparison.

- C. The presence of a product, finish, or type of construction requires that patching, extending or matching will be performed as necessary to make work complete and consistent with identical standards of quality.

3.00 EXECUTION

3.01 PERFORMANCE

- A. Patch and extend existing construction using skilled workers capable of matching existing quality of workmanship. Quality of patched or extended work cannot be less than that specified for new work.

3.02 ADJUSTMENTS

- A. Where partitions are removed, patch floors, walls, and ceilings with finish materials to match existing.
 - 1. Where removal of partitions results in adjacent spaces becoming one, re-work floors and ceilings to provide smooth and clean planes without breaks, steps, or bulkheads.
 - 2. Where extreme change of plane of one inch or more occurs, request instructions from Architect as to method of making transition.
- B. Trim and refinish existing doors as necessary to clear new floor finishes.

3.03 DAMAGED SURFACES

- A. Patch and replace any portion of an existing finished surface which is found to be damaged, lifted, discolored, or shows other imperfections, with matching material.
 - 1. Provide adequate support of substrate prior to patching the finish.
 - 2. Refinish patched portions of painted or coated surfaces in a manner to produce uniform color and texture over the entire surface.
 - 3. When existing surface finish cannot be matched, refinish entire surface to nearest intersections.

3.04 TRANSITION FROM EXISTING TO NEW WORK

- A. When new work abuts or finishes flush with existing work, make a smooth and clean transition. Perform patched work to match existing adjacent work in texture and appearance so that the patch or transition is invisible at a distance of five feet.
- B. When finished surfaces are cut in such a way that a smooth and clean transition with the new work is not possible notify Architect. Terminate existing surface in a neat manner along a straight line at a natural line of division, and provide trim appropriate to finished surface, or as otherwise directed by Architect and the University Representative.

3.05 CLEANING

- A. Perform periodic and final cleaning as specified in Section 01700.
 - 1. Clean University-occupied areas daily.
 - 2. Clean spillage, overspray, and heavy collection of dust in University-occupied areas immediately.
- B. At completion of work of each trade, clean area and make surfaces ready for work of successive trades.

- C. At completion of alteration work in each area, provide final cleaning and return space to a condition suitable for use by University.

END OF SECTION

SECTION 01040 COORDINATION

1.00 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Project coordination requirements.
2. Electrical and mechanical coordination.

B. Related Work:

1. Documents affecting the work of this section include, but are not necessarily limited to, General Conditions, Supplementary General Conditions, Special Conditions, and sections in Division 1 of these specifications.
2. Section 01035: Alteration Project Procedures.
3. Section 01300: Submittals - Shop Drawings.

1.02 PROJECT COORDINATION

A. General:

1. Coordinate the work; do not delegate responsibility for coordination to any subcontractor.
2. Anticipate the interrelationship of all subcontractors and their relationship with the total work.
3. Resolve differences or disputes between subcontractors and materials suppliers concerning coordination, interference, or extent of work between Sections. The Contractor's decisions, if consistent with the Contract Documents, is final. The Architect is not required to coordinate work between Sections and will not do so.
4. Coordinate the work of subcontractors and material suppliers, so that their work is performed in a manner to minimize interference with, and to facilitate the progress of the work.
5. Be responsible for providing anchorage, blocking, joining and other detailing as required to provide complete project.
6. Do not obstruct spaces required by code in front of electrical equipment, access doors, and similar items.
7. Do not cover any piping, wiring, ducts, and similar items until properly inspected and approved and until proper certificates have been issued.
8. Remove and replace any and all work under any section, which is not in accordance with the Contract Documents, with other materials and work, which is in conformance with the Contract Documents. Repair or replace all other work damaged by these operations at no increase in contract price.
9. Coordination With Other Contracts: Coordinate work of this Contract with other contracts and contractors as appropriate.

10. Coordinate this work with all associated work in a manner that will insure that all work will be accomplished as rapidly as the progress of the project will permit and so that no work will be delayed for want of associated work.

B. Electrical and Mechanical Coordination

1. Work out all “tight” conditions involving work of various sections in advance before installation. If necessary, and before work proceeds in these areas, prepare supplementary drawings for review showing all work in “tight” areas.
2. Provide supplementary drawings and additional work necessary to overcome “tight” conditions at no increase in contract price. Refer to Section 01300, Article titled “Shop Drawings.”
3. Provide dimensionally accurate and detailed coordinated layout shop drawings, giving complete dimensions of all locations, elevations, and clearances. Show exact locations of the following:
 - a. Ductwork.
 - b. Piping, including fire protection systems.
 - c. Valves and piping specialties, including all air vents and drains.
 - d. Dampers.
 - e. Access doors.
 - f. Control and electrical panels.
 - g. Adjustable frequency controllers.
 - h. Motor control centers and transformers.
 - i. Disconnect switches.
 - j. Electrical cable trays and main conduits.
 - k. University-furnished, Contractor-installed equipment.
4. Show actual architectural and structural constraints and site conditions on coordinated layout shop drawings.
5. Coordination:
 - a. Fully coordinate work between trades with actual architectural and structural conditions.
 - b. Coordinate all adjustments required. Clearly identify by circling these adjustments on the coordinated layout shop drawings.
 - c. If Contractor has specific questions regarding coordination of the installation with structural and architectural conditions and work between trades, submit same with appropriate shop drawings documenting areas in question with Contractor’s proposed installation.
6. Submission and review of coordinated layout shop drawings:
 - a. Prepare reproducible drawings.
 - b. Submit to each trade for review of space allocated to all trades.
 - c. Revise drawings to compensate for review by each trade.
 - d. Review revisions with each trade.
 - e. Submit to Architect for review.
 - f. Architect’s review of coordinated layout shop drawings if only for verification that Contractor has performed coordination work as specified herein.

- (a) Architect's review does not include verification of exact dimensions, clearances, arrangements and / or compliance with codes.
- 7. On final coordinated layout shop drawings, show that all trades affected have made reviews and are signed by each trade at completion of coordination.
 - a. General Contractor is to assure that each trade has coordinated work with other trades.
 - b. Include stamp with labeled space for each trade to sign on each submittal indicating that layout shop drawing has been coordinated.
 - c. No layout shop drawing will be reviewed without stamped and signed coordination assurance by General Contractor.
- 8. Coordinated layout shop drawings showing work of all trades are required. Individual trade layout shop drawings will not be accepted.

2.00 PRODUCTS

Not Used.

3.00 EXECUTION

Not Used.

END OF SECTION

**SECTION 01045
CUTTING AND PATCHING**

1.00 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Administrative and procedural requirements for cutting and patching.
2. Cutting and patching not required to be performed as part of the work of other sections.
3. Cutting and patching existing work altered or disturbed to accommodate new construction.
4. Cutting and patching existing work damaged or defaced during new construction as required to restore to existing or better condition at the time of award of Contract.
5. Cutting and patching required to:
 - a. Install or correct non-coordinated work.
 - b. Remove and replace defective and non-conforming work.
 - c. Remove samples of installed work for testing.

B. Refer to other sections and drawings for specific requirements of the extent and limitations applicable to cutting and patching, demolishing, or altering existing work of individual parts of the work.

C. Requirements of this section also apply to mechanical and electrical installations. (Refer to sections of Division 15 and Division 16 for other requirements and limitations applicable to cutting and patching mechanical and electrical installations).

D. Related Work:

1. Documents affecting the work of this Section include, but are not necessarily limited to, General Conditions, Supplementary General Conditions, Special Conditions, and Sections in Division 1 of these Specifications.
2. Section 01035: Alteration Project Procedures - Cutting and patching.

1.02 SUBMITTALS

A. Cutting and Patching Proposal: Where approval of procedures for cutting and patching is required before proceeding, submit a proposal describing procedures well in advance of the time cutting and patching will be performed and request approval to proceed. Include the following information, as applicable, in the proposal:

1. Describe the extent of cutting and patching required and how it is to be performed.
2. Describe anticipated results in terms of changes to existing construction; include changes to structural elements and operating components as well as changes in the building's appearance and other significant visual elements.
3. List products to be used and firms or entities that will perform work.

4. Indicate dates when cutting and patching is to be performed.
5. List utilities that will be disturbed or affected, including those that will be relocated and those that will be temporarily out of service. Indicate how long service will be disrupted.
6. Where cutting and patching involves addition of reinforcement to structural elements, submit details to show how reinforcement is integrated with the original structure.
7. Approval by the Architect or the University Representative to proceed with cutting and patching does not waive the University's right to later require complete removal and replacement of a part of the work found to be unsatisfactory.
8. Effects on University operations and on concurrent operations construction by other contractors.

1.03 QUALITY ASSURANCE

- A. Requirements for Structural Work: Do not cut and patch structural elements in a manner that would reduce their load-carrying capacity or load-deflection ratio.
 1. Obtain approval from the Architect of the cutting and patching proposal before cutting and patching the following structural elements:
 - a. Bearing and retaining walls.
 - b. Structural concrete.
 - c. Structural steel.
 - d. Lintels.
 - e. Structural decking.
 - f. Stair systems.
 - g. Miscellaneous structural metals.
 - h. Equipment supports.
 - i. Piping, ductwork, vessels and equipment.
- B. Operational and Safety Limitations: Do not cut and patch operating elements or safety related components in a manner that would result in reducing their capacity to perform as intended, or result in increased maintenance, or decreased operational life or safety.
 1. Obtain approval of the cutting and patching proposal before cutting and patching the following operating elements safety related systems:
 - a. Primary operational systems and equipment.
 - b. Air or smoke barriers.
 - c. Water, moisture, or vapor barriers.
 - d. Membranes and flashings.
 - e. Fire protection systems.
 - f. Noise and vibration control elements and systems.
 - g. Control systems.
 - h. Communication systems.
 - i. Electrical wiring systems.
- C. Visual Requirements: Do not cut and patch construction exposed in occupied spaces, in a manner that would, in the Architect's opinion, reduce the building's aesthetic qualities, or result in visual evidence of cutting and patching. Remove and replace work cut and patched in a visually unsatisfactory manner.
- D. If possible, retain the original installer or fabricator throughout construction phases to cut and patch the following categories of exposed work, or if it is not possible to engage the original installer or fabricator, engage another recognized experienced and specialized firm:

1. Concrete finishes.
2. Masonry.
3. Plaster.
4. Acoustical ceilings.
5. Painting.
6. Wall covering.
7. HVAC enclosures, cabinets or covers.

2.00 PRODUCTS

2.01 MATERIALS

- A. Use materials that are identical to existing materials unless not available.
 1. If identical materials are not available or cannot be used where exposed surfaces are involved, use materials that match existing adjacent surfaces to the fullest extent possible with regard to visual effect (Before proceeding, obtain approval of the Architect).
 2. Use materials whose installed performance will equal or surpass that of existing materials.

3.00 EXECUTION

3.01 INSPECTION

- A. Before cutting existing surfaces, examine surfaces to be cut and patched and conditions under which cutting and patching is to be performed. Take corrective action before proceeding, if unsafe or unsatisfactory conditions are encountered.
- B. Before proceeding, meet at the site with parties involved in cutting and patching, including asbestos abatement, mechanical and electrical trades. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.

3.02 PREPARATION

- A. Temporary Support: Provide temporary support of work to be cut where required.
- B. Protection: Protect existing construction during cutting and patching to prevent damage.
- C. Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.
- D. Take all precautions necessary to avoid cutting existing pipe, conduit or ductwork serving the building, but scheduled to be removed or relocated until provisions have been made to bypass such items.

3.03 PERFORMANCE

- A. Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time and complete without delay.
- B. Cut existing construction to provide for installation of other components or performance of other construction activities and the subsequent fitting and patching required to restore surfaces to their original condition.

- C. Cutting: Cut existing construction using methods least likely to damage elements to be retained or adjoining construction. Where possible review proposed procedures with the original installer; comply with the original installer's recommendations.
1. In general, where cutting is required use hand or small power tools designed for sawing or grinding, not hammering and chopping. Cut holes and slots neatly to size required with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
 2. To avoid marring existing finished surfaces, cut or drill from the exposed or finished side into concealed surfaces.
 3. Cut through concrete and masonry using a cutting machine such as a carborundum saw or diamond core drill.
 4. By-pass utility services such as pipe or conduit, before cutting, where services are shown or required to be removed, relocated or abandoned. Cut-off pipe or conduit in walls or partitions to be removed. Cap, valve or plug and seal the remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after by-passing and cutting.
 5. Provide fire-safe seals to maintain fire rating at all penetrations.
- D. Patching: Patch with durable seams that are as invisible as possible. Comply with specified tolerances.
1. Where feasible, inspect and test patched areas to demonstrate integrity of the installation.
 2. Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.
 3. Where removal of walls or partitions extends one finished area into another, patch and repair floor and wall surfaces in the new space to provide an even surface of uniform color and appearance. Remove existing floor and wall coverings and replace with new materials, if necessary to achieve uniform color and appearance.
 4. Where patching occurs in a smooth painted surface, extend final paint coat over entire unbroken surface containing the patch, after the patched area has received primer and second coat.
 5. Patch, repair or re-hang existing ceilings as necessary to provide an even plane surface of uniform appearance.
- E. Plaster Installation: Comply with manufacturer's instructions and install thickness and coats as indicated.

3.04 CLEANING

- A. Thoroughly clean areas and spaces where cutting and patching is performed or used as access. Remove completely, paint, mortar, oils, putty and items of similar nature. Thoroughly clean piping, conduit and similar features before painting or other finishing is applied. Restore damaged pipe covering to its original condition.

END OF SECTION

**SECTION 01060
REGULATORY REQUIREMENTS**

1.00 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Certain Codes and Standards and relevant requirements applicable to the work required under this Contract.

B. Related Work:

1. Documents affecting the work of this section include, but are not necessarily limited to, General Conditions, Supplementary General Conditions, Special Conditions and sections in Division 1 of these specifications.

1.02 STATUTORY AND JURISDICTIONAL REGULATIONS

- A. Perform the work in accordance with Applicable Code Requirements indicated on the drawings and applicable requirements of all other regulatory agencies.
- B. Unless otherwise specified, specific references to codes, regulations, standards, manufacturers' instructions, or requirements of regulatory agencies, when used to specify requirements for materials or design elements, mean the edition of each in effect as identified in the Contract Documents.

1.03 CONFLICTS

- A. Unless otherwise directed by the Architect, if a conflict exists between referenced regulatory requirements, comply with the one establishing more stringent requirements.
- B. Unless otherwise directed by the Architect, if a conflict exists between referenced regulatory requirements and the Contract Documents, comply with the more stringent requirements.

END OF SECTION

SECTION 01095
REFERENCE STANDARDS AND DEFINITIONS

1.00 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Quality assurance.
2. Definitions.
3. Specification content explanation.

B. Related Work:

1. Documents affecting the work of this section include, but are not necessarily limited to, General Conditions, Supplementary General Conditions, Special Conditions and sections in Division 1 of these specifications.

1.02 QUALITY ASSURANCE

- A. For products or workmanship specified by association, trade, or other consensus standards, comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable codes.
- B. Conform to reference standard by date of issue current on date of Contract Documents.
- C. Obtain copies of standards when required by the Contract Documents.
- D. Maintain copy at project site during submittals, planning, and progress of the specific work, until Final Project Acceptance.
- E. Should specified reference standards conflict with Contract Documents, request clarification from the Architect before proceeding.
- F. Neither the contractual relationship, duties, and responsibilities of the parties in Contract nor those of the Architect shall be altered by the Contract Documents by mention or inference otherwise in any reference document.

1.03 DEFINITIONS

- A. General: Basic Contract definitions are included in the General Conditions.
- B. Indicated: The term "indicated" refers to graphic representations, notes, or schedules on the drawings, or other paragraphs or schedules in the specifications, and similar requirements in the Contract Documents. Terms such as "shown, noted, scheduled, and specified" are used to help the reader locate the reference. There is no limitation on location.
- C. Directed: Terms such as "directed, requested, authorized, selected, approved, required, and permitted" mean directed by the Architect, requested by the Architect, and similar phrases.
- D. Approve: The term "approved", when used in conjunction with the Architect's action on the Contractor's submittals, applications, and requests, is limited to the Architect's duties and responsibilities as stated in the General Conditions.

- E. Regulation: The term “regulations” includes laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, as well as rules, conventions, and agreements within the construction industry that control performance of the work.
- F. Furnish: The term “furnish” means supply and deliver to the project site, ready for unloading, unpacking, assembly, installation, and similar operations.
- G. Install: The term “install” describes operations at the project site including the actual unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations.
- H. Provide: The term “provide” means to furnish and install, complete and ready for the intended use.
- I. Installer: An Installer is the Contractor or an entity engaged by the Contractor, either as an employee, subcontractor, or contractor of lower tier, to perform a particular construction activity, including installation, erection, application, and similar operations. Installers are required to be experienced in the operations they are engaged to perform.
- J. Project site is the space available to the Contractor for performing construction activities, either exclusively or in conjunction, with others performing other work as part of the project.
- K. Testing Agencies: A testing agency is an independent entity engaged to perform specific inspections or tests, either at the project site or elsewhere, and to report on and, if required, to interpret results of those inspections or tests.

1.04 SPECIFICATION CONTENT EXPLANATION

- A. Specification Format: These specifications are organized into divisions and sections based on the Construction Specifications Institute’s 16-Division format.

2.00 PRODUCTS

Not Used.

3.00 EXECUTION

Not Used.

END OF SECTION

SECTION 01151

CONSTRUCTION AND DEMOLITION MATERIALS RECYCLING REQUIREMENTS

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes: Requirements and procedures for ensuring optimal diversion of construction and demolition (C&D) waste materials generated by the Work from landfill disposal within the limits of the Construction Schedule and Contract Sum.
1. California State law (Assembly Bill 75), requires the California State University to develop source reduction, re-use, recycling, and composting programs, to reduce the tonnage of solid waste disposed in landfills 50% by the year 2004. Construction waste materials generated by the Work are targeted to achieve these diversion rates.
 2. The Work of this Contract requires that a minimum of 50% by weight of the construction and demolition materials generated in the Work is diverted from landfill disposal through a combination of re-use and recycling activities.
 3. For LEED® projects, requirements for submittal of LEED documentation in compliance with Materials and Resources Credit 2.1 and Materials or Resources Credit 2.2, Construction Waste Management.
 3. Requirements for submittal of Contractor's Construction Waste and Recycling Plan prior to the commencement of the Work.
 4. Contractor's quantitative reports for construction waste materials as a condition of approval of the third progress payment.

1.2 DEFINITIONS

- A. Class III Landfill: A landfill that accepts non-hazardous resources such as household, commercial, and industrial waste, resulting from construction, remodeling, repair, and demolition operations. A Class III landfill must have a solid waste facilities permit from the California Integrated Waste Management Board (CIWMB) and is regulated by the Enforcement Agency (EA).
- B. Construction and Demolition Debris: Building materials and solid waste resulting from construction, remodeling, repair, cleanup, or demolition operations that are not hazardous as defined in California Code of Regulations, Title 22, Section 66261.3 et seq. This term includes, but is not limited to, asphalt concrete, Portland cement concrete, brick, lumber, gypsum wallboard, cardboard and other associated packaging, roofing material, ceramic tile, carpeting, plastic pipe, and steel. The debris may be commingled with rock, soil, tree stumps, and other vegetative matter resulting from land clearing and landscaping for construction or land development projects.
- C. C&D Recycling Center. A facility that receives only C&D material that has been separated for reuse prior to receipt, in which the residual (disposed) amount of waste in the material is less than 10% of the amount separated for reuse by weight.
- D. Disposal. Final deposition of construction and demolition or inert debris into land, including stockpiling onto land of construction and demolition debris that has not been sorted for further processing or resale, if such stockpiling is for a period of time greater than 30 days; and construction and demolition debris that has been sorted for further processing or resale, if such stockpiling is for a period of time greater than one year, or stockpiling onto land of inert debris that is for a period of time greater than one year.
- E. Enforcement Agency. Enforcement agency as defined [i.e. in Public Resources Code 40130].

- F. Inert Disposal Facility or Inert Waste Landfill: A disposal facility that accepts only inert waste such as soil and rock, fully cured asphalt paving, uncontaminated concrete (including fiberglass or steel reinforcing rods embedded in the concrete), brick, glass, and ceramics, for land disposal.
- G. Mixed Debris: Loads that include commingled recyclable and non-recyclable materials generated at the construction site.
- H. Mixed Debris Recycling Facility: A processing facility that accepts loads of commingled construction and demolition debris for the purpose of recovering re-usable and recyclable materials and disposing the non-recyclable residual materials.
- I. Recycling: The process of sorting, cleansing, treating and reconstituting materials for the purpose of using the altered form in the manufacture of a new product. Recycling does not include burning, incinerating or thermally destroying solid waste.
- J. Reuse. The use, in the same or similar form as it was produced, of a material which might otherwise be discarded.
- K. Separated for Reuse. Materials, including commingled recyclables, that have been separated or kept separate from the solid waste stream for the purpose of additional sorting or processing those materials for reuse or recycling in order to return them to the economic mainstream in the form of raw material for new, reused, or reconstituted products which meet the quality standards necessary to be used in the marketplace, and includes materials that have been "source separated."
- L. Solid Waste: All putrescible and nonputrescible solid, semisolid, and liquid wastes, including garbage, trash, refuse, paper, rubbish, ashes, industrial wastes, demolition and construction wastes, abandoned vehicles and parts thereof, discarded home and industrial appliances, dewatered, treated, or chemically fixed sewage sludge which is not hazardous waste, manure, vegetable or animal solid and semisolid wastes, and other discarded solid and semisolid wastes. "Solid waste" does not include hazardous waste, radioactive waste, or medical waste as defined or regulated by State law.
- M. Source-Separated: Materials, including commingled recyclables, that have been separated or kept separate from the solid waste stream at the point of generation for the purpose of additional sorting or processing of those materials for reuse or recycling in order to return them to the economic mainstream in the form of raw materials for new, reused, or reconstituted products which meet the quality standards necessary to be used in the marketplace.
- N. Waste Hauler: A company that possesses a valid permit from the local waste management authority to collect and transport solid wastes from individuals or businesses for the purpose of recycling or disposal in the locality.

1.3 SUBMITTALS

- A. Contractor's Construction Waste and Recycling Plan
 - 1. Review Contract Documents and estimate the types and quantities of materials under the Work that are anticipated to be feasible for on-site processing, source separation for re-use or recycling. Indicate the procedures that will be implemented in this program to effect jobsite source separation, such as, identifying a convenient location where dumpsters would be located, putting signage to identify materials to be placed in dumpsters, etc.
 - 2. Prior to commencing the Work, submit Contractor's Construction Waste and Recycling Plan. Submit in format provided (Section 01151A). The Plan must include, but is not limited to the following:

- a. Contractor's name and project identification information;
 - b. Procedures to be used;
 - c. Materials to be re-used and recycled;
 - d. Estimated quantities of materials;
 - e. Names and locations of re-use and recycling facilities/sites;
 - f. Tonnage calculations that demonstrate that Contractor will re-use and recycle a minimum 50% by weight of the construction waste materials generated in the Work.
 3. Contractor's Construction Waste and Recycling Plan must be approved by the Construction Administrator prior to the start of Work.
 4. Contractor's Construction Waste and Recycling Plan will not otherwise relieve the Contractor of responsibility for adequate and continuing control of pollutants and other environmental protection measures.
- B. Contractor's Reuse, Recycling, and Disposal Report
- Submit Contractor's Reuse, Recycling, and Disposal Report on the form provided (Section 01151B) with each application for progress payment. Failure to submit the form and its supporting documentation will render the application for progress payment incomplete and delay progress payments. If applicable, include manifests, weight tickets, receipts, and invoices specifically identifying the Project for re-used and recycled materials:
1. Reuse of building materials or salvage items on site (i.e. crushed base or red clay brick).
 2. Salvaging building materials or salvage items at an off-site salvage or reuse center (i.e. lighting, fixtures).
 3. Recycling source separated materials on site (i.e. crushing asphalt/ concrete for base course, or grinding for mulch).
 4. Recycling source separated material at an off site recycling center (i.e. scrap metal or green materials).
 5. Use of material as Alternative Daily Cover (ADC) at landfills.
 6. Delivery of soils or mixed inerts to an inerta landfill for disposal (inert fill).
 7. Disposal at a landfill or transfer station (where no recycling takes place).
 8. Other (describe).

Contractor's Reuse, Recycling, and Disposal Report must quantify all materials generated in the Work, disposed in [Class III] landfills, or diverted from disposal through recycling. Indicate zero (0) if there is no quantity to report for a type of material.

As indicated on the form:

1. Report disposal or recycling either in tons or in cubic yards: if scales are available at disposal or recycling facility, report in tons; otherwise, report in cubic yards. Report in units for salvage items when no tonnage or cubic yard measurement is feasible.
2. Indicate locations to which materials are delivered for reuse, salvage, recycling, accepted as daily cover, inert backfill, or disposal in landfills or transfer stations.
3. Provide legible copies of weigh tickets, receipts, or invoices that specifically identify the project generating the material. Said documents must be from recyclers and/or disposal site operators that can legally accept the materials for the purpose of re-use, recycling, or disposal.

Indicate project title, project number, progress payment number, name of the company completing the Contractor's Report and compiling backup documentation, the printed name, signature, and daytime phone number of the person completing the form, the beginning and ending dates of the period covered on the Contractor's Report, and the date that the Contractor's Report is completed.

- C. For LEED Projects, LEED Letter Template: Materials and Resources Credit [2.1 or 2.2]
Construction Waste Management

Complete and sign LEED Letter Template in format provided under the U.S. Green Building Council's Leadership in Energy and Environmental Design (LEED) program. Prepare Letter Template on company letterhead.

1. Certify that the project has completed a waste management plan and diverted construction, demolition, and land clearing waste to uses other than landfill.
2. Provide quantities of diverted materials and means of diversion in the table provided in the LEED Letter Template.
3. Indicate how and where waste was diverted.
4. Indicate quantities of waste diverted in tons [or cubic yards].
5. Letter Template will calculate: Total quantity of diverted waste, total quantity of waste, and the percentage of waste diverted.
6. For projects where 50% of waste is diverted, one LEED credit will be achieved; where 75% is diverted, two LEED credits will be achieved.
7. Include name, organization, role in project, provide signature and date completed.

PART 2 PRODUCTS

(Not used.)

PART 3 EXECUTION

3.1 SALVAGE, RE-USE, RECYCLING AND PROCEDURES

- A. Identify re-use, salvage, and recycling facilities.
- B. Develop and implement procedures to re-use, salvage, and recycle new construction and excavation materials, based on the Contract Documents, the Contractor's Construction Waste and Recycling Plan, estimated quantities of available materials, and availability of recycling facilities. Procedures may include on-site recycling, source separated recycling, and/or mixed debris recycling efforts.
1. Identify materials that are feasible for salvage, determine requirements for site storage, and transportation of materials to a salvage facility.
 2. Source separate new construction, excavation and demolition materials including, but not limited to the following types:
 - f. Asphalt.
 - g. Concrete, concrete block, slump stone (decorative concrete block), and rocks.
 - c. Drywall.
 - d. Green materials (i.e. tree trimmings and land clearing debris).
 - e. Metal (ferrous and non-ferrous).
 - f. Miscellaneous Construction Debris.
 - g. Paper or cardboard.
 - h. Red Clay Brick.
 - Reuse or Salvage Materials
 - i. Soils.
 - Wire and Cable.
 - j. Wood.
 - k. Other (describe)

3. Miscellaneous Construction Debris: Develop and implement a program to transport loads of mixed (commingled) new construction materials that cannot be feasibly source separated to a mixed materials recycling facility.

3.2 DISPOSAL OPERATIONS AND WASTE HAULING

- A. Legally transport and dispose of materials that cannot be delivered to a source separated or mixed recycling facility to a transfer station or disposal facility that can legally accept the materials for the purpose of disposal.
- B. Use a permitted waste hauler or Contractor's trucking services and personnel. To confirm valid permitted status of waste haulers, contact the local solid waste authority.
- C. Become familiar with the conditions for acceptance of new construction, excavation and demolition materials at recycling facilities, prior to delivering materials.
- D. Deliver to facilities that can legally accept new construction, excavation and demolition materials for purpose of re-use, recycling, composting, or disposal.
- E. Do not burn, bury or otherwise dispose of solid waste on the project job-site.

3.3 RE-USE AND DONATION OPTIONS

- A. Implement a re-use program to the greatest extent feasible. Options may include:
 1. California Materials Exchange (CAL-MAX) Program is sponsored by the California Integrated Waste Management Board. CAL-MAX is a free service provided by the California Integrated Waste Management Board, designed to help businesses find markets for materials that traditionally would be discarded. The premise of the CAL-MAX Program is that material discarded by one business may be a resource for another business. To obtain a current Materials Listings Catalog, call CAL-MAX/California Integrated Waste Management Board at (916) 255-2369 or send a FAX to (916) 255-2200. The CALMAX Catalog is available through the Internet Site at <http://www.ciwmb/ca.gov/calmax>.

3.4 REVENUE

- A. Revenues or other savings obtained from recycled, re-used, or salvaged materials shall accrue to Contractor unless otherwise noted in the Contract Documents.

END OF SECTION

SECTION 01151A
CONTRACTOR'S CONSTRUCTION WASTE AND RECYCLING PLAN

(Submit After Award of Contract and Prior to Start of Work)

Project Title:		
Contract or Work Order No.:		
Contractor's Name:		
Street Address:		
City:	State:	Zip:
Phone: ()	Fax: ()	
E-Mail Address:		
Prepared by: (Print Name)		

Date Submitted:		
Project Period:	From:	TO:

Reuse, Recycling or Disposal Processes To Be Used

Describe the types of recycling processes or disposal activities that will be used for material generated in the project. Indicate the type of process or activity by number, types of materials, and estimated quantities that will be recycled or disposed in the sections below:

- 01 - Reuse of building materials or salvage items on site (i.e. crushed base or red clay brick)
- 02 - Salvaging building materials or salvage items at an off site salvage or re-use center (i.e. lighting, fixtures)
- 03 - Recycling source separated materials on site (i.e. crushing asphalt/concrete for reuse or grinding for mulch)
- 04 - Recycling source separated materials at an off site recycling center (i.e. scrap metal or green matls)
- 05 - Recycling commingled loads of C&D matls at an off site mixed debris recycling center or transfer station
- 06 - Recycling material as Alternative Daily Cover at landfills
- 07 - Delivery of soils or mixed inerts to an inert landfill for disposal (inert fill).
- 08 - Disposal at a landfill or transfer station.
- 09 - Other (please describe) _____

Types of Material To Be Generated

Use these codes to indicate the types of material that will be generated on the project

A = Asphalt	C = Concrete	M = Metals	I = Mixed Inert	G = Green Matls
D = Drywall	P/C=Paper/Cardboard	W/C = Wire/Cable	S= Soils (Non Hazardous)	
M/C = Miscellaneous Construction Debris	R = Reuse/Salvage	W = Wood	O = Other (describe)	

Facilities Used: Provide Name of Facility and Location (City)

Total Truck Loads: Provide Number of Trucks Hauled from Site During Reporting Period

Total Quantities: If scales are available at sites, report in tons. If not, quantify by cubic yards. For salvage/reuse items, quantify by estimated weight (or units).

SECTION I - RE-USED/RECYCLED MATERIALS

Include all recycling activities for source separated or mixed material recycling centers where recycling will occur.

Type of Material	Type of Activity	Facility to be Used, Location	Total Truck Loads	Total Quantities		
				Tons	Cubic YD	Other Wt.
(ex.) M	04	ABC Metals, Los Angeles	24	355		
a. Total Diversion			-	-	-	-

SECTION 011511A
CONTRACTOR'S CONSTRUCTION WASTE AND RECYCLING PLAN
Continued

SECTION II - DISPOSED MATERIALS						
<i>Include all disposal activities for landfills, transfer stations, or inert landfills where no recycling will occur.</i>						
Type of Material	Type of Activity	Facility to be Used, Location	Total Truck Loads	Total Quantities		
				Tons	Cubic YD	Other Wt.
(ex.) D	08	DEF Landfill, Los Angeles	2	35		
b. Total Disposal				-	-	-

SECTION III - TOTAL MATERIALS GENERATED						
<i>This section calculates the total materials to be generated during the project period (Reuse/Recycle + Disposal = Generation)</i>						
				Tons	Cubic YD	Other Wt.
a. Total Reused/Recycled				-	-	-
b. Total Disposed				-	-	-
c. Total Generated				-	-	-

SECTION IV - CONTRACTOR'S LANDFILL DIVERSION RATE CALCULATION						
<i>Add totals from Section I + Section II</i>						
		Tons	Cubic Yards	Other Wt.		
a. Materials Re-Used and Recycled		-				
b. Materials Disposed		-				
c. Total Materials Generated (a. + b. = c.)		-	-	-		
d. Landfill Diversion Rate (Tons Only)*		#DIV/0!				

* Use tons only to calculate recycling percentages: $\text{Tons Reused/Recycled/Tons Generated} = \% \text{ Recycled}$

Contractor's Comments (Provide any additional information pertinent to planned reuse, recycling, or disposal activities):						

Notes:

- Section 01151A is a Division 01 General Requirement under CSI MasterFormat 1998 Edition.
For CSI MasterFormat 2004 Edition, this Section may be renumbered as follows:
Under Division 00, Procurement and Contracting Requirements, Project Forms 00 60 00
Use: Section 00 62 22 Construction Waste Diversion Plan
- Suggested Conversion Factors: From Cubic Yards to Tons (Use when scales are not available)
Asphalt: .61 (ex. 1000 CY Asphalt = 610 tons. Applies to broken chunks of asphalt)
Concrete: .93 (ex. 1000 CY Concrete = 930 tons. Applies to broken chunks of concrete)
Ferrous Metals: .22 (ex. 1000 CY Ferrous Metal = 220 tons)
Non-Ferrous Metals: .10 (ex. 1000 CY Non-Ferrous Metals = 100 tons)

Drywall Scrap: .20
Wood Scrap: .16

SECTION 01151B
CONTRACTOR'S REUSE, RECYCLING, AND DISPOSAL REPORT
(Submit With Each Progress Payment)

Project Title:		
Contract or Work Order No.:		
Contractor's Name:		
Street Address:		
City:	State:	Zip:
Phone: ()	Fax: ()	
E-Mail Address:		
Prepared by: (Print Name)		

Date Submitted:		
Period Covered:	From:	To:

Reuse, Recycling or Disposal Processes Used

Describe the types of recycling processes or disposal activities used for material generated in the project. Indicate the type of process or activity by number, types of materials, and quantities that were recycled or disposed in the sections below:

01 - Reuse of building materials or salvage items on site (i.e. crushed base or red clay brick)
02 - Salvaging building materials or salvage items at an off site salvage or re-use center (i.e. lighting, fixtures)
03 - Recycling source separated materials on site (i.e. crushing asphalt/concrete for reuse or grinding for mulch)
04 - Recycling source separated materials at an off site recycling center (i.e. scrap metal or green matls)
05 - Recycling commingled loads of C&D matls at an off site mixed debris recycling center or transfer station
06 - Recycling material as Alternative Daily Cover at landfills
07 - Delivery of soils or mixed inerts to an inert landfill for disposal (inert fill).
08 - Disposal at a landfill or transfer station.
09 - Other (please describe) _____

Types of Material Generated

Use these codes to indicate the types of material that were generated on the project

A = Asphalt	C = Concrete	M = Metals	I = Mixed Inert	G = Green Matls
D = Drywall	P/C=Paper/Cardboard	W/C = Wire/Cable	S= Soils (Non Hazardous)	
M/C = Miscellaneous Construction Debris	R = Reuse/Salvage	W = Wood	O = Other (describe)	

Facilities Used: Provide Name of Facility and Location (City)

Total Truck Loads: Provide Number of Trucks Hauled from Site During Reporting Period

Total Quantities: If scales are available at sites, report in tons. If not, quantify by cubic yards. For salvage/reuse items, quantify by estimated weight (or units).

SECTION I - RE-USED/RECYCLED MATERIALS

Include all recycling activities for source separated or mixed material recycling centers where recycling occurred.

Type of Material	Type of Activity	Facilities Used, Location	Total Truck Loads	Total Quantities		
(ex.) M	04	ABC Metals, Los Angeles	24	Tons	Cubic YD	Other Wt.
a. Total Diversion			-	-	-	-

SECTION 011511B
CONTRACTOR'S REUSE, RECYCLING, AND DISPOSAL REPORT
Continued

SECTION II - DISPOSED MATERIALS						
<i>Include all disposal activities for landfills, transfer stations, or inert landfills where no recycling occurred.</i>						
Type of Material	Type of Activity	Facilities Used, Location	Total Truck Loads	Total Quantities		
				Tons	Cubic YD	Other Wt.
(ex.) D	08	DEF Landfill, Los Angeles	2	35		
b. Total Disposal				-	-	-

SECTION III - TOTAL MATERIALS GENERATED						
<i>This section calculates the total materials generated during the project period (Reuse/Recycle + Disposal = Generation)</i>						
				Tons	Cubic YD	Other Wt.
a. Total Reused/Recycled				-	-	-
b. Total Disposed				-	-	-
c. Total Generated				-	-	-

SECTION IV - CONTRACTOR'S LANDFILL DIVERSION RATE CALCULATION						
<i>Add totals from Section I + Section II</i>						
		Tons	Cubic Yards	Other Wt.		
a. Materials Re-Used and Recycled		-				
b. Materials Disposed		-				
c. Total Materials Generated (a. + b. = c.)		-	-	-		
d. Landfill Diversion Rate (Tons Only)*		#DIV/0!				

* Use tons only to calculate recycling percentages: $\text{Tons Reused/Recycled/Tons Generated} = \% \text{ Recycled}$

Contractor's Comments (<i>Provide any additional information pertinent to planned reuse, recycling, or disposal activities</i>):						

Notes:

- Section 01151A is a Division 01 General Requirement under CSI MasterFormat 1998 Edition.
For CSI MasterFormat 2004 Edition, this Section may be renumbered as follows:
Under Division 00, Procurement and Contracting Requirements, Project Forms 00 60 00
Use: Section 00 62 22 Construction Waste Diversion Plan

- Suggested Conversion Factors: From Cubic Yards to Tons (Use when scales are not available)

Asphalt: .61 (ex. 1000 CY Asphalt = 610 tons. Applies to broken chunks of asphalt)

Concrete: .93 (ex. 1000 CY Concrete = 930 tons. Applies to broken chunks of concrete)

Ferrous Metals: .22 (ex. 1000 CY Ferrous Metal = 220 tons)

Non-Ferrous Metals: .10 (ex. 1000 CY Non-Ferrous Metals = 100 tons)

Drywall Scrap: .20

Wood Scrap: .16

**SECTION 01200
PROJECT MEETINGS**

1.00 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Preconstruction conference.
2. Progress meetings.
3. Project closeout meeting.
4. Partnering.

B. Related Work:

1. Documents affecting work of this Section include, but are not necessarily limited to, General Conditions, Supplementary General Conditions, Special Conditions, and sections in Division 1 of these specifications.

1.02 PRECONSTRUCTION CONFERENCE

A. A meeting will be scheduled at the Campus by the University Representative immediately prior to Contractor move-in. Representatives of the University, the Contractor, Architect, and appropriate campus representatives will be present as needed. Job site procedures and the following items will be discussed:

1. Procedures for maintaining record documents.
2. Trustees' and Architect's requirements.
3. Construction facilities and controls.
4. Temporary utilities.
5. Security and construction area clearing.
6. Materials testing and inspection.
7. Requirements of start-up trades.
8. Project layout.
9. Safety program.
10. Progress payments.
11. Change order procedures.
12. Project closeout.

1.03 PROGRESS MEETINGS

A. A meeting will be conducted weekly by the University for the purpose of coordinating the work. It is expected that the Contractor's Project Manager and the Contractor's Superintendent be in attendance.

B. The meeting will be held in the job office or other designated location on a regularly scheduled basis. The date and hour will be announced by the University.

C. Provide at least a three-week look ahead schedule, updated every two weeks. The Project Manager and Architect will review this schedule to identify any early scheduling changes or conflicts.

D. Standard Site-Meeting Agenda:

1. Job Status/Schedule:

- a. Construction schedule
 - b. Long-lead procurement items effecting schedule.
 - c. Trustees-induced delays, if any.
 - d. Contractor-caused delays, if any.
 - e. RFIs - review responses effecting schedule.
 - f. Shop drawing - review submittals and responses effecting schedule.
 - g. Change Order items effecting schedule, if any.
- 2. Old business.
 - 3. New business.
 - 4. Non-conformance items.
 - 5. Status of As-builts.
 - 6. Other current problem areas and resolutions.
 - 7. Environmental/Safety considerations.
 - 8. Change Order meeting.
- E. The essence of the discussion of each meeting will be entered into the minutes and copies will be furnished by the University or the Architect to all interested parties within one week.

1.04 PROJECT CLOSE-OUT MEETING

- A. Approximately four (4) to six (6) weeks prior to the scheduled completion of the project, for the convenience of the Contractor, the University will include in the standard meeting agenda a Project Closeout meeting.
- B. The purpose is to produce an action-list of major items required to be completed prior to the issuance of the Notice of Completion.
- 1. The action-list will assign an action-responsibility and a projected action-completion date to each item.
 - 2. Be solely responsible for the timely completion of all required closeout items.
 - 3. Items to be considered include:
 - a. Punch list.
 - b. O & M manuals.
 - c. HVAC Balance Report.
 - d. Spare Parts/Materials.
 - e. Keys/Keying.
 - f. Warrantees.
 - g. As-built Drawings and Specifications.
 - h. As-built Schedule.
 - i. State Fire Marshal Inspection.
 - j. Other Regulatory Inspection.
 - k. Removal of Temporary Facilities.
 - l. Final Cleaning and Pest Control.
 - m. Landscape Maintenance.
 - n. Commissioning/Equipment Startup.
 - o. Acceptance.
 - p. Notice of Completion.
 - q. Final Payment.
 - r. Occupancy.
 - s. Other closeout items.

Not Used.

3.00 EXECUTION

Not Used.

END OF SECTION

SECTION 01300 SUBMITTALS

1.00 GENERAL

1.01 SUMMARY

A. Section Includes: This section specifies administrative and procedural requirements for submittals required for performance of the work, including:

1. Submittal procedures.
2. Proposed products list.
3. Product data.
4. Shop drawings.
5. Samples.
6. Design data.
7. Test reports.
8. Certificates.
9. Manufacturers' instructions.
10. Manufacturers' field reports.
11. Erection drawings.
12. Architect's action.

B. Related Work:

1. Documents affecting work of this section include, but are not necessarily limited to, General Conditions, Supplementary General Conditions, Special Conditions, and sections in Division 1 of these specifications.
2. See also Article 5.04 of the General Conditions for additional requirements, especially those regarding requests for Alternatives or Equals and for Substitutions.
3. Administrative Submittals: Refer to other Division 1 sections and other Contract Documents for requirements for administrative submittals. Such submittals include, but are not limited to:
 - a. Permits.
 - b. Applications for payment.
 - c. Performance and payment bonds.
 - d. Insurance certificates.
 - e. List of Subcontractors.
4. Individual requirements for submittals also may be described in pertinent sections of these specifications.

C. Work Not Included:

1. Unrequired submittals will not be reviewed by Architect.
2. The Contractor may require his Subcontractors to provide drawings, setting diagrams, and similar information to help coordinate the work, but such data remains between the Contractor and his Subcontractors and will not be reviewed by Architect unless specifically called for within the Contract Documents.

1.02 SUBMITTAL PROCEDURES

- A. Coordination: Coordinate preparation and processing of submittals with performance of construction activities. Transmit each submittal sufficiently in advance of performance of related construction activities to avoid delay.
 1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals and related activities that require sequential activity.
 2. Coordinate transmittal of different types of submittals for related elements of the work so processing will not be delayed by the need to review submittals concurrently for coordination.
 - a. The Architect will return without action any submittals requiring coordination with other submittals until related submittals are coordinated.
 3. Processing: Allow sufficient review time so that installation will not be delayed as a result of the time required to process submittals, including time for resubmittals.
 - a. See General Conditions and Supplementary General Conditions for additional requirements.
 - b. If an intermediate submittal is necessary, process the same as the initial submittal.
 - c. No extension of Contract Time will be authorized because of failure to transmit submittals to the Architect sufficiently in advance of the work to permit processing.
- B. Submittal Preparation: Place a permanent label or title block on each submittal for identification. Indicate the name of the entity that prepared each submittal on the label or title block.
 1. Provide a space approximately 4" x 5" on the label or beside the title block on shop drawings to record the Contractor and Architect/Engineer review and approval markings and the action taken.
 2. Include the following information on the label for processing and recording action taken:
 - a. Project name.
 - b. Date.
 - c. Name and address of Architect.
 - d. Name and address of Contractor.
 - e. Name and address of subcontractor.
 - f. Name and address of supplier.
 - g. Name of manufacturer.
 - h. Number and title of appropriate specification section.
 - i. Drawing number and detail references, as appropriate.
 3. Sequentially number the transmittal forms. Revise submittals with original number and a sequential alphabetic suffix.
- C. Submittal Transmittal: Package each submittal appropriately for transmittal and handling. Transmit each submittal from Contractor to Architect using University's accepted form. Submittals received from sources other than the Contractor will be returned without action.
 1. On the transmittal, record relevant information and requests for data. On the form, or separate sheet, record deviations from Contract Document requirements, including minor variations and limitations.
 2. Apply Contractor's stamp, signed or initialed, certifying that review, approval, verification of products required, field dimensions, adjacent construction work, and coordination of information, is in accordance with the requirements of the work and Contract Documents.

- D. For each submittal for review, allow fifteen (15) working days excluding delivery time to and from the Contractor.
- E. Provide space for Contractor and Architect/Engineer review stamps.
- F. Architect will review submittals but only for conformance with the design concept of the project and with the information given in the Contract Documents.
- G. It is definitely understood that Architect's review of submittals is for design only and not for dimensional accuracy, and although Architect may occasionally check dimensions, such a check is for convenience only and is not to be presumed by Contractor as verification of dimensions.
- H. Architect's review of a separate item does not indicate approval of an assembly in which the item functions.
- I. Architect's review of submittals does not relieve Contractor of responsibility for any deviation from requirements of Contract Documents unless Contractor has informed Architect in writing of such deviation at time of submission and Architect has given written approval to the specific deviation, nor shall Architect's review relieve Contractor from responsibility for errors or omissions in submittals.
- J. When revised for re-submission, identify all changes made since previous submission.
- K. Distribute copies of reviewed submittals as appropriate. Instruct parties to promptly report any inability to comply with requirements.
- L. Designate in the construction schedule and in a separate coordinated schedule, the dates for submission and the dates that shop drawings, product data, and samples will be needed.
- M. Do not commence any portion of work requiring a shop drawing or sample submission until submission has been approved by Architect.
- N. Submittals not requested will not be recognized or processed.

1.03 PROPOSED PRODUCTS LIST

- A. Within ten (10) working days after date on Notice to Proceed, submit complete list of major products proposed for use, with name of manufacturer, trade name, and model number of each product.
- B. For products specified only by reference standards, give manufacturer, trade name, model or catalog designation, and reference standards.

1.04 PRODUCT DATA

- A. Collect product data into a single submittal for each element of construction or system. Product data includes printed information such as manufacturer's installation instructions, catalog cuts, standard color charts, roughing-in diagrams and templates, standard wiring diagrams and performance curves. Where product data must be specially prepared because standard printed data is not suitable for use, submit as "Shop Drawings."
 - 1. Mark each copy to show applicable choices and options. Where printed product data includes information on several products, some of which are not required, mark copies to indicate the applicable information. Include the following information:
 - a. Manufacturer's printed recommendations.

- b. Compliance with recognized trade association standards.
 - c. Compliance with recognized testing agency standards.
 - d. Application of testing agency labels and seals.
 - e. Notation of dimensions verified by field measurement.
 - f. Notation of coordination requirements.
- 2. Do not submit product data until compliance with requirements of the Contract Documents has been confirmed.
- B. Submittals: Submit a minimum of six (6) copies of each required submittal as well as additional copies as required by the Architect, (the actual number of submittals and distribution required shall be determined by the University's Representative at the Preconstruction Conference). The Architect will return two (2) sets marked with action taken and corrections or modifications required.
- C. Distribution: Furnish copies of final submittal to installers, subcontractors, suppliers, manufacturers, fabricators, and others required for performance of construction activities.
 - 1. Do not proceed with installation until an applicable copy of product data is in the installer's possession.
 - 2. Do not permit use of unmarked copies of product data in connection with construction.

1.05 SHOP DRAWINGS

- A. Submit newly prepared information, drawn to accurate scale. Highlight, encircle, or otherwise indicate deviations from the Contract Documents. Do not reproduce Contract Documents or copy standard information as the basis of shop drawings. Standard information prepared without specific reference to the project is not considered shop drawings.
- B. Shop drawings include fabrication and installation drawings, setting diagrams, schedules, patterns, templates, and similar drawings. Include the following information:
 - 1. Dimensions.
 - 2. Identification of products and materials included.
 - 3. Compliance with specified standards.
 - 4. Notation of coordination requirements.
 - 5. Notation of dimensions established by field measurement.
 - 6. Special utility and electrical characteristics and utility connection requirements.
- C. Sheet Size: Except for templates, patterns and similar full-size drawings, submit shop drawings on sheets at least 8-1/2" x 11" but no larger than 30" x 42".
- D. Submittals: Submit one (1) correctable translucent reproducible print and six (6) blue- or black-line prints for the Architect's review; the reproducible and one print will be returned.
- E. Do not use shop drawings without an appropriate final stamp indicating action taken in connection with construction.

1.06 SAMPLES

- A. Submit full-size, fully fabricated samples cured and finished as specified and physically identical with the material or product proposed. Samples include partial sections of manufactured or fabricated components, cuts or containers of materials, color range sets, and swatches showing color, texture and pattern.

1. Mount, display, or package samples in the manner specified to facilitate review of qualities indicated. Prepare samples to include the following:
 - a. Generic description of the sample.
 - b. Sample source.
 - c. Product name or name of manufacturer.
 - d. Compliance with recognized standards.
 - e. Availability and delivery time.
 2. Submit samples for review of kind, color, pattern, and texture, for a final check of these characteristics with other elements, and for a comparison of these characteristics between the final submittal and the actual component as delivered and installed.
- B. Preliminary Submittals: Where samples are for selection of color, pattern, texture or similar characteristics from a range of standard choices, submit a full set of choices for the material or product.
1. Preliminary submittals will be reviewed and returned with the Architect's mark indicating selection and other action.
- C. Submittals: Except for samples illustrating assembly details, workmanship, fabrication techniques, connections, operation, and similar characteristics, submit 3 sets; one will be returned marked with the action taken.
1. Maintain sets of samples, as returned, at the project site, for quality comparisons throughout the course of construction.
- D. Distribution of Samples: Prepare and distribute additional sets to subcontractors, manufacturers, fabricators, suppliers, installers, and others as required for performance of the work.
- E. Samples will not be used for testing purposes unless specifically stated in the specification section.

1.07 DESIGN DATA

- A. Submit for the Architect's knowledge.
- B. Submit for information for the limited purpose of assessing conformance with information given and the design concept expressed in the Contract Documents.

1.08 TEST REPORTS

- A. Submit for the Architect's knowledge.
- B. Submit test reports for information for the limited purpose of assessing conformance with information given and the design concept expressed in the Contract Documents.

1.09 CERTIFICATES

- A. When specified in individual specification sections, submit certification by the manufacturer's installation/application subcontractor, or the Contractor to Architect, in quantities specified for product data.
- B. Indicate material or product conforms to or exceeds specified requirements. Submit supporting reference data, affidavits, and certifications as appropriate.
- C. Certificates may be recent or previous test results on material or product, but must be acceptable to University.

1.10 MANUFACTURERS' INSTRUCTIONS

- A. When specified in individual specification sections, submit printed instructions for delivery, storage, assembly, installation, start-up, adjusting, and finishing to Architect for delivery to University in quantities specified for product data.
- B. Indicate special procedures, perimeter conditions requiring special attention, and special environmental criteria required for application or installation.
- C. Refer to Section 01400 - Quality Control, Manufacturers' Field Services article.

1.11 MANUFACTURERS' FIELD REPORTS

- A. Submit reports for the University's benefit.
- B. Submit report in duplicate within thirty (30) days of observation.
- C. Submit for information for the limited purpose of assessing conformance with information given and the design concept expressed in the Contract Documents.

1.12 ERECTION DRAWINGS

- A. Submit drawings for the University's benefit.
- B. Submit for information for the limited purpose of assessing conformance with information given and design concept expressed in the Contract Documents.
- C. Data indicating inappropriate or unacceptable work may be subject to action by the University.

1.13 ARCHITECT'S ACTION

- A. Except for submittals for record, information or similar purposes, where action and return is required or requested, the Architect will review each submittal, mark to indicate action taken, and return promptly.
 - 1. Compliance with specified characteristics is the Contractor's responsibility.
- B. Action Stamp: The Architect will stamp each submittal with a uniform, self-explanatory action stamp. The stamp will be appropriately marked, as follows, to indicate the action taken:
 - 1. Final Unrestricted Release: Where submittals are marked "No Exceptions Taken", that part of the work covered by the submittal may proceed provided it complies with requirements of the Contract Documents; final acceptance will depend upon that compliance.
 - 2. Final-But-Restricted Release: When submittals are marked "Furnish As Corrected", that part of the work covered by the submittal may proceed provided it complies with notations or corrections on the submittal and requirements of the Contract Documents; final acceptance will depend on that compliance.
 - 3. Returned for Resubmittal: When submittal is marked "Rejected", "Revise and Resubmit," or "Submit Specified Item", do not proceed with that part of the work covered by the submittal, including purchasing, fabrication, delivery, or other activity. Revise or prepare a new submittal in accordance with the notations; resubmit without delay. Repeat if necessary to obtain a different action mark.

- a. Do not permit submittals marked “Rejected”, “Revise and Resubmit”, or “Submit Specified Item” to be used at the project site or elsewhere where work is in progress.
- b. Any work performed prior to receiving a fully approved submittal is done at the Contractors’ own risk and is subject to being replaced if any of the submittal requirements are not met.

2.00 PRODUCTS

Not Used.

3.00 EXECUTION

Not Used.

END OF SECTION

SECTION 01400
QUALITY CONTROL

1.00 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Quality assurance and control of installation.
2. Tolerances.
3. References and standards.
4. Mock-up.
5. Testing services.
6. Inspection services.
7. Manufacturers' field services.

B. Related Work:

1. Documents affecting work of this section include, but are not necessarily limited to, General Conditions, Supplementary General Conditions, and sections in Division 1 of these specifications.
2. Section 01300: Submittals.
3. Section 01650: Starting of Systems.
4. Requirements for quality control may be described in various sections of these specifications.
5. Where no testing requirements are described, but University decides that testing is required, University may require such testing to be performed under current pertinent standards for testing. Payment for such testing will be made as described in this section.

C. Work Not Included:

1. University will approve a pre-qualified independent testing laboratory.

1.02 QUALITY ASSURANCE/CONTROL OF INSTALLATION

- A. Monitor quality control over suppliers, manufacturers, products, services, site conditions, and workmanship to produce work of specified quality.
- B. Comply with manufacturers' instructions, including each step in sequence.
- C. Should manufacturers' instructions conflict with Contract Documents, request clarification from University before proceeding.
- D. Comply with specified standards as a minimum quality for the Work except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.
- E. Perform work by persons qualified to produce required and specified quality.
- F. Verify that field measurements are as indicated on shop drawings or as instructed by the manufacturer.

- G. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, or disfigurement.

1.03 TOLERANCES

- A. Monitor fabrication and installation tolerance control of products to produce acceptable work. Do not permit tolerances to accumulate.
- B. Comply with manufacturers' tolerances. Should manufacturers' tolerances conflict with Contract Documents, request clarification from University before proceeding.
- C. Adjust products to appropriate dimensions; position before securing products in place.

1.04 REFERENCES AND STANDARDS

- A. For products or workmanship specified by association, trade, or other consensus standards, comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable codes.
- B. Conform to reference standard by date of issue current on date specified in Notice to Contractors, except where a specific date is established by code.
- C. Obtain copies of standards where required by product specification sections.
- D. Neither the contractual relationship, duties, or responsibilities of the parties in Contract, nor those of the University, shall be altered from the Contract Documents by mention or inference otherwise in any reference document.
- E. Conform to additional requirements in Paragraph 5.03 of General Conditions.

1.05 MOCK-UP

- A. Tests will be performed under provisions identified in this section and identified in the respective product specification sections.
- B. Assemble and erect specified items, with specified attachment and anchorage devices, flashings, seals, and finishes.
- C. Accepted mock-ups are the comparison standards for the remaining work.
- D. Where mock-up has been accepted by University and is specified in product specification sections to be removed, remove mock-up and clear area when directed to do so.

1.06 TESTING SERVICES

- A. University will appoint, employ, and pay for specified services of an independent firm to perform testing.
- B. The independent firm will perform tests and other services specified in individual specification sections and as required by University, and Authority Having Jurisdiction.
- C. Testing and source quality control may occur on or off the project site. Perform off-site testing as required by University.
- D. Reports will be submitted by the independent firm to University, and Contractor, in duplicate, indicating observations and results of tests and indicating compliance or non-compliance with Contract Documents.

- E. Cooperate with independent firm; furnish samples of materials, design mix, equipment, tools, storage, safe access, and assistance by incidental labor as requested.
 - 1. Notify University in writing, at least three (3) working days prior to expected time for operations requiring services.
 - 2. Make arrangements with independent firm and pay for additional samples and tests required for Contractor's use.
- F. Testing does not relieve Contractor to perform work to contract requirements.
- G. Perform and pay for re-testing required because of non-conformance to specified requirements by the same independent firm on instructions by University.
- H. Perform special inspections as required by the California Building Code.
- I. Conform to additional requirements in Article 5 of General Conditions.

1.07 INSPECTION SERVICES

- A. The University will appoint, employ, and pay for specified services of a Construction Inspector and Project Manager to perform inspection.
- B. These individuals will perform inspections and other services specified in individual specification sections and as required by the University, and Authority Having Jurisdiction.
- C. Inspecting may occur on or off the project site.
- D. Reports will be submitted to the University, and Contractor, in duplicate, indicating inspection observations and indicating compliance or non-compliance with Contract Documents.
- E. Notify University, and inspectors, in writing, prior to expected time for operations requiring services as indicated in Paragraph 4.20 of General Conditions.
- F. Inspecting does not relieve Contractor to perform work to contract requirements.
- G. Conform to additional requirements in Paragraph 4.20 of General Conditions.

1.08 MANUFACTURERS' FIELD SERVICES

- A. When specified in individual specification sections, require material or product suppliers or manufacturers to provide qualified staff personnel to observe site conditions, conditions of surfaces and installation, quality of workmanship, start-up of equipment, test, adjust, and balance of equipment as applicable, and to initiate instructions when necessary.
- B. Submit qualifications of observer to University ten (10) days in advance of required observations.
- C. Report observations and site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturers' written instructions.
- D. Refer to Section 01300 - Submittals.

2.00 PRODUCTS

Not Used

3.00 EXECUTION

3.01 EXAMINATION

- A. Verify that existing site conditions and substrate surfaces are acceptable for subsequent work. Beginning new work means acceptance of existing conditions.
- B. Verify that existing substrate is capable of structural support or attachment of new work being applied or attached.
- C. Examine and verify specific conditions described in individual specification sections.
- D. Verify that utility services are available, of the correct characteristics, and in the correct locations.

3.02 PREPARATION

- A. Clean substrate surfaces prior to applying next material or substance.
- B. Seal cracks or openings of substrate prior to applying next material or substance.
- C. Apply manufacturer required or recommended substrate primer, sealer, or conditioner prior to applying any new material or substance in contact or bond.

END OF SECTION

SECTION 01500
CONSTRUCTION FACILITIES AND TEMPORARY CONTROLS

1.00 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Temporary Controls: Barriers, enclosures, and protection of the work.
2. Construction Facilities: Progress cleaning.

B. Related Work:

1. Documents affecting work of this section include, but are not necessarily limited to, General Conditions, Supplementary General Conditions, Special Conditions and sections in Division 1 of these specifications.
2. Except that equipment furnished by individual trades is required to comply with requirements of pertinent safety regulations, such equipment normally furnished by the individual trades in execution of their own portions of the work are not a part of this section.

1.02 ELECTRICITY

- A. Contractor is responsible to provide electricity to the site for the purpose of their work. University does not guarantee a point of connection. Contractor to provide generators for work.

1.03 LIGHTING FOR CONSTRUCTION PURPOSES

- A. Contractor is responsible to provide lighting and generators during construction.

1.04 HEATING, COOLING, AND VENTILATION

- A. Permanent building heating, cooling, and ventilation will not be available during construction.

1.05 WATER SERVICE

- A. Contractor can utilize existing fire hydrants on campus for water supply but need to provide a water meter and backflow at point of connection. Fire hydrants shall remain accessible in case of emergency. Location of fire hydrants to be reviewed by contractor as there may not be one near job site. If no hydrant exists then contractor responsible for bring water supply to site.

1.06 SANITARY FACILITIES

- A. No Permanent building sanitary service may be utilized during construction. Contractor to provide temp services.

1.07 BARRIERS

- A. Provide barriers to prevent unauthorized entry to construction areas, to allow for University's use of site, and to protect existing facilities and adjacent properties from damage from construction operations and demolition.
- B. Provide barricades and covered walkways required by governing authorities for public rights-of-way and for public access to existing buildings.

- C. Provide, install, and maintain portable workyard chain link fencing, with green wind screen over entire length at locations indicated on drawings and as required otherwise in this section.
1. Portable Chain-Link Fencing: Minimum 2-inch 9-gage, galvanized steel, chain-link fabric fencing; minimum 6 feet high with galvanized steel pipe posts; minimum 2-3/8-inch- OD line posts and 2-7/8-inch- OD corner and pull posts, with 1-5/8-inch- OD top and bottom rails. Provide galvanized steel bases for supporting posts with appropriate ballast to prevent movement. Do not nail, drill or otherwise secure fence to concrete or asphalt walks, drives or other paved surfaces. Fencing placed on any surface scheduled to remain should not damage the surface. Upon removal of the temporary fencing, Contractor to repair damage made to any and all surfaces.
 2. Design and install to prevent easy access to site by people and animals.
 3. Locate fence as required to ensure complete security of entire site.
 4. Provide gates as required for access.
 5. Do not remove until other security facilities, either temporary or permanent, are in place and in operation.
 6. Continuous wind screen shall block view of site by people outside work area.
 7. Existing permanent University fencing:
 - a. Where permanent fencing exists in a location suitable for use as workyard fencing, it may be used by the contractor as a portion of the workyard fencing.
 - b. Provide screening over the entire length of existing fencing utilized as workyard fencing.
 - c. Contractor shall be responsible for, and shall make repairs to, or replace existing University fencing, which may be damaged during its use as workyard fencing.
 8. Submit plan showing exact location of fencing to be installed, including size and location of all gates, for review and approval by the University prior to installation. Failure to do so shall make the Contractor subject to removal and relocation of any fencing component to a suitable position at no cost to the University and at the sole discretion of the University.
- D. Provide locks and keys for all gates in temporary fencing.
1. Locks to be calibrated to "double lock" with the University so as to provide emergency access.
 2. Provide six (6) copies of keys to the University and their Representatives for their use.

1.08 INTERIOR ENCLOSURES

- A. Provide temporary partitions to separate work areas from University-occupied areas, to prevent penetration of dust into University-occupied areas, and to prevent damage to existing materials and equipment.
- B. Provide and maintain temporary legal exits from all areas at all times for safe exiting purposes.

1.09 PROTECTION OF INSTALLED WORK

- A. Protect installed work and provide special protection where specified in individual specification sections.
- B. Provide protective coverings at walls, projections, jambs, sills, and soffits of openings.
- C. Protect finished floors, stairs, and other surfaces from traffic, dirt, wear, damage, or movement of heavy objects, by protecting with durable sheet materials.

1.10 PARKING

- A. Contractor is required to pay for parking in University parking lots per General Conditions, Supplementary General Conditions, and Specification Section 01010 – Summary of Work

1.11 PROGRESS CLEANING AND WASTE REMOVAL

- A. Maintain areas free of waste materials, debris, and rubbish. Maintain building in a clean and orderly condition.
- B. Remove debris and rubbish from pipe chases, plenums, attics, crawl spaces, and other closed or remote spaces, prior to enclosing the space.
- C. Broom and vacuum clean interior areas prior to start of surface finishing, and continue cleaning to eliminate dust.
- D. Collect and remove waste materials, debris, and rubbish from site weekly and dispose legally off-site.
- E. Conform to additional requirements in Paragraph 4.21 of the General Conditions.

1.12 TEMPORARY CONSTRUCTION AND STRUCTURES

- A. Provide and maintain for the duration of construction all scaffolds, tarpaulins, warning signs, ladders, ramps, and other temporary construction necessary for proper completion of the work in compliance with applicable laws and ordinances and pertinent safety regulations.

1.13 TEMPORARY FIRE PROTECTION

- A. Provide operable fire protection during period of this Contract in conformance with current requirements of applicable governing authorities.
- B. Take adequate precautions against fire throughout all the Contractor's operations.
- C. Keep flammable materials at an absolute minimum and, if any, properly handle and store.
- D. Do not permit fires to be built or open salamanders to be used in any part of the work.
- E. Provide hand-carried, portable UL-rated, Class "A" fire extinguishers for temporary offices and similar spaces.
- F. Comply with NFPA 10 and 241 for classification, extinguishing agent and size required by location and class of fire exposure.

1.14 FIRST AID SUPPLIES

- A. Provide fresh first aid supplies and facilities in conformance with current requirements of applicable governing authorities.

1.15 REMOVAL OF UTILITIES, FACILITIES AND CONTROLS

- A. Remove temporary utilities, equipment, facilities, and materials prior to Final Application for Payment review.
- B. Clean and repair damage caused by installation or use of temporary work.
- C. Restore existing and permanent facilities used during construction to original condition.

2.00 PRODUCTS

Not Used.

3.00 EXECUTION

Not Used.

END OF SECTION

**SECTION 01540
SECURITY**

1.00 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Security program.
2. Entry control.
3. Permanent keys.

B. Related Work:

1. Documents affecting the work of this section include, but are not necessarily limited to, General Conditions, Supplementary General Conditions, Special Conditions, and sections in Division 1 of these specifications.

1.02 SECURITY PROGRAM

- A. Protect the work from theft, vandalism, and unauthorized entry. The Contractor has the sole responsibility for job site security.
- B. Maintain security throughout construction period until the University's occupancy or acceptance precludes the need for the Contractor's security.

1.03 ENTRY CONTROL

- A. Restrict entrance of persons into project site.
- B. Allow entrance only to authorized persons with proper identification.

1.04 PERMANENT KEYS

- A. Immediately upon receipt of permanent keys for whatever purpose, tag or otherwise clearly identify keys according to one approved system and turn them over to the University's Representative.

2.00 PRODUCTS

Not Used.

3.00 EXECUTION

Not Used.

END OF SECTION

**SECTION 01545
SAFETY AND HEALTH**

1.00 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Stop work orders.
2. Protection.

B. Related Work:

1. Documents affecting the work of this section include, but are not necessarily limited to, General Conditions, Supplementary General Conditions, Special Conditions and sections in Division 1 of these specifications.

1.02 SUBMITTALS

- A. Accident Reporting: Forward a copy of each accident report, which the Contractor or Subcontractors submit to their insurance carriers, to the Architect and to the University's Representative as soon as possible, but in no event later than seven (7) calendar days after the day the accident occurred.

2.00 PRODUCTS

2.01 HAZARDOUS MATERIALS

- A. Bring to the attention of the University any material suspected of being hazardous which is encountered during execution of the work. The University will perform tests to determine if the material is hazardous. If the material is found hazardous and additional protective measures are needed, the University will provide removal and disposal under a separate Contract.

3.00 EXECUTION

3.01 STOP WORK ORDERS

- A. When the Contractor or its Subcontractors are notified by the University's Representative of any noncompliance with the provisions of the Contract, and the action(s) to be taken, immediately, if so directed, or within 48 hours after receipt of a notice of violation, correct the unsafe or unhealthy condition. If the Contractor fails to comply promptly, all or any part of the work being performed may be stopped by the University's Representative with a "Stop Work Order." When, in the opinion of the University's Representative, satisfactory corrective action has been taken to correct the unsafe and unhealthy condition, a start order will be given immediately. The Contractor will not be allowed any extension of time or compensation for damages by reason of or in connection with such work stoppage.

3.02 PROTECTION

- A. Take all necessary precautions to prevent injury to the public, building occupants, or damage to property of others. For the purposes of this contract, the public or building occupants include all

persons not employed by the Contractor or a Subcontractor working under the Contractor's direction.

- B. Do not perform work in any area occupied by the public or University's employees unless specifically permitted by the Contract or the University and unless adequate steps are taken for the protection of the public and the University's employees.
- C. Whenever practicable, barricade, or otherwise block off from the public or building occupants to prevent unauthorized entry into the work area.
- D. Alternate Precautions: When the nature of the work prevents isolation of the work area, and the public or building occupants may be in or pass through, under, or over the work area, use alternate precautions such as the posting of signs, the erection of barricades or similar protection around particularly hazardous operations as appropriate.
- E. Public Thoroughfare: When work is to be performed over a public thoroughfare such as a corridor, close the thoroughfare, if possible, or take other precautions such as the installation of screens or barricades. When the exposure to heavy falling objects exists, as during the erection of building walls or during demolition, provide special protection of the type detailed in 29 CFR 1910/1926.
- F. Remove barricades upon completion of the project to the satisfaction of the University's Representative.
- G. Storing, positioning or use of equipment, tools, materials, scraps, and trash in a manner likely to present a hazard to the public or building occupants by its accidental shifting, ignition, or other hazardous qualities is prohibited.

END OF SECTION

SECTION 01600
MATERIAL AND EQUIPMENT

1.00 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Products.
2. Transportation and handling.
3. Storage and protection.
4. Product options.
5. Substitutions.

B. Related Work:

1. Documents affecting work of this section include, but are not necessarily limited to, General Conditions, Supplementary General Conditions, Special Conditions, and section in Division 1 of these specifications.
2. Section 01400: Quality Control.

1.02 PRODUCTS

- A. Do not use materials and equipment removed from existing premises, except as specifically permitted by the Contract Documents.
- B. Provide interchangeable components of the same manufacturer for components being replaced.

1.03 TRANSPORTATION AND HANDLING

- A. Transport and handle products in accordance with manufacturer's instructions.
- B. Promptly inspect shipments to assure that products comply with requirements, quantities are correct, and products are undamaged.
- C. Provide equipment and personnel to handle products by methods to prevent soiling, disfigurement, or damage.
- D. Equip carts, hand trucks, wheelbarrows, and similar wheeled conveyances used on or in any portion of the structure with pneumatic tires except where otherwise expressly authorized.
- E. Internal Combustion Engines and Compressors:
1. Equip with mufflers to reduce noise to a minimum.
 2. Provide safeguards against fire hazards and store gasoline in a well ventilated location specifically assigned for gasoline storage.
- F. Do not deliver material and equipment to the site unless storage space is adequate to receive and protect it.

1.04 STORAGE AND PROTECTION

- A. Confine on-site storage to remodeled areas of structure.

- B. Store and protect products in accordance with manufacturer's instruction.
- C. Store with seals and labels intact and legible.
- D. Store sensitive products in weathertight, climate-controlled enclosures in an environment favorable to product.
- E. Provide off-site storage and protection when site does not permit on-site storage or protection.
- F. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to prevent condensation and degradation of products.
- G. Provide equipment and personnel to store products by methods to prevent soiling, disfigurement, or damage.
- H. Arrange storage of products to permit access for inspection. Periodically inspect to verify products are undamaged and are maintained in acceptable conditions.
- I. Protect finished surfaces, including jambs and soffits of openings used as passageways, through which products are handled.
- J. Provide protection for finished floor surfaces in traffic areas prior to allowing products to be moved over such surfaces.
- K. Maintain finished surfaces clean, unmarred, and suitably protected until accepted by University.
- L. In event of damage, promptly make replacements and repairs to the approval of Architect and at no additional cost to University.
- M. Additional time required to secure replacements and to make repairs will not be considered by Architect to justify an extension in the Contract Time of Completion.

1.05 PRODUCT OPTIONS

- A. Products Specified by Reference Standards or by Description Only: Any product meeting those standards or description.
- B. Products Specified by Naming One or More Manufacturers: Products of manufacturers named and meeting specifications.
- C. Products Specified by Naming One or More Manufacturers with a Provision for Equivalent Substitutions: Submit a request for substitution for any manufacturer not named in accordance with the following article.

1.06 SUBSTITUTIONS

- A. Conform to requirements of Paragraph 5.04 in General Conditions and Supplementary Conditions.

2.00 PRODUCTS

07110SP074

**MATERIALS AND EQUIPMENT
Bob Cole Conservatory of Music
Pavilion and Plaza - Phase 2 2011/2012**

01600 - 02

Not Used.

3.0 EXECUTION
Not Used.

END OF SECTION

**SECTION 01631
ALTERNATIVES OR EQUALS**

1.00 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. This Section includes administrative and procedural requirements for handling requests for alternatives or equals.

1.03 DEFINITIONS

- A. Definitions in this Article do not change or modify the meaning of other terms used in the Contract Documents.
- B. All requests for use of an alternate product, material and / or equipment shall be submitted in accordance with the requirements noted in the Supplementary General Conditions. No proposal will be considered unless accompanied by documentation required by this Section.

1.04 SUBMITTALS

- A. The Architect of Record will consider requests for use of an alternate product, material and / or equipment only if the following documentation is submitted within the time frame noted in the Supplementary General Conditions.
 - 1. Submit four (4) copies of each request. Submit requests according to procedures required for submittals / shop drawings. Include the name, address, and telephone number of the manufacturer of the proposed alternative product.
 - 2. Identify the product or the fabrication or installation method to be replaced in each request. Include related Specification Section and Drawing numbers.
 - 3. Provide complete documentation showing compliance with the requirements for use of alternative and equal items and the following information, as appropriate:
 - a. Coordination information, including a list of changes or modifications needed for other parts of the Work and for construction performed by the University and separate contractors that will be necessary to accommodate the proposed alternate.
 - b. A detailed comparison of significant qualities of the proposed item with those of the Work specified. Significant qualities may include elements, such as performance, weight, size, durability, and visual effect.
 - c. Product data, including test data, performance and reference standards, Drawings and descriptions of products, and fabrication and installation procedures. Provide complete data substantiating compliance with requirements of the Contract Documents.
 - d. Samples, where applicable or requested.

- e. A statement indicating the effect of the alternate on the Contractor's Construction Schedule compared to the schedule without approval of the alternate. Indicate the effect of the proposed alternate on overall Contract Time.
 - f. The Contractor's certification that the proposed alternate conforms to requirements in the Contract Documents in every respect and is appropriate for the applications indicated.
 - g. The Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of the failure of the alternate to perform adequately.
 - h. Name and address of similar projects in the general location of this project on which the proposed alternative product was used. Provide approximate date product was installed.
4. Architect of Record's Action: The Architect of Record will notify the Contractor of acceptance or rejection of the alternate via addendum. Use the product specified if the Architect of Record cannot make a decision on the use of a proposed substitute within the time allocated.

2.00 PRODUCTS

2.01 ALTERNATES OR EQUALS

- A. Conditions: The Architect of Record will receive and consider the Contractor's request for use of alternate or equal when one (1) or more of the following conditions are satisfied, as determined by the Architect of Record. If the following conditions are not satisfied, the Architect of Record will return the requests without action except to record non-compliance with these requirements.
- 1. Extensive revisions to the Contract Documents are not required.
 - 2. Proposed changes are in keeping with the general intent of the Contract Documents.
 - 3. The request is timely, fully documented, and properly submitted.
 - 4. The specified product or method of construction cannot be provided within the Contract Time. The Architect of Record will not consider the request if the product or method cannot be provided as a result of failure to pursue the Work promptly or coordinate activities properly, including, but not limited to, awarding subcontracts, investigating lead times, and ordering materials sufficiently in advance to ensure delivery in time to meet the construction schedule.
 - 5. The requested alternate offers the University a substantial advantage in cost, time, energy conservation, or other considerations, after deducting additional responsibilities the University must assume. The University' additional responsibilities may include compensation to the Architect of Record for re-design and evaluation services, increased cost of other construction by the University, and similar considerations.
 - 6. The specified product or method of construction cannot receive necessary approval by a governing authority, and the requested alternate can be approved.
 - 7. The specified product or method of construction cannot be provided in a manner that is compatible with other materials and where the Contractor certifies that the alternate will overcome the incompatibility.
 - 8. The specified product or method of construction cannot be coordinated with other materials and where the Contractor certifies that the proposed alternate can be coordinated.

9. The specified product or method of construction cannot provide a warranty required by the Contract Documents and where the Contractor certifies that the proposed alternate provides the required warranty.
 10. The specified product has been discontinued by the manufacturer or the manufacturer has ceased operations.
- B. The Contractor's submittal and the Architect of Record's acceptance of Shop Drawings, Product Data, or Samples for construction activities not complying with the Contract Documents do not constitute an acceptable or valid request for alternate nor do they constitute approval.

3.00 EXECUTION

Not Used

END OF SECTION

**SECTION 01650
STARTING OF SYSTEMS**

1.00 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Starting systems.
2. Demonstration and instructions.
3. Testing and adjusting.

B. Related Work:

1. Documents affecting work of this section include, but are not necessarily limited to, General Conditions, Supplementary General Conditions, Special Conditions and sections in Division 1 of these specifications.
2. Section 01700: Contract Closeout.

1.02 STARTING SYSTEMS

- A. Coordinate schedule for start-up of various equipment and systems.
- B. Notify Architect, Engineer, and University seven (7) days prior to start-up of each item.
- C. Verify that each piece of equipment or system has been checked for conditions, which may cause damage.
- D. Verify tests, meter readings, and specified electrical characteristics agree with those required by the equipment or system manufacturer.
- E. Verify wiring and support components for equipment are complete and tested.
- F. Execute start-up under supervision of applicable manufacturer's representative in accordance with manufacturer's instructions.
- G. When specified in individual specification sections, require manufacturer to provide authorized representative to be present at site to inspect, check, and approve equipment or system installation prior to start-up, and to supervise placing equipment or system in operation.
- H. Submit a written report in accordance with Section 01300 that equipment or system has been properly installed and is functioning correctly.

1.03 DEMONSTRATION AND INSTRUCTIONS

- A. Demonstrate operation and maintenance of products to University's personnel two (2) weeks prior to date of Final Acceptance.
- B. Utilize operation and maintenance manuals as basis for instruction. Review contents of manual with University's personnel in detail to explain all aspects of operation and maintenance.
- C. Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, maintenance, and shutdown of each item of equipment at agreed-upon times, at designated location.

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

1.04 TESTING AND ADJUSTING

- A. Appoint, employ, and pay for services of a University-approved independent firm to perform testing and adjusting.
- B. Submit reports by the independent firm to Architect and University indicating observations and results of tests and indicating compliance or non-compliance with specified requirements and with the requirements of the Contract Documents.

2.00 PRODUCTS

Not Used.

3.00 EXECUTED

Not Used.

END OF SECTION

**SECTION 01700
PROJECT CLOSEOUT**

1.00 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Punch-list inspection.
2. Record document submittals.
3. Closeout procedures.
4. Final cleaning.
5. Adjusting
6. Spare parts and maintenance materials.
7. Maintenance service.
8. Final acceptance.
9. Guarantees, warranties, and bonds.

B. Related Work:

1. Documents affecting work of this section include, but are not necessarily limited to, General Conditions, Supplementary General Conditions, Special Conditions and sections in Division 1 of these specifications.
2. Section 01500: Construction Facilities and Temporary Controls.
3. Section 01730: Operating and Maintenance Manual Submittal.

1.02 PUNCH LIST INSPECTION

- A. When each phase is, in the opinion of the Contractor, complete in all respects, call for a punch list inspection.
- B. Inspection Procedures: On receipt of a request for inspection, the University will schedule the inspection. The University will then perform a preliminary walk-through. If, in the judgment of the University, the project is not sufficiently complete in all respects, the University will so advise the Contractor and discontinue the inspection.
1. The University will schedule a repeat inspection when requested and assured that the work has been completed.
 2. Results of the completed inspection will form the basis of requirements for final acceptance punch list.

1.03 RECORD DOCUMENT SUBMITTALS

- A. Do not use record documents for construction purposes; protect from deterioration and loss in a secure, fire-resistive location; provide access to record documents for the University and the Architect's reference during normal working hours.
- B. Record Drawings: Maintain a clean, undamaged set of prints of Contract Drawings and Shop Drawings. Mark the set to show the actual installation where the installation varies substantially from the work as originally shown. Mark whichever drawing is most capable of showing conditions fully and accurately; where Shop Drawings are used, record a cross-reference at the corresponding location on the Contract Drawings. Give particular attention to concealed elements that would be difficult to measure and record at a later date.

1. Mark record sets with red erasable pencil; use other colors to distinguish between variations in separate categories of the work.
 2. Mark new information that is important to the University but was not shown on Contract Drawings or Shop drawings.
 3. Note related change order numbers where applicable.
 4. Organize record drawing sheets into manageable sets, bind with durable paper cover sheets and print suitable titles, dates and other identification on the cover of each set.
- C. Record Specifications: Maintain one (1) complete copy of the project specifications, including addenda, and one (1) copy of other written construction documents such as change orders and modifications issued in printed form during construction. Mark these documents to show substantial variations in actual work performed in comparison with the text of the specifications and modifications.

Give particular attention to substitutions, selection of options and similar information on elements that are concealed or cannot otherwise be readily discerned later by direct observation. Note related record drawing information and product data.

1. Upon completion of the work, submit record specifications to the University for the University's records.
- D. Operating and Maintenance Manuals: Submit three (3) sets to the University for review and approval.

1.04 CLOSEOUT PROCEDURES

- A. The Construction Engineer and the Inspector will call for a "Closeout" meeting approximately four (4) to six (6) weeks prior to the anticipated completion date.
1. At this meeting a completion Action List will be prepared listing all major items required to be completed prior to the issuance of the Notice of Completion.
 2. The action list will assign an action-responsibility and a projected action-completion date to each item.
 3. The Contractor is solely responsible for the timely completion of all required closeout items.

1.05 FINAL CLEANING

- A. General cleaning during construction is required by the General Conditions and included in Section 01500.
- B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to the condition expected in a normal, commercial building cleaning and maintenance program. Comply with manufacturer's instructions.
1. Complete the following cleaning operations before requesting inspection for Certification of Completion.
 - a. Remove non-permanent labels.

- b. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compound and other substances that are noticeable vision-obscuring materials. Replace chipped or broken glass and other damaged transparent materials.
 - c. Clean exposed interior hard-surfaced finishes to a dust-free condition, free of stains, films and similar foreign substances. Restore reflective surfaces to their original reflective condition. Leave concrete and resilient floors broom clean. Vacuum carpeted surfaces.
 - d. Wipe surfaces of mechanical and electrical equipment. Remove excess lubrication and other substances. Clean light fixtures and lamps.
- C. Removal of Protection: Remove temporary protection and facilities installed for protection of the work during construction.
- D. Compliance: Comply with regulations of authorities having jurisdiction and safety standards for cleaning. Do not burn waste materials. Do not bury debris or excess materials on the University's property. Do not discharge volatile, harmful or dangerous materials into drainage systems. Remove waste materials from the site and dispose of in a lawful manner. Where extra materials of value have become the University's property, after completion of associated work, arrange for disposition of these materials as directed.

1.06 ADJUSTING

- A. Adjust operating products and equipment to ensure smooth and unhindered operation.

1.07 SPARE PARTS AND MAINTENANCE MATERIALS

- A. Provide spare parts, maintenance and extra products in quantities specified in individual specification sections.
- B. Deliver to project site and place in location as directed; obtain receipt prior to final payment.

1.08 MAINTENANCE SERVICE

- A. Furnish service and maintenance of components indicated in specification sections for one (1) year from date of project acceptance.
- B. Examine system components at a frequency consistent with reliable operation. Clean, adjust, and lubricate as required.
- C. Include systematic examination, adjustment, and lubrication of components. Repair or replace parts whenever required. Use parts produced by the manufacturer of the original component.
- D. Do not assign or transfer maintenance service to any agent or Subcontractor without prior written consent of the University and Trustees.

1.09 FINAL ACCEPTANCE

- A. Preliminary Procedures: Before requesting final inspection for certification of University's final acceptance, complete the following:
 - 1. Submit a certified copy of the University's final inspection list of items to be completed or corrected, stating that each item has been completed or otherwise resolved for acceptance, and the list has been endorsed and dated by the University.

- B. Re-inspection Procedure: The University will re-inspect the work upon receipt of notice that the work, including inspection list items from earlier inspections (punch list), has been completed, except items whose completion has been delayed because of circumstances acceptable to the University.
1. Upon completion of re-inspection, the University will advise the Contractor of work that is incomplete or of obligations that have not been fulfilled but are required for final acceptance.
 2. Upon final acceptance by the University, the Inspector of Record, (IOR) will prepare a letter stating that the project has been constructed in accordance with the Contract Documents and is complete in all respects.

1.10 GUARANTEES, WARRANTIES AND BONDS

- A. Provide duplicate notarized copies.
- B. Execute and assemble transferable documents from Subcontractors, suppliers, and manufacturers.
- C. Provide Table of Contents and assemble in three ring, D-side binder with durable plastic cover.
- D. Submit prior to final Application for Payment.
- E. For items of work delayed beyond date of acceptance, provide updated submittal within ten (10) days after acceptance, listing date of acceptance as start of warranty period.
- F. Conform to additional requirements in Paragraph 8.05 of the Contract General Conditions.

2.00 PRODUCTS

Not Used.

3.00 EXECUTION

Not Used.

**SECTION 01730
OPERATING AND MAINTENANCE DATA**

1.00 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Compile product data and related information appropriate for University's maintenance and operation of products furnished under Contract.
2. Prepare operating and maintenance data as specified in this section and as referenced in other pertinent sections of specification.
3. Instruct University's personnel in maintenance of products and in operation of equipment and systems.

B. Related Work:

1. Documents affecting the work of this section include, but are not necessarily limited to General Conditions, Supplementary General Conditions, Special Conditions, and sections in Division 1 of these specifications.

1.02 QUALITY ASSURANCE

A. Prepare data by personnel:

1. Trained and experienced in maintenance and operation of described products.
2. Familiar with requirements of this section.
3. Skilled as technical writer to the extent required to communicate essential data.
4. Skilled as draftsman competent to prepare required drawings.

1.03 FORM OF SUBMITTALS

A. Prepare data in form of an instructional manual for use by University's personnel.

B. Format:

1. Size: 8-1/2 in. by 11 in.
2. Paper: Manufacturer's printed data, or neatly typewritten.
3. Drawings:
 - a. Provide reinforced punched binder tab; bind in with text.
 - b. Fold larger drawings to size of text pages.
4. Provide flyleaf for each separate product or each piece of operating equipment.
5. Organize manual in order of specification divisions and sections.

- a. Provide typed description of product, and major component parts of equipment.
 - b. Provide indexed tabs.
- 6. Cover: Identify each volume with typed or printed title, "Operating and Maintenance Instructions". List:
 - a. Title of Project.
 - b. Identity of separate structure as applicable.
 - c. Identity of general subject matter covered in the manual.
- C. Binders:
 - 1. Commercial quality three-ring binders with durable and cleanable plastic covers.
 - 2. Maximum ring size: 2 inches per 1700 sheets.
 - 3. When multiple binders are used, correlate the data into related consistent groupings.
- D. Review:
 - 1. Submit three (3) sets of the manual to Architect for review and approval. If the manual is acceptable, the Architect will forward two (2) of the sets to the University's Representative.

1.04 CONTENT OF MANUAL

- A. Neatly typewritten table of contents for each volume, arranged in systematic order.
 - 1. Contractor, name of responsible principal, address, and telephone number.
 - 2. A list of each product required to be included, indexed to content of the volume.
 - 3. List, with each product, name, address and telephone number of:
 - a. Subcontractor or installer.
 - b. Maintenance contractor, as appropriate.
 - c. Identify area of responsibility of each.
 - d. Local source of supply for parts and replacement.
 - 4. Identify each product by product name and other identifying symbols as set forth in Contract Documents.
- B. Product Data:
 - 1. Include only those sheets which are pertinent to the specific product.
 - 2. Annotate each sheet to:
 - a. Clearly identify specific product or part installed.
 - b. Clearly identify data applicable to installation.

- c. Delete references to inapplicable information.
- C. Drawings:
 - 1. Supplement product data with drawings as necessary to clearly illustrate:
 - a. Relations of component parts of equipment and systems.
 - b. Control and flow diagrams.
 - 2. Coordinate drawings with information in Project Record Documents to assure correct illustration of completed installation.
 - 3. Do not use Project Record Documents as maintenance drawings.
- D. Written text, as required to supplement product data for the particular installation:
 - 1. Organize in a consistent format under separate headings for different procedures.
 - 2. Provide logical sequence of instructions for each procedure.
- E. Copy of each warranty, bond and service contract issued.
 - 1. Provide information sheet for University's personnel, give:
 - a. Proper procedures in event of failure.
 - b. Instances which might affect validity of warranties or bonds.
- F. Copy of each Material Safety Data Sheet (MSDS) received with products or materials delivered to the site for incorporation into the project for University's future reference.

1.05 MANUAL FOR MATERIALS AND FINISHES

- A. Submit three (3) copies of complete manual in final form.
- B. Content, for architectural products, applied materials and finishes:
 - 1. Manufacturer's data, giving full information on products.
 - a. Catalog number, size, and composition.
 - b. Color and texture designations.
 - c. Information required for re-ordering special manufactured products.
 - 2. Instructions for care and maintenance:
 - a. Manufacturer's recommendation for types of cleaning agents and methods.
 - b. Cautions against cleaning agents and methods which are detrimental to the product.
 - c. Recommended schedule for cleaning and maintenance.
- C. Content, for moisture-protection and weather-exposed products:

1. Manufacturer's data, giving full information on products.
 - a. Applicable standards.
 - b. Chemical composition.
 - c. Details of installation.
 2. Instructions for inspection, maintenance, and repair.
- D. Additional requirements for maintenance data: Respective sections of specifications.

1.06 MANUAL FOR EQUIPMENT AND SYSTEMS

- A. Submit three (3) copies of complete manual in final form.
- B. Content, for each unit of equipment and system, as appropriate:
 1. Description of Unit and Component Parts:
 - a. Function, normal operating characteristics, and limiting conditions.
 - b. Performance curves, engineering data and tests.
 - c. Complete nomenclature and commercial number of replaceable parts.
 2. Operating Procedures:
 - a. Start-up, break-in, routine and normal operating instructions.
 - b. Regulation, control, stopping, shut-down, and emergency instructions.
 - c. Summer and winter operating instructions.
 - d. Special operating instructions.
 3. Maintenance Procedures:
 - a. Routine operations.
 - b. Guide to "trouble shooting".
 - c. Disassembly, repair and re-assembly.
 - d. Alignment, adjusting and checking.
 4. Servicing and lubrication schedule:
 - a. List of lubricants required.
 5. Manufacturer's printed operating and maintenance instructions.
 6. Description of sequence of operation by control manufacturer.
 7. Original manufacturer's parts list, illustrations, assembly drawings and diagrams required for maintenance.

- a. Predicted life of parts subject to wear.
 - b. Items recommended to be stocked as spare parts.
- 8. As-installed control diagrams by controls manufacturer.
- 9. Each contractor's coordination drawings.
 - a. As-installed, color-coded piping diagrams.
- 10. Charts of valve tag numbers, with location and function of each valve.
- 11. List of original manufacturer's spare parts, manufacturer's current prices, and recommended quantities to be maintained in storage.
- 12. Other data as required under pertinent sections of specifications.
- C. Content, for each electric and electronic system, as appropriate:
 - 1. Description of system and component parts.
 - a. Function, normal operating characteristics and limiting conditions.
 - b. Performance curves, engineering data and tests.
 - c. Complete nomenclature and commercial number of replaceable parts.
 - 2. Circuit directories of panel boards.
 - a. Electrical service.
 - b. Controls.
 - c. Communications.
 - 3. As-installed, color-coded wiring diagrams.
 - 4. Operating procedures:
 - a. Routine and normal operating instructions.
 - b. Sequences required.
 - c. Special operating instructions.
 - 5. Maintenance procedures:
 - a. Routine operations.
 - b. Guide to "trouble-shooting."
 - c. Disassembly, repair and re-assembly.
 - d. Adjustment and checking.
 - 6. Manufacturer's printed operating and maintenance instructions.

7. List of original manufacturer's spare parts, manufacturer's current prices, and recommended quantities to be maintained in storage.
 8. Other data as required under pertinent sections of specifications.
- D. Prepare and include additional data when the need for such data becomes apparent during instruction of University's personnel.
- E. Additional requirements for operating and maintenance data: Respective sections of specifications.

1.07 INSTRUCTION OF OWNER'S PERSONNEL

- A. Operating and maintenance manual constitutes the basis of instruction.
1. Review contents of manual with personnel in full detail to explain all aspects of operations and maintenance.

END OF SECTION

SECTION 02221

DEMOLITION

PART 1 - GENERAL

1.01 SUMMARY

- A. Provisions of Division 01 apply to this section.
- B. Section Includes: Furnishing labor, materials and equipment necessary for demolition, dismantling, cutting and alterations as indicated, specified, or required for completion of the Work. Includes items such as the following:
 - 1. Protection of existing improvements to remain.
 - 2. Cleaning existing improvements to remain.
 - 3. Disconnecting and capping utilities.
 - 4. Removing debris, waste materials, and equipment.
 - 5. Removal of items for performance of the Work.
 - 6. Salvageable items to be retained by the Owner.
- C. Related Sections:
 - 1. Section 01005: Summary of the Work.
 - 2. Section 01120: Cutting and Patching
 - 3. Section 01500: Construction Facilities and Temporary Controls.
 - 4. Division 15: Mechanical
 - 5. Division 16: Electrical

1.02 SUBMITTALS

- A. Shop Drawings: Submit Shop Drawings indicating the extent of items and systems to be removed. Indicate items to be salvaged or items to be protected during demolition. Indicate locations of utility terminations and the extent of abandoned lines to be removed. Include details indicating methods and location of utility terminations.

1.03 QUALITY ASSURANCE

- A. Perform the Work of this section by workers skilled in the demolition of buildings and structures. Perform the Work of this section under direct superintendence at all times.

- B. Prior to commencement of Work, schedule a walkthrough with the OAR, to confirm Owner property items have been removed from scheduled Work areas. Identify and mark remaining property items and schedule their removal.
- C. Coordinate demolition for the correct sequence, limits, and methods. Schedule demolition work to create least possible inconvenience to the public and facility operations.
- D. Related Standard: American National Standard A10.6-1983

1.04 PROJECT CONDITIONS

- A. Drawings may not indicate in detail all demolition Work to be performed. Examine existing conditions to determine the full extent of required demolition.
- B. Repair damage to existing improvements or damage due to excessive demolition.
- C. Provide all measures to avoid excessive damage from inadequate or improper means and methods, improper shoring, bracing or support.
- D. If conditions are encountered that varies from those indicated, promptly notify the Architect for clarification before proceeding.

PART 2 - PRODUCTS

2.01 HANDLING OF MATERIALS

- A. Items scheduled for salvage by the Owner shall be delivered to a location designated by the OAR. Items shall be cleaned, packaged and labeled for storage.
- B. Items scheduled for reuse shall be stored on the Project site and protected from damage, theft and other deleterious conditions.

PART 3 - EXECUTION

3.01 GENERAL

- A. Protection:
 - 1. Do not commence demolition until safety partitions, barricades, warning signs and other forms of protection are installed. Refer to Section 01500: Construction Facilities and Temporary Controls.
 - 2. Provide all safeguards, including warning signs, lights and barricades, for protection of workers, occupants, and the public.
- B. If, at any time, safety of existing construction appears to be endangered, take immediate measures to correct such conditions; cease operations and immediately notify the Architect and OAR.

3.02 DEMOLITION

- A. Do not throw or drop materials. Furnish ramps or chutes as required by the Work.
- B. Remove existing construction only to extent necessary for proper installation of Work and interfacing with existing construction. Cut back finished surfaces to straight, plumb or level lines as required for a smooth transition.
- C. Where openings are cut oversize or in improper locations, replace or repair to required condition.

3.03 CUTTING EXISTING CONCRETE

- A. Cutting of existing concrete shall be performed by skilled workers familiar with the requirements and space necessary for placing concrete. Perform concrete cutting with concrete cutting wheels and hand chisels. Do not damage concrete intended to remain.
- B. Extent of cutting of structural concrete shall be as indicated on Drawings. Cutting of non-structural concrete shall be as indicated on Drawings or as reviewed by the Architect or structural engineer. Replace concrete demolished in excess of amounts indicated.
- C. Prior to cutting or coring concrete, determine locations of hidden utilities or other existing improvements and provide necessary measures to protect them from damage.

3.04 REMOVAL OF EXISTING PLUMBING AND ELECTRICAL EQUIPMENT AND SERVICES

- A. Remove existing plumbing and electrical equipment fixtures and services not indicated for reuse and not necessary for completion of the Work. Remove abandoned lines and cap unused portions of existing lines.

3.05 REMOVAL OF OTHER MATERIALS

- A. Masonry: Cut back to joint lines and remove mortar without damaging units to remain. Allow space for repairs to backing where applicable.
- B. Woodwork: Cut or remove to a joint or panel line.
- C. Roofing: Remove as required, including accessory components such as insulation and flashings. At penetrations through existing roofing, trim cut edges back to sound roofing with openings restricted to the minimum size necessary to receive Work.
- D. Sheet Metal: Remove back to joint, lap, or connection. Secure loose and unfastened ends or edges and provide a watertight condition. Re-seal as required.
- E. Glass: Remove broken or damaged glass and clean rebates and stops of glazing channels.
- F. Modular materials such as acoustical ceiling panels, resilient tile, or ceramic tile: Remove to a natural joint without leaving damaged or defective Work where joining new Work. After flooring removal, clean substrates to remove setting materials and adhesives.
- G. Gypsum Board: Remove to a panel joint line on a stud or support line.

- H. Plaster: Saw cut plaster on straight lines, leaving a minimum 2 inch width of firmly attached metal lath for installing new lath and plaster.
- I. Remove existing improvements not specifically indicated or required but necessary to perform Work. Cut to clean lines, allowing for installation of Work.

3.06 PATCHING

- A. Patch and/or repair materials to remain when damaged by the performance of the Work of this section. Finish material and appearance of patch and/or repair Work shall match existing.

3.07 CLEANING

- A. Clean existing materials to remain with appropriate tools and equipment.
- B. Protect existing improvements during cleaning operations.
- C. Debris shall be dampened by fog water spray prior to transporting by truck.
- D. Debris pick-up area shall be kept broom-clean and shall be washed daily with clean water.
- E. Remove waste and debris, other than items to be salvaged. Turn over salvaged items to Owner, or store and protect for reuse where required. Continuously clean up and remove items as demolition Work progresses.
- F. Remove rubbish, debris, and waste materials and legally dispose of off the Project site.

END OF SECTION

SECTION 02230

SITE CLEARING

PART 1 - GENERAL

1.01 SUMMARY

- A. Provisions of Division 01 apply to this section.
- B. Section Includes:
 - 1. Removal of vegetation, grass, grass roots, shrubs, tree stumps, trees, upturned stumps, weed growth, tree roots, brush, masonry, concrete, rubbish, debris and other objectionable materials, within limits of the Work.
 - 2. Removal of concrete and bituminous surfaces.
 - 3. Removal of existing fences and gates.
- C. Related Sections:
 - 1. Section 02300: Earthwork.
 - 2. Section 02231: Landscape.

1.02 SUBMITTALS

- A. Shop Drawings: Submit site plan indicating extent of site clearing.

1.03 QUALITY ASSURANCE

- A. Comply with Standard Specifications for Public Works Construction, current edition, as a minimum requirement.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION

3.01 TREE AND STUMP REMOVAL

- A. Remove trees and stumps indicated and/or required to be removed. Remove trees, together with bulk of roots, to a minimum depth of 4 feet below required grade, and within a radius of approximately 7 feet beyond perimeter of trunk at grade.
- B. Fill and compact excavation from tree and stump removal. Fill in 6 inch layers, each compacted to 90 percent of maximum density in accordance with ASTM D 1557.
 - 1. Back filling shall not commence until the excavation is inspected and tested.

3.02 CONCRETE AND BITUMINOUS SURFACING REMOVAL

- A. Break up and completely remove existing concrete surfacing, curbs, gutters, walks and bituminous surfacing to indicated limits. Cutting shall be performed to a neat and even line with proper tools or a concrete cutting saw. Minimum depth of cut shall be 1-1/2 inches, unless otherwise indicated. Remove concrete broken beyond the indicated limits to the nearest joint or score line and replace with new concrete to match existing.

3.03 FENCING

- A. Existing fences scheduled to remain may be removed to facilitate the Work, provided they are installed to their original condition in accordance with requirements of Section 02821: Chain Link Fences and Gates.
- B. Fencing indicated to be removed and not reinstalled shall be completely removed, including footings. Fill and compact excavations.
- C. Install chain link fencing indicated to be relocated or reset in accordance with applicable requirements specified under Section 02821: Chain Link Fences and Gates.

3.04 CLEANUP

- A. Remove rubbish, debris and waste materials and legally dispose of off the Project site.

END OF SECTION

SECTION 02231 - TREE PROTECTION AND TRIMMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the protection and trimming of trees that are to remain but interfere with, or are affected by, execution of the Work, whether temporary or new construction.

1.3 SUBMITTALS

- A. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.
- B. Product data for each type of product specified.
- C. Qualification data for firms and persons specified in the "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.
- D. Certification by a qualified arborist that trees indicated to remain have been protected during construction according to recognized standards and that trees were promptly and properly treated and repaired when damaged.
- E. Maintenance recommendations for care and protection of trees affected by construction after completing the Work.

1.4 QUALITY ASSURANCE

- A. Tree Service Qualifications: Engage an experienced tree service firm that has successfully completed tree protection and trimming work similar to that required for this Project and that will maintain an experienced, qualified arborist on the Project site on a full-time basis during execution of the Work.
 - 1. Arborist Qualifications: An arborist certified by the International Society of Arboriculture or licensed in the jurisdiction where the Project is located.
- B. Tree Pruning Standards: Comply with the National Arborist Association's "Pruning Standards for Shade Trees" except where more stringent requirements are indicated.
- C. Preinstallation Conference: Conduct conference at the Project site to comply with requirements of Division 1 Section "Project Meetings."
 - 1. Before commencing tree protection and trimming, meet with representatives of authorities having jurisdiction, Owner, Architect, consultants, and other concerned entities. Review tree protection

and trimming procedures and responsibilities. Notify participants at least 3 working days prior to convening conference. Record discussions and agreements and furnish a copy to each participant.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Drainage Fill: Selected crushed stone, or crushed or uncrushed gravel, washed, ASTM D 448, size 24, with 90 to 100 percent passing a 2-1/2-inch sieve and not more than 10 percent passing a 3/4-inch sieve.
- B. Topsoil: Fertile, friable, surface soil, containing natural loam and complying with ASTM D 5268. Provide topsoil that is free of stones larger than 1 inch in any dimension and free of other extraneous or toxic matter harmful to plant growth. Obtain topsoil only from well-drained sites where soil occurs in depth of 4 inches or more; do not obtain from bogs or marshes.
- C. Filter Fabric: Manufacturer's standard, nonwoven, pervious, geotextile fabric of polypropylene, nylon, or polyester fibers.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Temporary Protection: Provide temporary fencing, barricades, or other suitable guards located outside the drip line (outer perimeter of branches) to protect remaining trees and other plants from damage.
- B. Protect tree root systems from damage due to noxious materials caused by run-off or spillage while mixing, placing, or storing construction materials. Protect root systems from flooding, eroding, or excessive wetting caused by dewatering operations.
- C. Do not store construction materials, debris, or excavated material within the drip line of remaining trees. Do not permit vehicles or foot traffic within the drip line, and prevent soil compaction over root systems.
- D. Do not allow fires under or adjacent to remaining trees or other plants.

3.2 TREE AND VEGETATION PROTECTION

- A. Protect existing trees and other vegetation indicated to remain in place against the following:
 - 1. Storage or parking of automobiles or other vehicles.
 - 2. Stockpiling of building materials, refuse, or excavated materials.
 - 3. Use of trees as support posts, power posts, or sign posts, anchorage for ropes, guy wires, or power lines, or other similar functions.
 - 4. Dumping of poisonous materials on or around plant roots, trunks, branches, or foliage. Such materials include, but are not limited to, paint, petroleum products, dirty water, or other deleterious materials.
 - 5. Cutting, breaking, or skinning of roots caused by utility trenching, foundation digging, placement of curbs and trenches, and other miscellaneous excavation without prior written approval by the Landscape Architect.
 - 6. Damage by skinning or bruising of bark on trunks or branches, caused by maneuvering vehicles or stacking material or equipment too close to the plant.

7. Compaction of the soil within the drip-line of the plants due to movement of trucks or grading machines, pedestrian or vehicular traffic, storage of equipment or materials.
 8. Excessive water or heat from equipment, utility line construction, or burning of trash under or near vegetation to remain.
 9. Damage to root system from flooding, erosion, and excessive wetting and drying resulting from watering and other operations.
- B. Prior to commencement of construction activities, the Contractor shall erect and maintain a temporary fenced barricade around the drip-line of individual trees, around perimeter drip-line of groups of trees, or around other vegetation to remain.
1. Prevent damage to roots during installation of barricade posts. Space posts approximately 4'-0" on-center (O.C.) and securely attach fabric.
 2. Barricades shall be installed plumb, taut, and sturdy to prevent unauthorized access around drip-line of trees and protected vegetation. Repair sagging or damaged barricades immediately.
 3. Immediately after barricade fencing is installed, cover entire soil area inside of the fence area with a four-inch (4") layer of mulch. Keep mulch eighteen-inches (18") away from root crown. Irrigate protected trees and vegetation to a moist soil depth of eighteen-inches (18") deep.
 4. During the course of construction, relocation of the barricade may be required to facilitate construction. Contractor shall relocate barricade as directed by the Landscape Architect at no additional expense to the Owner.
 5. Remove barricade when construction operations are complete or when directed by the Landscape Architect.
- C. Irrigation: Contractor shall supply fresh potable water in adequate amounts and rates of application as required to maintain the health of protected plant material in addition to surrounding plant materials affected by construction throughout the duration of the construction operations. Contractor shall maintain a watering schedule and document dates and duration of irrigation applications.
1. Construct a temporary watering basin, as required, on the surface of the existing undisturbed grade, with imported soil, to aid in the retention of water around existing protected trees and planting.

3.3 EXCAVATION

- A. Install shoring or other protective support systems to minimize sloping or benching of excavations.
- B. Do not excavate within tree drip line, unless otherwise indicated.
- C. Where excavation for new construction is required within tree drip lines, hand excavate to minimize damage to root systems. Use narrow-tine spading forks and comb soil to expose roots.
1. Relocate roots in backfill areas wherever possible. If encountering large, main lateral roots, expose beyond excavation limits as required to bend and relocate without breaking. If encountered immediately adjacent to location of new construction and relocation is not practical, cut roots approximately 3 inches back from new construction.
 2. Do not allow exposed roots to dry out before placing permanent backfill. Provide temporary earth cover or pack with peat moss and wrap with burlap. Water and maintain in a moist condition and temporarily support and protect roots from damage until they are permanently relocated and covered with earth.
- D. Where utilities trenches are required within tree drip lines, tunnel under or around the roots by drilling, auger boring, pipe jacking, or digging by hand.
1. Root Pruning: Do not cut main lateral roots or tap roots; cut only smaller roots that interfere with installation of new work. Cut roots with sharp, sterilized pruning instruments; do not break or chop.

3.4 REGRADING

- A. Grade Lowering: Where new finish grade is indicated below existing grade around trees, slope grade beyond tree drip line. Maintain existing grades within tree drip lines.
- B. Grade Lowering: Where new finish grade is indicated below existing grade around trees, slope grade away from trees as recommended by arborist.
 - 1. Root Pruning: Prune tree roots exposed during grade lowering. Do not cut main lateral roots or tap roots; cut only smaller roots. Cut roots with sharp pruning instruments; do not break or chop.
- C. Minor Fill: Where existing grade is 6 inches or less below elevation of finish grade shown, fill with topsoil. Place topsoil in a single uncompacted layer and hand grade to required finish elevations.
- D. Moderate Fill: Where existing grade is more than 6 inches but less than 12 inches below finish grade elevation, place a layer of drainage fill, filter fabric, and a final layer of topsoil on existing grade.
 - 1. Carefully place drainage fill against tree trunk approximately 2 inches above finish grade elevation and extend not less than 18 inches from tree trunk on all sides. For balance of area within drip-line perimeter, place drainage fill to an elevation 6 inches below grade.
 - 2. Place filter fabric with overlapping edges of 6 inches minimum.
 - 3. Place fill layer of topsoil to finish grade. Do not compact drainage fill or topsoil. Hand grade to required finish elevations.

3.5 TREE PRUNING

- A. Prune remaining trees affected by temporary and new construction.
- B. Prune remaining trees to compensate for root loss caused by damaging or cutting root system. Provide subsequent maintenance during the Contract period as recommended by arborist.
- C. Pruning Standards: Prune trees according to the National Arborist Association's "Pruning Standards for Shade Trees."
 - 1. Class II: Standard pruning.
 - 2. Class III: Hazard pruning.
 - 3. Class IV: Crown-reduction pruning.
- D. Cut branches with sharp pruning instruments; do not break or chop.
- E. Chip branches removed from trees. Spread material where indicated or as directed by Architect.

3.6 TREE REPAIR AND REPLACEMENT

- A. Promptly repair trees damaged by construction operations to prevent progressive deterioration.
- B. Remove and replace dead and damaged trees that the arborist determines to be incapable of restoring to a normal growth pattern.
 - 1. Provide new trees as per plan. Plant and maintain as specified under Section 02930 – Exterior Plants.

3.7 DISPOSAL OF WASTE MATERIALS

- A. Burning on Owner's Property: Burning is not permitted on Owner's property.

- B. Disposal: Remove excess excavated material, displaced trees, and excess chips from Owner's property unless otherwise instructed by owner.

END OF SECTION

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SECTION 02300

EARTHWORK

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Preparing subgrades for slabs-on-grade, walks, pavements, lawns and grasses, and exterior plants.
 - 2. Drainage course for slabs-on-grade.
 - 3. Base course for concrete walks and pavements.
 - 4. Base course for asphalt paving.
 - 5. Excavating and backfilling for utility trenches.

1.2 QUALITY ASSURANCE

- A. Standard Specifications: Comply with the Standard Specifications for Public Works Construction (SSPWC), latest addition and supplements for rock materials. The Standard Specifications apply only to performance and materials and how they are to be incorporated into the Work. The legal/contractual relationship sections and the measurement and payment sections do not apply to this document.

1.3 REFERENCES

- A. This specification section has been prepared based on the Geotechnical Engineering and Percolation Testing Report for California State University Long Beach Parking Lots 17 & 18 dated February 25, 2011.

1.4 DEFINITIONS

- A. Backfill: Soil material used to fill an excavation.
 - 1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
 - 2. Final Backfill: Backfill placed over initial backfill to fill a trench.
- B. Base Course: Course placed between compacted soil and hot-mix asphalt or concrete paving.
- C. Bedding Course: Course placed over the excavated subgrade in a trench before laying pipe.
- D. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill.
- E. Classified Excavation: Removal and disposal of materials not defined as rock
- F. Drainage Course: Course supporting the slab-on-grade that also minimizes upward capillary flow of pore water.

- G. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.
 - 1. Authorized Additional Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions as directed by University. Authorized additional excavation and replacement material will be paid for according to Contract provisions changes in the Work.
 - 2. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by University. Unauthorized excavation, as well as remedial work directed by University, shall be without additional compensation.
- H. Fill: Soil materials used to raise existing grades.
- I. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.
- J. Subgrade: Surface or elevation remaining after completing excavation, or top surface of a fill or backfill immediately below subbase, drainage fill, or topsoil materials.
- K. Unclassified Excavation: Removal and disposal of materials encountered regardless of nature of materials, including rock.
- L. Utilities: On-site underground pipes, conduits, ducts, and cables, as well as underground services within buildings.

1.5 PROJECT CONDITIONS

- A. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted in writing by University and then only after arranging to provide temporary utility services according to requirements indicated.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

- A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.
- B. Satisfactory Soils: Sand, gravel, friable earth, or non-expansive clays, subject to Testing Laboratory's approval. Fill and backfill material shall be free of organic material, slag, cinders, expansive soils, trash or rubble and stones having maximum dimension greater than 6 inches.
- C. Unsatisfactory Soils: Expansive and other soils containing organic material, slag, cinders, trash or rubble and stones having maximum dimension greater than 6 inches.
 - 1. Unsatisfactory soils also include satisfactory soils not maintained within 2 percent of optimum moisture content at time of compaction.
- D. Base Course: Material conforming to SSPWC section 200-2.2, Crushed Aggregate Base.
- E. Recycled Pulverized Material: Pulverized Materials to be reused as base course for new pavement.

- F. Engineered Fill: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 90 percent passing a 1-1/2-inch sieve and not more than 12 percent passing a No. 200 sieve.
- G. Bedding Course: Naturally or artificially graded clean, crushed sand; ASTM D 2940; except with 100 percent passing a 3/8-inch sieve and not more than 8 percent passing a No. 200 sieve.
- H. Drainage Course: Narrowly graded mixture of washed, crushed stone, or crushed or uncrushed gravel; ASTM D 448; coarse-aggregate grading Size 57; with 100 percent passing a 1-1/2-inch sieve and 0 to 5 percent passing a No. 8 sieve.

2.2 ACCESSORIES

- A. Warning Tape: Acid- and alkali-resistant polyethylene film warning tape manufactured for marking and identifying underground utilities, 6 inches wide and 4 mils thick, continuously inscribed with a description of the utility. Color coding shall be according to the American Public Works Association (APWA) standards:
 - 1. Blue – Potable water and fire suppression lines.
 - 2. Green – Sanitary sewer and storm drain lines
 - 3. Orange – Communication, alarm or signal lines
 - 4. Purple – Reclaimed water, irrigation, and slurry lines
 - 5. Red – Electrical power lines, cables, conduit and lighting lines
 - 6. Yellow – Gas, oil, steam, petroleum, or gaseous material lines.

Refer to requirements in other areas of these specifications for additional items.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.
- B. Preparation of subgrade for earthwork operations including removal of vegetation, topsoil, debris, obstructions, and deleterious materials from ground surface is specified in Division 2 Section "Site Clearing".
- C. Protect and maintain erosion and sedimentation controls, which are specified in Division 2 Section "Site Clearing," during earthwork operations.

3.2 EXCAVATION

- A. Unclassified Excavation: Excavate to subgrade elevations regardless of the character of surface and subsurface conditions encountered. Unclassified excavated materials may include rock, soil materials, and obstructions. No changes in the Contract Sum or the Contract Time will be authorized for rock excavation or removal of obstructions.
 - 1. If excavated materials intended for fill and backfill include unsatisfactory soil materials and rock, replace with satisfactory soil materials.

3.3 EXCAVATION FOR WALKS AND PAVEMENTS

- B. Excavate surfaces under walks and pavements to indicated lines, cross sections, elevations, and subgrades.

3.4 EXCAVATION FOR UTILITY TRENCHES

- A. Excavate trenches to indicated gradients, lines, depths, and elevations.
- B. Excavate trenches to uniform widths to provide 6 inch clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to 12 inches higher than top of pipe or conduit, unless otherwise indicated.
- C. Trench Bottoms: Excavate and shape trench bottoms to provide uniform bearing and support of pipes and conduit. Shape subgrade to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits. Remove projecting stones and sharp objects along trench subgrade.
 - 1. Excavate trenches at least 6 inches deeper than elevation required in rock or other unyielding bearing material, at least 4 inches deeper elsewhere, to allow for bedding course.

3.5 SUBGRADE PREPARATION (PER PROJECT GEOTECH REPORT RECOMMENDATIONS)

- A. Subgrade preparation includes subgrade stabilization. Subgrade stabilization consists of removal of approximately 1 foot of subgrade soils, placement of geogrid (Tensar BX-1200 or equivalent) at the bottom of the relatively undisturbed excavation and then placement of aggregate base material to replace the unstable soils. The aggregate base material should be placed and compacted using static compactive effort in 1-ft thick lifts by "pioneering" from the edge(s) of the work area.
 - 1. The recommended depths of stabilization of 1 foot could be greater depending on the conditions encountered. A test section should be prepared during construction to evaluation the effectiveness of this option.
- B. Proof-roll subgrade below pavements with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.
- C. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by University, without additional compensation.

3.6 UNAUTHORIZED EXCAVATION

- A. Fill unauthorized excavation under foundations or wall footings by extending bottom elevation of concrete foundation or footing to excavation bottom, without altering top elevation. Lean concrete fill, with 28-day compressive strength of 2500 psi, may be used when approved by University.
 - 1. Fill unauthorized excavations under other construction or utility pipe as directed by University.

3.7 STORAGE OF SOIL MATERIALS

- A. Stockpile borrow soil materials and excavated satisfactory soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
 - 1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

3.8 UTILITY TRENCH BACKFILL

- A. Place backfill on subgrades free of mud, frost, snow, or ice.
- B. Place and compact bedding course on trench bottoms and where indicated. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.
- C. Provide 4-inch-thick, concrete-base slab support for piping or conduit less than 30 inches below surface of roadways. After installing and testing, completely encase piping or conduit in a minimum of 4 inches of concrete before backfilling or placing roadway subbase.
- D. Place and compact initial backfill of satisfactory soil, free of particles larger than 1 inch in any dimension, to a height of 12 inches over the utility pipe or conduit.
 - 1. Carefully compact initial backfill under pipe haunches and compact evenly up on both sides and along the full length of utility piping or conduit to avoid damage or displacement of piping or conduit. Coordinate backfilling with utilities testing.
- E. Place and compact final backfill of satisfactory soil to final subgrade elevation.
- F. Install warning tape directly above utilities, minimum 6 inches above top of pipe, minimum 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.

3.9 SOIL FILL

- A. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material.
- B. Place and compact fill material in layers to required elevations as follows:
 - 1. Under grass and planted areas, use satisfactory soil material.
 - 2. Under walks and pavements, use engineered fill.
 - 3. Under steps and ramps, use engineered fill.

3.10 SOIL MOISTURE CONTROL

- A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction to within 2 percent of optimum moisture content.
 - 1. Do not place backfill or fill soil material on surfaces that are muddy, frozen, or contain frost or ice.
 - 2. Remove and replace, or scarify and air dry otherwise satisfactory soil material that exceeds optimum moisture content by 2 percent and is too wet to compact to specified dry unit weight.

3.11 COMPACTION OF SOIL BACKFILLS AND FILLS

- A. Place backfill and fill soil materials in layers not more than 8 inches in loose depth for material compacted by heavy compaction equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers.
- B. Place backfill and fill soil materials evenly on all sides of structures to required elevations, and uniformly along the full length of each structure.
- C. Compact soil materials to not less than the following percentages of maximum dry unit weight according to ASTM D 1557:

- D. Percentages of maximum dry unit weight are examples only; revise to suit Project. Delete scarifying and recompacting existing subgrade when proof-rolling will suffice.
 - 1. Under structures, building slabs, steps, and pavements, scarify and recompact top 12 inches of existing subgrade and each layer of backfill or fill soil material to 90 percent.
 - 2. Under walkways, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill soil material to 90 percent.
 - 3. Under lawn or unpaved areas, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill soil material to 85 percent.
 - 4. For utility trenches, compact each layer of initial and final backfill soil material to 90 percent.

3.12 GRADING

- A. General: Uniformly grade areas to a smooth surface, free of irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.
- B. Site Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to required elevations within the following tolerances:
 - 1. Lawn or Unpaved Areas: Plus or minus 1 inch.
 - 2. Walks: Plus or minus 1 inch .
 - 3. Pavements: Plus or minus 1/2 inch.

3.13 BASE COURSES

- A. Place base course on subgrades free of mud, frost, snow, or ice.
- B. On prepared subgrade, place subbase and base course under pavements and walks as follows:
 - 1. Shape base course to required crown elevations and cross-slope grades.
 - 2. Base course layer should be placed in lifts no thicker than 12 inches to required grades, lines, cross sections, and thickness and compacted to not less than 90 percent of maximum dry unit weight according to ASTM D 1557.

3.14 DRAINAGE COURSE

- C. Place drainage course on subgrades free of mud, frost, snow, or ice.
- D. On prepared subgrade, place and compact drainage course under cast-in-place concrete slabs-on-grade as follows:
 - 1. Place drainage course that exceeds 6 inches in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches thick or less than 3 inches thick.
 - 2. Compact each layer of drainage course to required cross sections and thicknesses to not less than 95 percent of maximum dry unit weight according to ASTM D 698.

3.15 FIELD QUALITY CONTROL

- A. Testing Agency: University will engage a qualified independent geotechnical engineering testing agency to perform field quality-control testing.
- B. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earthwork only after test results for previously completed work comply with requirements.

- C. Testing agency will test compaction of soils in place according to ASTM D 1556, ASTM D 2167, ASTM D 2922, and ASTM D 2937, as applicable.
- D. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil to depth required; recompact and retest until specified compaction is obtained.

3.16 PROTECTION

- A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.
- B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.
- C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.
 - 1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

3.17 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Disposal: Remove surplus satisfactory soil and waste material, including unsatisfactory soil, trash, and debris, and legally dispose of it off University property.

END OF SECTION

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SECTION 02310 - FINISH GRADING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes landscape finish grading complete, as shown, and as specified.
- B. Unit Pricing: Per square foot.

1.3 PROJECT/SITE CONDITIONS

- A. Existing Conditions: For protection of existing trees to remain, see Division 2, Section "Tree Protection and Trimming".
- B. Dust Nuisance: Assume full responsibility for alleviation or prevention of dust as a result of grading work.
- C. Work under this Section shall be performed only during the period when beneficial and optimum Landscape Grading results may be obtained. If the moisture content of the soil should reach such a level that working it would destroy soil structure or cause compaction. Landscape Grading operations shall be suspended until, in the opinion of the Landscape Architect, the moisture content is increased or reduced to acceptable levels and the desired results are likely to be obtained.
- D. Soil moisture level prior to Landscape Grading shall be no less than 75% of field capacity. The determination of adequate soil moisture for Landscape Grading shall be in the sole judgment of the Landscape Architect.

1.4 SEQUENCING AND SCHEDULING:

- A. Complete all finish grading prior to installation of sprinkler irrigation systems in each area graded.
- B. Re-grade, as required, to acceptable Landscape Grades established by Landscape Architect once irrigation system is installed.
- C. Utilities: Determine location of above grade and underground utilities and perform Work in a manner which will avoid damage to utilities. Hand excavate, as required. Maintain grade stakes until removal is mutually agreed upon by parties concerned.
- D. Excavation: When conditions detrimental to adequate Finish Grading operations are encountered, such as rubble fill, adverse drainage conditions, or obstructions, cease operations and notify Landscape Architect for further direction.

- E. Perform Finish Grading operations only when weather and soil conditions are suitable in accordance with locally accepted practices.
- F. Construction Site Observations: Periodic site observations shall be made by the Landscape Architect during the installation of Work under this Section for compliance with requirements. Landscape Architect retains right to observe Work for defects and to reject unsatisfactory or defective work under this Section at any time during progress of Work. The Contractor shall request, in writing, at least one (1) week in advance of the time when mandatory site observation(s) by the Landscape Architect are required.

PART 2 - PRODUCTS Not Applicable

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verification of Conditions: Verify that the following items have been completed prior to commencement of finish grading:
 - 1. Installation of topsoil and soil preparation including debris removal.
 - 2. Incorporation of soil amendments.

3.2 INSTALLATION

- A. Finish Grading:
 - 1. Provide all grades for natural runoff of water without low spots or pockets. Accurately set flow line grades at 2 percent minimum gradient unless otherwise noted in Drawings.
 - 2. Finish grades shall be smooth, even and on a uniform plane with no abrupt changes of surface. Slope uniformly between given spot elevations.
 - 3. Grades not otherwise indicated shall be uniform levels or slopes between points where elevations are given, or between points established by walks, paving, curbs or catch basins.
 - 4. Tops and toes of all slopes shall be rounded to produce a gradual and natural-appearing transition between relatively level areas and slopes.
- B. Tolerances:
 - 1. All planting areas, including lawn areas, shall be true to grade within 1 in. when tested with a 10 ft. straightedge.
 - 2. Hold finished grades below top of adjacent pavement, headers, curbs, or walls as follows:
 - a. Shrub, Annual and Groundcover Areas: 1-1/2 inches.
 - b. Seeded Lawn Areas: 3/4 inch.
 - c. Sodded Lawn Areas: 1 inch.

END OF SECTION

SECTION 02320 - LANDSCAPE EXCAVATING AND BACKFILLING

1.1 GENERAL

- A. Summary: This Section includes landscape excavating and backfilling, complete, as shown and as specified.

1.2 PRODUCTS

- A. Fill:
 - 1. Stockpiled Site Material: As approved by Soils Engineer.
 - 2. Imported: Non-expansive, free from organic matter, and not containing materials over 2 in. in greatest dimension.
- B. Soil Sterilant: Oxycil Ureabor, by Best Products Division, Occidental Chemical Company, Lathrop, CA.
- C. Vapor Barrier: Six [6] mil. polyethylene sheeting per Federal Specifications. UU-P-147B.

1.3 EXECUTION

- A. Excavation: Excavate and remove all materials to dimensions and elevations indicated on Drawings. All material to be excavated shall be non-classified.
- B. Earth Forms: May be used for pouring subgrade walls, upon acceptance by Soils Engineer.
- C. Excavated Material: TBD
- D. Placement of Fills: Supervision by Soils Engineer.
 - 1. Surface Preparation: Scarify subgrade to 6 in. Bench all slopes exceeding 1:4.
 - 2. Spreading: Place fill material in lifts not exceeding 8 in. in uncompacted thickness.
- E. Soil Sterilization: Apply to prepared subgrade, following manufacturer's recommendations.
- F. Vapor Barriers: Install with complete coverage over rock base. Lap all joints. Return barriers up perimeter wall. Seal all tears and breaks and all pipe penetrations. Cover all vapor barriers with 2 in. of clean sand.
- G. Spreading of Topsoil: See Division 02 - Soil Preparation.
- H. Finish Grading: See Division 02 - Finish Grading.
- I. Testing: Perform under the direct supervision and control of the Soils Engineer.
 - 1. Density Standards: ASTM D1557 or AASHTO T180.
 - 2. Unacceptable Installation: Rework and recompact until project density requirements are met.

END OF SECTION

SECTION 02370 - EROSION CONTROL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes slope protection and erosion control, complete as shown and as specified.

1.3 SUBMITTALS

- A. Erosion Control Fabric:
 - 1. Woven Fabric:
 - a. Type: "Soil Saver" jute mesh by Jim Walls Company, Dallas, TX; Tel. [214] 239-8557.
 - b. Description: Single jute yarn, 135 lbs/14,400 yd. spindle, 75 yds. per roll, 1 in. x 1 in. x 48 in., 41 warp ends per width of cloth, 1.22 lbs./linear yard.
 - c. Color: brown
- B. Seam Staples: 1/4 in. hog rings.
- C. Staples on End Overlap: 11 gauge steel wire.

1.4 PROJECT/SITE CONDITIONS

- A. Existing Conditions: For protection of existing trees to remain, see [Division 2, Section "Tree Protection and Trimming"].

PART 2 - PRODUCTS

2.1 EROSION CONTROL FABRIC

- A. Jute Mesh: Uniform open plain weave of single jute yarn averaging 130 lbs. per 14,400 yd. spindle. The yarn shall be of loosely twisted construction and meet the following requirements:
 - 1. Size: 1 in. x 1 in. x 48 in. roll width.
 - 2. Weight of Cloth: 1.22 lbs. per linear yard +5%.
 - 3. Color: Brown
 - 4. Staples: Hog rings or "U"-shaped steel wires.
 - a. Lengthwise Overlaps: 1-1/2 in. hog rings.
 - b. End Overlaps: #11 ga. steel wire formed into a "U" shape, 1 in. wide x 6 in. long.
 - 5. Product: "Soil Guard" by Santa Fe Bag Co., [213] 426-9133, or accepted equal.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verification of Conditions:

1. Finished Grades: Verify that areas to receive erosion control fabric have been graded to within 1 in. plus or minus of the required finished grades.
2. Soil Preparation: Do not commence installation of erosion control fabric prior to acceptance of soil preparation under another section.
3. Irrigation: Do not commence installation of erosion control fabric prior to acceptance of irrigation under another section.

3.2 PREPARATION

- #### A.
- Areas to receive erosion control fabric shall be 2:1 and greater as delineated on the Drawings.
- #### B.
- Rip or cultivate subgrade in planting areas to a depth of 6 in. immediately prior to installing erosion control fabric.

3.3 INSTALLATION

A. Jute Mesh Fabric:

1. Layout: Place fabric neatly, perpendicular to the slope, with straight seams and no unsightly wrinkles after shrinkage. Do not stretch fabric during installation.
2. Top and Bottom Slopes: Bury top edge of fabric in 6 in. trench 1 foot back from lip of slope and staple with 12 in. metal stakes at 12 in. on center maximum. Anchor and staple bottom edge in same manner.
3. End of Roll Overlap: At junction of two rolls, provide 18 in. overlap as per "Top and Bottom of Slopes" above.
4. Edge of Roll Overlap: Provide 4 in. overlap at edges of adjacent rolls and staple with 6 in. #11 gauge wire staples at 3 ft. to 4 ft. on center.
5. Edge at Structure: Install fabric edge at structure per "Top and Bottom of Slopes" above. Fill and tamp trench firmly against edge of structure prior to unrolling fabric.

- #### B.
- Planting: See Division 2, Section 02930 "Exterior Plants".

3.4 FIELD QUALITY CONTROL

- #### A.
- Manufacturer's Field Services: Supervision of the installation of the manufacturer's product.

END OF SECTION

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SECTION 02630
STORM DRAINAGE

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes gravity-flow, nonpressure storm drainage pipe and drainage structures outside the building.

1.2 PERFORMANCE REQUIREMENTS

- B. Gravity-Flow, Nonpressure, Drainage-Piping Pressure Rating: 10-foot head of water.

1.3 SUBMITTALS

- C. Product Data: Before any pipe, fittings or drainage structures are delivered to the job site, submit for approval product data including manufacturer's standard drawings or catalog cuts, manufacturer's Certificates of Conformance for materials, which are specified to conform to publications referenced under "Products" in this section, and shop drawings.
- D. Field quality-control test reports.

PART 2 - PRODUCTS

2.1 BEDDING

- E. Bedding shall be sand in accordance with Section 306-1.2.1 of the SSPWC, unless otherwise indicated on the plans, or unless otherwise approved in advance by the University.

2.2 MANUFACTURERS

- F. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the work include, but are not limited to, manufacturers specified.
 - 2. Submit shop drawings for alternative materials along with manufacturer's material plans with dimensions and specifications for review and approval before delivery.

2.3 POLYVINYL CHLORIDE (PVC)

- G. Pipe and Fittings, Type PSM PVC Pipe, shall conform to ASTM D3034, Type PSM, SDR 35. Pipe and fittings shall have elastomeric gasket joints providing a watertight seal when tested in accordance with ASTM D 3212. Gaskets shall conform to ASTM F 477. Solvent welded joints shall not be permitted.

2.4 GALVANIZED CORRUGATE METAL PIPE (CMP)

- H. Corrugated Steel (CSP) Drainage Pipe and Fittings: AASHTO M 218 or ASTM A 760.
 - 1. Soiltight Couplings: Fittings shall comply with ASTM D 2683 or D 3261.

2.5 NONPRESSURE-TYPE PIPE COUPLINGS

- I. Comply with ASTM C 1173, elastomeric, sleeve-type, reducing or transition coupling, for joining underground nonpressure piping. Include ends of same sizes as piping to be joined and corrosion-resistant-metal tension band and tightening mechanism on each end.
- J. Sleeve Materials:
 - 1. For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
 - 2. For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.

PART 3 - EXECUTION

3.1 GENERAL

- K. It shall be the Contractor's responsibility to verify the actual locations (horizontal and vertical) of all utilities prior to beginning trench excavation. If utilities are to remain in place, provide protection from damage during construction operations.

3.2 PIPING APPLICATIONS

- L. Pipe couplings and fittings with pressure ratings at least equal to piping rating may be used in applications below, unless otherwise indicated.
 - 1. Use nonpressure-type flexible couplings where required to join gravity-flow, nonpressure piping, unless otherwise indicated.
 - a. Shielded flexible couplings for same or minor difference OD pipes.
 - b. Unshielded, increaser/reducer-pattern, flexible couplings for pipes with different OD.
 - c. Ring-type flexible couplings for piping of different sizes where annular space between smaller piping's OD and larger piping's ID permits installation.

3.3 PIPING INSTALLATION

- M. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for using lubricants, cements, and other installation requirements.
- N. Install proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.
- O. Install gravity-flow, nonpressure drainage piping according to the following:
 - 1. Install piping pitched down in direction of flow, at minimum slope of 1 percent, unless otherwise indicated.
- P. Clear interior of piping and manholes of dirt and superfluous material as work progresses.

3.4 PIPE JOINT CONSTRUCTION

- Q. Join gravity-flow, nonpressure drainage piping according to the following:
 - 1. Join dissimilar pipe materials with nonpressure-type flexible couplings.

3.5 CONNECTIONS

- R. Make connections to existing piping and underground manholes.
 - 1. Use commercially manufactured wye fittings for piping branch connections. Remove section of existing pipe; install wye fitting into existing piping; and encase entire wye fitting, plus 6-inch overlap, with not less than 6 inches of concrete with 28-day compressive strength of 3250 psi.

3.6 FIELD QUALITY CONTROL

- S. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects.
 - 1. Do not enclose, cover, or put into service before inspection and approval.
 - 2. Test completed piping systems according to requirements of authorities having jurisdiction.
 - 3. Schedule tests and inspections by authorities having jurisdiction with at least 24 hours' advance notice.
 - 4. Submit separate report for each test.
- T. Leaks and loss in test pressure constitute defects that must be repaired.
- U. Replace leaking piping using new materials, and repeat testing until leakage is within allowances specified.

END OF SECTION

SECTION 02751 - CEMENT CONCRETE PAVEMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.01 SUMMARY

- A. This Section includes materials, labor, apparatus, tools, equipment, temporary construction, transportation, and services necessary for and incidental to performing the proper completion of Work for Cast-in-Place Site Concrete Paving and Integrally Colored Cast-in-Place Site Concrete Paving as shown in the Contract Drawings, and as specified herein this Section.
- B. Work under this Section consists of, but is not necessarily limited to, furnishing and installing the following:
 - 1. Cast-in-Place Concrete Ramps.
 - 2. Concrete Driveways & Roadways
 - 3. Concrete Curbs & Gutters
 - 4. Cast-in-Place Concrete Walkways, Patios, Courtyards, and/or Plazas.
 - 5. Cast-in-Place Concrete Sidewalks.
 - 6. Jointing (Expansion Joints, Contraction Joints, Isolation Joints, Keyway/Construction Joints and/or Architectural Score Joints).
 - 7. Joint Sealants.
 - 8. Steel Reinforcement.
 - 9. Steel Dowels and Sleeves.
 - 10. Compacted Sub-Surface Materials.
 - 11. Concrete Pavement Finishes.
 - 12. Concrete Paving Surface Sealants.
- C. Related Sections: The following Sections contain requirements that relate to Work in this Section:
 - 1. Section 03310 – Site Concrete (misc. footings, headers, foundations, etc.)
 - 2. Section 02764 - Pavement Joint Sealants

1.02 DEFINITIONS AND APPLICABLE STANDARDS

- A. References:
 - 1. ASTM – American Society for Testing and Materials.
 - 2. ANSI – American National Standards Institute.
 - 3. ACI – American Concrete Institute.
 - 4. PCA – Portland Cement Association.
 - 5. CRSI – Concrete Reinforcing Steel Institute.
 - 6. SWRI – Sealant, Waterproofing & Restoration Institute.
 - 7. UBC – Uniform Building Code.
 - 8. NRMCA – National Ready Mix Concrete Association.

9. Standard Specifications – Standard Specifications of the State of California, Business and Transportation Agency, Department of Transportation, CALTRANS, latest edition.
 10. CBC – California Building Code, Title 24 Disabled Access Regulations.
 11. ADAAG – American with Disabilities Act Accessibility Guidelines.
- B. Definitions:
1. Cementitious Materials: Portland Cement alone or in combination with one or more of blended hydraulic cement, expansive hydraulic cement, fly ash and other pozzolans, ground granulated blast-furnace slag, and silica fume.
 2. Percent Compaction: Per ASTM D1557, percentage of the maximum in-place dry density of the same material, as determined by Geotechnical Engineer.
- C. Standards of Construction:
1. ACI 214 – Recommended Practice for Evaluation of Strength Tests Results of Concrete.
 2. ACI 301 – Details and Detailing of Concrete Reinforcement.
 3. ACI 305 – Recommended Practices for Cold Weather Concreting.
 4. ACI 306 – Recommended Practices for Hot Weather Concreting.
 5. ACI 308 – Standard Practice for Curing Concrete.
 6. ACI 347 – Recommended Practice for Concrete Formwork.
 7. ASTM A185 – Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete.
 8. ASTM A615 – Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
 9. ASTM C33 – Specification for Concrete Aggregates.
 10. ASTM C39 – Test Method for Compressive Strength of Cylindrical Concrete Specimens.
 11. ASTM C94 – Specification for Ready-Mix Concrete.
 12. ASTM C136 – Method for Sieve Analysis of Fine and Coarse Aggregate.
 13. ASTM C143 – Test Method for Slump of Portland Concrete Cement.
 14. ASTM C150 – Specification for Portland Cement.
 15. ASTM C260 – Air-Entraining Admixtures for Concrete.
 16. ASTM C309 – Liquid Membrane-Forming Compounds for Curing Concrete.
 17. ASTM C494 – Chemical Admixtures for Concrete.
 18. ASTM C920 – Standard Specification for Elastomeric Joint Sealants.
 19. ASTM D1751 – Standard Specification for Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Non-Extruding and Resilient Bituminous Types).
 20. National Ready Mix Concrete Association, latest revision: *"Certificate of Conformance for Concrete Production Facilities"*.
- D. Measurements.
1. PSI: Measurement, in pounds per square foot.
 2. CU/FT: Measurement, in cubic-foot.

1.03 SUBMITTALS

- A. General: Submit each item in this Article in four (4) bound Submittal Booklets for review by the Landscape Architect.
- B. Submittal Booklets: Each Submittal Booklet under this Section shall be tabbed into specific sections, containing clearly identified (through yellow highlighter or other specific identification methods) and legible information on the following information indicated in this Article.
- C. Product/Material Data. Submit available Product/Material data, manufacturing source (name, address, and telephone number), and distributor source (name, address, and telephone number) for each type of material and product indicated:
 1. Reinforcement and Forming Accessories.

2. Cementitious Materials.
 3. Integral Aggregates (Coarse and Fine).
 4. Chemical Admixtures.
 5. Jointing Materials and Systems, including Joint Sealants.
 6. Curing Compounds.
 7. Finishing Materials (top-seeding materials, color hardeners, surface retarders, etc.)
 8. Paving Surface Sealants.
- D. Statement of Mix Design: Prepared by the batch plant servicing the Project, submit for each type or load delivered to Project. Include revised mix proportions when characteristics of materials, project conditions, weather, test results, or other circumstances warrant adjustments. Each Statement of Mix Design shall include following information:
1. Name, address, and telephone number of batch plant preparing Statement of Mix Design.
 2. Date of Mix Design.
 3. Project location.
 4. Contractor requesting load delivery.
 5. Mix Design Number.
 6. Admixtures (as required).
 7. Integral Color Admixtures (as required).
 8. Gradations for sand and aggregate.
 9. Material weights, specific gravity, and absolute volumes.
 10. Basis of testing, i.e. UBC 2605 D4 and CBC Title 24 2604 D4.
 11. Water/Cementitious Materials Ratio (W/CM Ratio).
 12. Slump.
 13. PSI Rating.
- E. Material Test Reports: Signed and stamped laboratory test reports for evaluation of concrete materials and mix design tests.
- F. Material certificates, in lieu of material laboratory test reports, when permitted by the Landscape Architect. Material certificates shall be signed by the Manufacturer and Contractor certifying that each material item complies with or exceeds requirements. Provide certification from admixture manufacturers that chloride content complies with requirements.
- G. Material Samples: Samples of the material items indicated herein this Section shall be furnished for review and approval. Submit two (2) sets of samples that are consistent with the specified products for each item indicated:
1. One (1) 2-pound sample of each seeded Aggregate.
 2. One-foot (1'-0") section of each Joint Sealant material.
- H. Scaled Shop Drawings for form work, indicating fabrication and erection of forms for specific finished concrete surfaces. Show form construction including jointing, special form joints or reveals, location and pattern of form tie placement, pour sequencing, dimensioned locations of all construction, control and expansion joints, and other items that affect exposed concrete visually.
1. Review with the Landscape Architect for general architectural applications and features only. Designing form work for structural stability and efficiency shall be the Contractor's responsibility.
- I. Qualification Data: Submit names for firms and persons specified in the "Quality Assurance and Control" Article to demonstrate their capabilities and experience on similar Concrete Paving installations. Include lists of completed projects with project names and addresses, names and addresses of Architects/Landscape Architects, Artists and Owners, and other information specified.

- J. Field-Constructed Mock-up Samples:
1. General: Prior to the installation of Work under this Section, Contractor shall erect Field-Constructed Mock-up Samples for each type and pattern of Concrete Paving required for review and approval by the Landscape Architect, to verify selections made under the referee samples obtained by the Landscape Architect.
 2. Build Field-Constructed Mock-up Samples to comply with the following requirements, using materials and same base construction including special features for form work, jointing, surface finishes, textures, color(s), and contiguous Work as indicated for the final unit of Work.
 - a). Locate Field-Constructed Mock-up Samples on the Project Site in location(s) as directed by the Owner.
 - b). Notify the Landscape Architect, in writing, at least one (1) week in advance of the dates and times when Field-Constructed Mock-up Samples will be erected.
 - c). Demonstrate quality and range of aesthetic effects and workmanship in the Field-Constructed Mock-up Samples that will be produced in final unit of Work.
 - d). Obtain the Landscape Architect's acceptance of Field-Constructed Mock-up Samples, in writing, before start of installation of Work.
 - e). Retain and maintain Field-Constructed Mock-up Samples during construction in an undisturbed condition as a standard for judging the completed unit of Work.
 - f). When directed by the Owner, Contractor shall demolish and remove Field-Constructed Mock-up Samples from Project Site.
 3. Size: Each Field-Constructed Mock-up Sample within this Section shall measure a minimum of three-feet (3'-0") wide x three-feet (3'-0") long to compare the aesthetics of material colors, textures, and finishes.
 4. When the Landscape Architect determines that a Field-Constructed Mock-up Sample does not meet acceptable requirements, retain it for reference and cast another Field-Constructed Mock-up Sample (as required) until the Sample is accepted.
 5. Accepted Field-Constructed Mock-up Samples will be the standard by which Work under this Section will be evaluated for technical and aesthetic merit. Accepted Field-Constructed Mock-up Samples are the prerequisite to the commencement of Work.
- K. Minutes of Pre-Installation Conference, distributed and approved in writing as to the content of the conference by concerned parties in attendance.
- L. Submittals under this Article will be rejected and returned without the benefit of review by the Landscape Architect if they are difficult to read due to insufficient scale, poor image quality, or poor drafting quality; or if all of the required information is missing or not presented in the format as requested. Partial Submittals will not be accepted.
- M. No Work under this Section shall proceed until all information indicated herein this Article have been reviewed, accepted, and approved by the Landscape Architect, in writing.

1.04 QUALITY ASSURANCE AND CONTROL

- A. Installer Qualifications: Engage an experienced Installer who has completed in the last two (2) years at least three (3) concrete installations similar in material, design, and extent to that indicated for this Project, and whose work has resulted in construction with a record of successful in-service performance.
- B. Applicable Standards of Work:
1. Applicable specifications and recommended practices of American Concrete Institute (ACI), American Society for Testing and Materials (ASTM), The Uniform Building Code, with their individual designations, are to be considered part of this Specification. Refer to "Standards of Construction" under "Definitions & Applicable Standards" Article herein this Section.

2. *Design and Control of Concrete Mixture*, Thirteenth Edition, Portland Cement Association.
 3. *Manual of Standard Practice*, Concrete Reinforcing Steel Institute (CRSI).
 4. *Sealants: The Professional's Guide*, Sealant, Waterproofing & Restoration Institute (SWRI).
- C. Single-Source Responsibility: Obtain each color, type, and variety of cementitious materials, aggregates (coarse and fine), chemical admixtures, water source, jointing materials, and other materials, from a single source, with resources to provide products and materials of consistent quality in appearance and physical properties without delaying the Work.
- D. Concrete Manufacturer Qualifications: Manufacturer of ready-mixed concrete products complying with ASTM C94 requirements for production facilities and equipment.
1. Manufacturer shall be certified according to the National Ready Mix Concrete Association's Plant Certification Program.
- E. Testing Agency Qualifications: An independent testing agency, acceptable to authorities having jurisdiction, qualified according to ASTM C1077 and ASTM E329 to conduct the testing indicated, as documented according to ASTM E548.
- F. Concrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixes.
- G. Lines and Levels: To be established by a licensed Surveyor or registered Civil Engineer.
- H. Pre-installation Conference: Before installing Work as indicated herein this Section, conduct a Pre-installation Conference at the Project Site with the Landscape Architect to review requirements and design objectives, including a review of concrete textures, colors, finishes, layouts, and other design intents of the Work. Conference shall be held prior to erecting the Field-Constructed Mock-up Samples.
1. Notify participants in writing at least five (5) working days prior to Conference.
- I. Permits, Fees, Bonds, and Inspections: Contractor shall arrange and pay for permits, fees, bonds, and inspections necessary to perform and complete Work under this Section.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in a timely manner to ensure un-interrupted progress of the Work.
- B. Store materials in a dry and protected location. Protect reinforcing steel and dowels from rusting, deformation, staining, and moisture damage.
- C. Store materials by methods that prevent damage and permit ready access for inspection and identification. Package cement delivered to the Project Site shall be in strong paper or jute bags with brand name and manufacturer's name stamped thereon. Store cement under cover. Remove packaged cement immediately from the Project Site should it become wet or show any signs of caking or deterioration.
- D. Keep surface seeded/finishing materials dry prior to installation, as required.

1.06 PROJECT SITE CONDITIONS

- A. Traffic Control: Maintain access for vehicular, bicycle, and pedestrian traffic as required for other construction activities. Access to the surrounding buildings shall also be unobstructed and maintained at all times to allow for entry and exit of emergency vehicles.

- B. Establish and maintain required levels and grade elevations. Review installation procedures and coordinate Work herein this Section with other Work affected.
- C. Do not place concrete during rain or adverse weather conditions without means to prevent damage. Conform to requirements specified hereinafter whenever concrete placement is required during cold or hot weather.
- D. Keep Work area clean, and in a safe and workmanlike condition so that rubbish, waste, and debris does not interfere with Work of other trades.
- E. Water and Dust Control: Maintain control of concrete dust and water during duration of Contract. Do not permit adjacent planting areas to be contaminated. Clean up debris resulting from this work at the end of each day's work.

1.07 COORDINATION, SCHEDULING, AND OBSERVATIONS

- A. Sequence and Scheduling: Notify contractors performing Work related to installation of Work under this Section in ample time so as to allow sufficient time for them to perform their portion of Work and that progress of Work is not delayed. Verify conditions at the Project Site for Work that affects installation under this Section. Coordinate items of other trades to be furnished and set in place, such as:
 - 1. Irrigation Pipe Sleeves under pavements. Refer to Section 328400 – Irrigation Systems.
 - 2. Accessories embedded in the concrete, and for the provision of holes, openings, etc., necessary to the execution of the Work of the trades.
- B. Field Measurements: Contractor shall take field measurements as required. Report major discrepancies between the Contract Drawings and field dimensions to the Landscape Architect prior to commencing Work.
- C. Utilities: Determine location of above grade and underground utilities and perform Work in a manner which will avoid damage to utilities. Hand excavate, as required. Maintain grade stakes until removal is mutually agreed upon by parties concerned.
- D. Excavation: When conditions detrimental to adequate installation operations are encountered, such as rubble fill, adverse drainage conditions, or obstructions, cease operations and notify Landscape Architect for further direction.
- E. Environmental Conditions: Perform installation operations only when weather and soil conditions are suitable in accordance with locally-accepted practices.
- F. Construction Site Observations: Periodic site observations shall be made by the Landscape Architect during the installation of Work under this Section for compliance with requirements for type, size, and quality. Landscape Architect retains right to observe Work for defects and to reject unsatisfactory or defective material at any time during progress of Work. Contractor shall remove rejected materials immediately from Project site. The Contractor shall request, in writing, at least one (1) week in advance of the time when mandatory site observation(s) by the Landscape Architect are required.

1.08 SUBSTITUTIONS

- A. Consideration: Materials to be considered equal to the Materials indicated herein this Section shall be reviewed by the Landscape Architect. Materials with equal performance characteristics produced by other Manufacturer's and/or Distributors may be considered, providing deviations in dimensional size, color, composition, operation, and/or other characteristics do not

change the design concept, aesthetic appearance, nor intended performance, as solely judged by the Landscape Architect. The burden of proof on product equality is on the Contractor.

- B. Specific reference to Manufacturer's names and products specified herein are used as standards of quality. This implies no right to the Contractor to substitute other materials without prior written approval by the Landscape Architect for Work under this Section.
- C. Materials substituted and installed by the Contractor, without prior written approval by the Landscape Architect, may be rejected. Contractor shall not be entitled to be compensated by the Owner where the Contractor has installed rejected substitutions without receiving prior written approval.
- D. Contract Price: Substituted Materials under this Section shall not increase the Contract price.

PART 2 – PRODUCTS

2.01 FORMS

- A. Form Materials: Plywood, wood, MDO plywood, metal, metal-framed plywood, or other approved panel-type materials, of size and strength to resist movement during concrete placement and to retain horizontal and vertical alignment until removal.
 - 1. Provide Forms that are full-depth, continuous, straight and free of distortions and defects, and level or sloping along exposed surfaces.
 - 2. Provide Forms of sufficient strength and durability to hold concrete properly in place and prevent leakage of water from Forms.
 - 3. Use flexible spring forms, laminated boards, or foam forms to form radius bends, as required.
 - 4. No wood-textured finish from Forms will be permitted on exposed concrete unless specified as such.
 - 5. Textured Form Facings: Refer to Contract Drawings or requirements indicated herein this Section, as required.
- B. Form Release Agent: Premium, Volatile Organic Compound (VOC)-compliant (low to no VOC), 100% biodegradable liquid-based (either natural emulsified vegetable oil-based, soy-based, or water-based), colorless, non-staining Form Release Agent. Agent shall not bond with, leave no residual matter on concrete surfaces, nor adversely affect the bond or performance of subsequent treatments to the concrete surfaces.
 - 1. Products & Manufacturers: Subject to compliance with requirements, provide products by one (1) of the following:
 - a). *Atlas Bio-Guard 2000*, Atlas Tech Products.
 - b). *Bio Release Agent*, Burke, Edoco.
 - c). *Enviroform, Conspec*, Dayton Superior Company.
 - d). *Bio-Form*, Leahy-Wolf Company.
 - e). *Crete-Lease 20-VOC*, Cresset Chemical Company.
 - f). *Duogard II*, W.R. Meadows, Inc.
 - g). *FORMSHIELD WB*, Tamms Industries.
 - h). *Greenplus Form Release Agent ES*, Greenland Corporation.
 - i). *Soy Form Release and Natural Form Oil*, Natural Soy, LLC.
 - j). *SOYsolv Concrete Form Release Agent*, SOYsolv.
 - k). or equal, as approved by the Landscape Architect.

2.02 STEEL REINFORCEMENT

- A. Plain-Steel Welded Wire Fabric: Meet ASTM A185, fabricated from as-drawn steel wire into flat sheets. Rolls are not acceptable.
- B. Deformed-Steel Welded Wire Fabric: Meet ASTM A497, flat sheet.
- C. Steel Reinforcement Bars: Meet ASTM A615, Grade 60 deformed, clean and free of rust, dirt, grease or oils.
- D. Steel Bar Mats: Meet ASTM A 184 with ASTM A615, Grade 60 deformed bars; assembled with clips.
- E. Steel Tie Wire: 16-gauge minimum, black annealed, plain cold-drawn steel conforming to ASTM A82, clean, and free of rust, dirt, grease or oils.
- F. Construction/Expansion Joint Dowel Bars & Slip Dowel Sleeves:
 - 1. Epoxy-Coated Steel Joint Dowel Bars: Meet ASTM A775, with ASTM A615, Grade 60, plain steel bars, free of rust, dirt, grease, and oils. Cut Bars true to length with ends square and free of burrs.
 - 2. Slip Dowel Sleeve System: A reusable base and plastic sleeve, manufactured from polypropylene plastic. Encase fifty percent (50%) of each dowel in a plastic sleeve to allow parallel lateral movement of each Dowel. Size of Sleeve to match size of Dowel.
 - a). Products & Manufacturers: Subject to compliance with requirements, provide products by one (1) of the following:
 - 1. *Speed Dowel*, Greenstreak.
 - 2. or equal (no known equal).
- G. Epoxy-Coated Steel Welded Wire Fabric: Meet ASTM A884, Class A, plain steel, fabricated from as-drawn steel wire into flat sheets. Rolls are not acceptable.
- H. Epoxy-Coated Steel Reinforcement Bars: Meet ASTM A775, with ASTM A615, Grade 60, deformed bars.
- I. Epoxy-Coated Steel Wire: Meet ASTM A884, Class A coated, plain steel.
- J. Epoxy Repair Coating: Liquid, two-part epoxy repair coating, compatible with epoxy coating on reinforcement.
- K. Snap Ties: Snap-off metal of fixed length capable of leaving no metal within 1 1/2 in. of surface or causing fractures, spall, or other defects larger than one (1) in. diameter.
- L. Hook Bolts: ASTM A307, Grade A internally and externally threaded. Design hook-bolt joint assembly to hold coupling against pavement form and in position during concreting operations, and to permit removal without damage to concrete or hook bolt.
- M. Supports for Reinforcement: Lightweight, strong, non-corrosive, durable, and impervious to water. Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcement bars, welded wire fabric, and dowels in place, as manufactured from 100% recycled-content plastic or engineered resins from recycled ABS plastic, polycarbonates, and fiberglass.
 - 1. Products & Manufacturers: Subject to compliance with requirements, provide products by one (1) of the following:
 - a). *Rebar Supports*, Eclipse Plastics Inc.
 - b). *Concrete Casting Plastic Rebar Supports*, Build Global, Inc.
 - c). *Reinforcing Bar Supports*, Shin Hwa Industrial Co.
 - d). *Plastic Rebar Supports*, Platicon International, Inc.

- e). *Bar Lift Plastic Support*, New Century Northwest.
- f). *Aztec Composite Plastic Rebar Supports*, Dayton Superior.
- g). or equal, as approved by the Landscape Architect.

2.03 FIBER REINFORCEMENT

- A. Synthetic Fiber: 100% virgin monofilament polypropylene fibers, engineered and designed for secondary reinforcement of concrete pavements, complying with ASTM C 1116-Type III, 1/2 to 1-1/2 inches long.
 - 1. Products & Manufacturers: Subject to compliance with requirements, provide products by one (1) of the following:
 - a). *Fibrasol IIP*, Axim Concrete Technologies.
 - b). *Fiberstrand 100*, Euclid Chemical Co.
 - c). *Fibermix Stealth*, Fibermesh, Division of Synthetic Industries.
 - d). *Forta Mono*, Forta Corporation.
 - e). *MicroFiber™*, W. R. Grace & Co., Construction Products Division.
 - f). *Polystrand 1000*, Metalcrete Industries.
 - g). or equal, as approved by the Landscape Architect.
 - 2. Application Rate: 1/2 lb./CY of Concrete Mix.

2.04 CONCRETE MATERIALS

- A. Portland Cement: Meet ASTM C150. Use one (1) brand of cement (single source) throughout the Project, unless otherwise acceptable to the Landscape Architect. Contractor shall verify the cement color with the Landscape Architect. Cement Type as follows:
 - 1. Portland Cement: ASTM C 150, Type II, low alkali. Supplement with the following: Pozzolan: ASTM C618, Class F or N Fly Ash, 100 pounds maximum per cubic yard, containing one percent or less carbon. Fly ash shall not be used in excess of 15 percent by weight of total cement quantity.
- B. Normal-Weight Aggregates: Meet ASTM C33, Class 1N, and as follows:
 - Fine Aggregates: Meet ASTM C33, clean, hard, non-reactive, and durable sand. Do use sand coated with injurious amounts of silt, loam, clay or other deleterious matter.
 - a). Grading Requirements:

Sieve Size	Percent Passing
3/8"	100%
No. 4	95-100%
No. 8	80-100%
No. 16	50-85%
No. 30	25-60%
No. 50	5-30%
No. 100	0-10%

Coarse Aggregates: Meet ASTM C33, hard, durable, non-reactive, un-coated, graded, cleaned, and screened crushed rock or gravel aggregate for regular weight concrete. Do not use crusher-run stone or bank-run gravel. Aggregate shall be from a single source and shall be like in visual appearance.

- a). Grading: Do not use Coarse Aggregate which has a maximum size exceeding 1/5 of the narrowest dimension between sides of forms of the member for which concrete is to be used, nor larger than 3/4 of the minimum clear spacing between reinforcing bars.
 - 1). Do not use coarse Aggregate for pavements which exceeds 3/4 inch diameter.
 - 2). Do not use coarse aggregates that contain substances that cause spalling.

Local aggregates not complying with ASTM C33 that have been shown to produce concrete of adequate strength and durability by special tests or actual service may be used when acceptable to the Landscape Architect.

- C. Water: Per ASTM C1602, from potable domestic source, free from deleterious materials such as oils, acids, and organic matter.

2.05 CHEMICAL ADMIXTURES FOR CONCRETE

- A. General: Admixtures shall be certified by the Manufacturer to contain not more than 0.1 percent water-soluble chloride ions by mass of cement and to be compatible with other Admixtures. Use of Admixtures shall not relieve the Contractor of the designated concrete requirements, including strength.
- B. Air-Entraining Admixture: Meet ASTM C260.
1. Products & Manufacturers: Subject to compliance with requirements, provide products by one (1) of the following:
 - a). *Daravair 1000*, Grace Construction Products, 800-433-0020.
 - b). *Micro-Air*, Master Builders, Inc., 800-628-9990.
 - c). *Catexol™ A.E. 360*, Axim Italcementi Group, 800-899-8795.
 - d). or equal, as approved by the Landscape Architect.
 2. Application Rate: Per selected Manufacturer's latest printed instructions.
- C. Water-Reducing Admixture: Meet ASTM C494, Type A.
1. Products & Manufacturers: Subject to compliance with requirements, provide products by one (1) of the following:
 - a). *WRDA*, Grace Construction Products, 800-433-0020.
 - b). *Micro-Air*, Master Builders, Inc., 800-628-9990.
 - c). *Eucon NW*, Euclid Chemical Co., 800-321-7628.
 - d). *Catexol™ 3000 GP*, Axim Italcementi Group, 800-899-8795.
 - e). or equal, as approved by the Landscape Architect.
 2. Application Rate: Per selected Manufacturer's latest printed instructions.
- D. Water-Reducing and Set Retarding Admixture: Meet ASTM C494, Type B and D.
1. Products & Manufacturers: Subject to compliance with requirements, provide products by one (1) of the following:
 - a). *Daratard 17 Set Retarder*, Grace Construction Products, 800-433-0020.
 - b). *Pozzolith Retarder*, Master Builders, Inc., 800-628-9990.
 - c). or equal, as approved by the Landscape Architect.
 2. Application Rate: Per selected Manufacturer's latest printed instructions.
- E. Shrinkage-Reducing Admixture: Meet ASTM C157. Provide at dosage of 2% by weight of cement.
1. Products & Manufacturers: Subject to compliance with requirements, provide products by one (1) of the following:
 - a). *Eclipse*, Grace Construction Products, 800-433-0020.
 - b). *Tetraguard*, Master Builders, Inc., 800-628-9990.
 - c). or equal, as approved by the Landscape Architect.
 2. Application Rate: Per selected Manufacturer's latest printed instructions.
- F. Dampproofing Admixture: Hydrophobic, Meeting ASTM C836-81, fluid-V single component, bitumen-modified, moisture-curing polyurethane, added at time of batching.
1. Products & Manufacturers: Subject to compliance with requirements, provide products by one (1) of the following:

- a). *Darapel*, Grace Construction Products, 800-433-0020.
 - b). *Rheomix 235*, Master Builders, Inc., 800-628-9990.
 - c). *Tremproof 60*, Tremco, 800-321-7906.
 - d). or equal, as approved by the Landscape Architect.
2. Application Rate: Per selected Manufacturer's latest printed instructions.
- G. Integral Concrete Coloring Admixture: Provide materials specifically designed for use in ready-mix concrete, from a single source, and shall be like in color and visual appearance. Meet ASTM C979.
- 1. Products & Manufacturers: Subject to compliance with requirements, provide products by one (1) of the following:
 - a). Refer to Section 'Site Concrete' for requirements.
 - b). or equal, as approved by the Landscape Architect.
 - 2. Application Rate: Per selected Manufacturer's latest printed instructions.

2.06 CURING MATERIALS

- A. Absorptive Cover: Burlap cloth, made from jute or kenaf, weighing approximately 9 oz. per sq. yd., complying with AASHTO M182, Class 2.
- B. Surface Set-Retarder: Spray-applied, ready-to-use, water-based solution with color dye, non-staining, non-corrosive, non-flammable, non-toxic, specifically formulated to retard the set of fresh concrete surfaces, temporarily delaying final hardening of concrete to a depth of 1/8 to 1/4 inch (to expose the surface aggregates). Material shall meet the maximum Volatile Organic Compound (VOC) content of 350 g/L for concrete curing compounds as required by the U.S. EPA Architectural Coatings Rule and shall be VOC-compliant for the State of California Regulation 8, Organic Compounds, Rule 3, Architectural Coatings.
- 1. Products & Manufacturers: Subject to compliance with requirements, provide products by one (1) of the following:
 - a). *Top-Cast™*, Grace Construction Products, Inc.
 - b). or equal, as approved by the Landscape Architect.
 - 2. Application Rate: Per selected Manufacturer's latest printed instructions.
- C. Spray applied, film forming protective coating, for surfaces adjacent to Set-Retarded finish surfaces.
- 1. Products & Manufacturers: Subject to compliance with requirements, provide products by one (1) of the following:
 - a). *Face Off*, Grace Construction Products, Inc.
 - b). or equal, as approved by the Landscape Architect.

2.07 RELATED MATERIALS

- A. Bonding Agent: ASTM C1059, Type II, non-redispersible, acrylic emulsion or styrene butadiene.
- B. Epoxy Bonding Adhesive: ASTM C881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class and grade to suit requirements, and as follows:
- 1. Type II, non-load bearing, for bonding freshly mixed concrete to hardened concrete.
 - 2. Types I and II, non-load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.
 - 3. Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.
- C. Expansion Joint Materials:
- 1. Expansion Joint-Filler Strips:

- a). Asphalt-Saturated Cellulosic Fiber, meeting ASTM D1751, with "guide strip" removable depth gauge cap. Expansion Joint-Filler Strip shall be versatile, resilient, flexible and non-extruding. When compressed to half of its original thickness, it shall recover to a minimum of 70% of its original thickness.
 - 1). Products & Manufacturers: Subject to compliance with requirements, provide products by one (1) of the following:
 - a). *Sealtight Fibre with Snap Cap*, WR Meadows.
 - b). *Fiber Board*, APS Supply.
 - c). or equal, as approved by the Landscape Architect.
 - 2). Thickness/Width: As indicated on the Contract Drawings.
2. Joint Sealant Backing:
 - a). General: Provide Joint Sealant Backings which are non-staining; are compatible with joint substrates, sealants, primers and other joint fillers; and are approved by sealant manufacturer.
 - b). Plastic Foam Joint-Fillers: Preformed, compressible, resilient, non-waxing, non-extruding strips of closed cell plastic foam, of size, shape and density to control sealant depth.
 - c). Bond Breaker: Pressure-sensitive tape, as recommended by Joint Sealant manufacturer, to suit application.
3. Miscellaneous Joint Sealant Materials:
 - a). Primer: As recommended by joint sealant Manufacturer for adhesion of sealant to joint substrates.
 - b). Cleaners for Nonporous Surfaces: Non-staining, chemical cleaner of type acceptable to manufacturer of sealant and sealant backing materials which are not harmful to substrates and adjacent nonporous materials.
 - c). Masking Tape: Non-staining, non-absorbent type compatible with joint sealants and to surfaces adjacent to joints.
4. Joint Sealant:
 - a). Horizontal Applications: Meet ASTM C920, Type S, Grade P, Class 25, Use T, Low-VOC, cold-applied, elastomeric polyurethane Joint Sealant for exterior applications. Color to match adjacent paving color finish.
 - 1). Products & Manufacturers: Subject to compliance with requirements, provide products by one (1) of the following:
 - a). Sika Corporation.
 - b). Tremco, Inc.
 - c). Sonneborn.
 - d). Pecora Corporation.
 - e). or equal, as approved by the Landscape Architect.

2.08 CONCRETE MIXES AND PROPORTIONING

- A. Proportion and mix of cement, aggregate, admixture and water to attain required plasticity and strength for each type of normal-weight concrete in accordance with current edition of ACI's *"Manual of Concrete Practice"* and the PCA's *"Design and Control of Concrete Mixtures."*
 1. Use transit mixer trucks equipped with automatic devices for recording number of revolution of drum.
- B. Use a qualified independent testing agency for preparing and reporting proposed mix designs for the trial batch method, using approved materials to obtain specified minimum compressive strength.
 1. Do not use the Owner's field quality-control testing agency as the independent testing agency.
- C. Slump: Adjust quantity of water so concrete at point and time of discharge does not exceed the aforementioned slumps when tested per ASTM C143. Use the minimum water necessary for workability required by part of item being cast.

- D. Proportion Concrete Mixes to provide Concrete with the following properties:
1. Vehicular Use Areas:
 - a). Compressive Strength (at 28 Days): Minimum 4,000 PSI.
 - b). Maximum Slump Limit: Four-inches (4") at point of discharge, with a 1/2-inch slump differential between successive batches. Obtain approval from the Landscape Architect if slump is outside these parameters.
 - c). Maximum Water/Cementitious Materials Ratio: .50.
 - d). Cement Content: Minimum seven (7)- sack mix (658 lbs. cement per cubic yard).
 2. Pedestrian Use Areas:
 - a). Compressive Strength (at 28 Days): Minimum 2,500 PSI.
 - b). Maximum Slump Limit: Four inches (4") at point of discharge, with a 1/2-inch slump differential between successive batches. Obtain approval from the Landscape Architect if slump is outside these parameters.
 - c). Maximum Water/Cementitious Materials Ratio: .50.
 - d). Cement Content: Minimum six (6)- sack mix (564 lbs. cement per cubic yard).
- E. Cementitious Materials: Limit percentage, by weight, of cementitious materials (other than Portland Cement) in concrete as follows:
1. Fly Ash: Provide twenty-percent (20%) maximum content.
- F. Add Air-Entraining Admixture at the Manufacturer's prescribed rate to result in concrete at point of placement having an air content of 2.5 to 4.5 percent.
- G. Coloring Agent: Add coloring agent to mix according to Manufacturer's written instructions.
- H. Non-Chloride Accelerators: Do not use corrosive accelerators such as calcium chloride.
- I. Concrete Delivery: Use of concrete loads exceeding ninety (90) minutes from time of batch plant must be approved by the Landscape Architect.
- J. Ensure that the batch plant guarantees a single-source supply for cementitious materials and aggregates (coarse and fine) for the entire project.

2.10 CONCRETE MIXING

- A. Ready-Mixed Concrete: Comply with requirements and with ASTM C94.
- B. When air temperature is between 85 deg. F. (30 deg. C.) and 90 deg. F. (32 deg. C.), reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg. F. (32 deg. C.), reduce mixing and delivery time to 60 minutes.

2.11 CONCRETE SEALANTS

- A. Penetrating Concrete Sealer:
1. Applications: Cast-in-Place Concrete
 2. General: Penetrating Concrete Sealer shall be an invisible, water-based penetrating Sealer, used to protect exterior cast-in-place concrete pavement installations. Sealer shall be a clear, non-flammable, UV-stabilized, non-yellowing solution which cures to reduce staining, soiling, discoloration, efflorescence, and acts as a dense, insoluble, invisible water-repellant coating, formulated to impart water repellence and dirt reduction to concrete surfaces with no change in the surface appearance. Sealer shall react with carbon dioxide, and atmospheric moisture to form a penetrating water, dirt and mildew repellent barrier within 24 hours. Moisture absorption rate shall be low to reduce visible sur-

face changes for up to ten (10) years. As recommended for ACI 302 Class 1 through 4 concrete floors.

3. Products & Manufacturers: Subject to compliance with requirements, provide products by one (1) of the following:
 - a). *Sinak Sealer S-101*, Sinak Corporation.
 - b). *Natural Look Penetrating Sealer*, Glaze 'N Seal.
 - c). *Cementone*, L.M. Scofield Company.
 - d). *Sure Klean Weather Seal SL100*, Prosoco Inc.
 - e). *Sealhard*, L&M Construction Chemicals.
 - f). or equal, as approved by the Landscape Architect.
- B. Multi-Purpose Water-Based (Film-forming) Sealer
Applications: Cast-in-Place Concrete with an exposed aggregate finish
General: Multi-Purpose Water-Based (Film-forming) Sealer shall be a clear, acrylic, non-flammable, non-yellowing, UV-stabilized, water-based Sealer, designed to protect and beautify exterior concrete finishes.. Applied by spray or brush in light, even coats, Sealer shall penetrate the surface to give a semi-gloss finish. Sealer shall protect concrete surfaces against organic stains, including oil, grease, and beverages.
Products & Manufacturers: Subject to compliance with requirements, provide products by one (1) of the following:
 - a). *Cureseal (Semi-Gloss)*, L.M. Scofield Company.
 - b). *Multi-Purpose Water-Based Sealer*, Glaze 'N Seal.
 - c). *Atlas Outshine Sealer*, Atlas Tech Products.
 - d). *Safe Cure & Seal™ 30%*, Dayton Superior Chemical & Cement Products.
 - e). or equal, as approved by the Landscape Architect.

PART 3 – EXECUTION

3.01 EXAMINATION

- A. Proof-roll prepared sub-base surface for foundations to check for unstable areas and verify need for additional compaction. Verify that sub-grade preparation for concrete paving has been completed including base course prior to commencement of Work.
- B. Surface Drainage:
 1. Report in writing conflicts discovered on the site or prior Work done by others, which would prevent positive drainage.
 2. Do not permit finished paving surfaces to vary more than 1/4 in. measured with a 10 ft. metal straightedge, except at grade changes. No "birdbaths" or other surface irregularities shall be permitted. Properly correct irregularities.

3.02 PREPARATION

- A. Templates: Use templates for anchor plates, bolts, inserts and/or other items embedded in concrete. Accurately secure so that they will not be displaced during placing of concrete.
- B. Piping and Conduit: Do not embed piping, other than electrical conduit, in structural concrete. Locate conduit to maintain strength of structures at maximum. Verify size, length and location of electrical conduit.
- C. Aggregate Base Course: Compact base course to thicknesses as shown on Contract Drawings or as indicated per the Geotechnical Report, to the relative compaction density as required per the Geotechnical Report. Aggregate Base Course shall be graded to the lines and levels indicated; no ruts or depressions shall be allowed.

- D. Gravel Fill or Sand Beds: Re-compact disturbed gravel fill or sand beds and bring to correct elevation.

3.03 FORMWORK

- A. Design, construct, erect, shore, brace, and maintain Formwork according to ACI 347 *"Guide to Formwork for Concrete."*
- B. Formwork shall be consistent with the orientation and pattern indicated on the Contract Drawings. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides to required lines, grades, and elevations. Install Formwork to allow continuous progress of Work and so that Formwork can remain in place at least twenty-four (24)-hours after concrete placement.
- C. Coordinate locations of drainage piping requirements, irrigation piping stub-outs, electrical conduits, or other items scheduled to be embedded into cast concrete.
- D. Check completed Formwork and screeds for grade and alignment to following tolerances:
 - 1. Top of Forms: Not more than 1/8 inch in ten- (10) feet.
 - 2. Vertical Face on Longitudinal Axis: Not more than 1/4 inch in ten-(10) feet.
- E. Coat Formwork with Form Release Agent, as required, to ensure Formwork separates from cast concrete without damage to concrete.
 - 1. Formwork surfaces shall be clean, dry, and free from contaminants (dirt, dust, rust, build-up, and existing form agents) prior to each use of Formwork
 - 2. Prior to each use, Formwork that comes into direct contact with concrete shall be coated with Form Release Agent in accordance with the Manufacturer's written instructions.
 - 3. Apply Form Release Agent in a uniform and even manner by low pressure spray, roller, or clean cloth, in accordance with the Manufacturer's written instructions.
 - 4. Prior to coating new Formwork, apply one (1) or two (2) heavy coats to edges for waterproofing protection.
 - 5. Excess Form Release Agent or dense form surfaces should be removed with a clean cloth.
 - 6. Do not apply Form Release Agent to reinforcing steel.
- F. Screeds:
 - 1. Set screeds at maximum 8'-0": centers between. Set to provide at grades per Contract Drawings. Check with an instrument level, transit, or laser during placing operations to maintain desired grades.

3.04 STEEL REINFORCEMENT

- A. General: Comply with CRSI's *"Manual of Standard Practice"* for fabricating reinforcement and with recommendations in CRSI's *"Placing Reinforcing Bars"* for placing and supporting reinforcement.
- B. Clean Reinforcement of loose rust and mill scale, earth, or other bond-reducing materials.
- C. Arrange, space, and securely Tie Bars and Bar Supports to firmly hold and support the Steel Reinforcement in position during concrete placement and to prevent displacement before or during casting. Maintain a minimum of two inches (2") cover to the Reinforcement.
- D. Install Steel Reinforcement Bars in sizes as indicated on the Contract Drawings, in lengths as long as practicable. Lap adjoining Bars at a minimum of fifty (50) bar diameters. Lace splic-

es accordingly with Tie Wire. Offset laps of adjoining widths to prevent continuous laps in either direction. Erect and maintain Reinforcement Bars on chairs, secured firmly in position, in the middle of the concrete during casting operations. Do not extend Reinforcement Bars through expansion joints.

- E. Install Welded Wire Fabric (where required) in sizes as indicated on the Contract Drawings, in continuous lengths as long as practicable. Lap adjoining pieces at least one-one half (1-1/2) courses of the full fabric mesh, and a minimum of six-inches (6"). Lace splices with Tie Wire. Offset laps of adjoining widths to prevent continuous laps in either direction. Erect and maintain Fabric on chairs, secured firmly in position, in the middle of the concrete during casting operations. Do not extend Welded Wire Fabric through expansion joints.
- F. Install Construction Joint Dowel Bars & Sleeves per the Manufacturer's recommendation. Reinforcing dowels, or sleeves for the reinforcing dowels, shall be secured in place prior to placing concrete. Align dowels in straight, even alignments in the middle of the concrete profile during casting operations. Dowels and sleeves shall not be pressed into the concrete during casting and after the concrete has been placed.
- G. Install fabricated Steel Bar Mats in lengths as long as practicable. Handle units to keep them flat and free of distortions. Straighten bends, kinks, and other irregularities, or replace units as required before placement. Set mats for a minimum two-inch (2") overlap to adjacent mats.
- H. Apply epoxy repair coating to uncoated or damaged surfaces of epoxy-coated reinforcement, as required.
- I. Vapor Barrier: If provided, do not cut or puncture Vapor Barrier. Repair damage and reseal Vapor Barrier before placing concrete.

3.05 CONCRETE PLACEMENT

- A. Preparation: Remove all free water from forms before concrete is deposited. Remove hardened concrete, debris, and foreign materials from interior surfaces of forms, exposed reinforcing, and from surfaces of mixing and conveying equipment.
- B. Sub-Base: Sub-Base shall be free of ruts, holes, ridges, etc. Smooth and compact sub-base to an even plane.
- C. Wetting: Wet wood forms sufficiently to tighten up cracks. Wet other materials sufficiently to reduce absorption and to help maintain concrete workability. Dampen earth sub-grade twenty-four (24) hours before placing concrete, but do not muddy. Re-roll where necessary for smoothness, and remove loose material from compacted sub-base surface prior to placing concrete.
- D. Inspection: Before placing concrete, inspect and complete formwork installation, reinforcement steel, dowels/sleeves, and items to be embedded or cast in. Notify other trades to permit installation of their Work.
 - 1. Reinforcement and Forms shall be secured firmly in position such that they will not be displaced during the placement of concrete.
 - 2. Reinforcement Bars, Ties, and Welded Wire Fabric shall be completely encased in concrete, at a maximum of two-inches (2") from the edge of the concrete.
 - 3. Do not place concrete around manholes or other structures until they are at the required finish elevation and alignment.

- E. Comply with requirements and with recommendations in ACI 304R for measuring, mixing, transporting, and placing concrete.
- F. Deposit and spread concrete in a continuous operation between transverse joints. Do not push or drag concrete into place or use vibrators to move concrete into place.
- G. Welded Wire Fabric, where specified, shall be secured firmly in position on chairs in the middle of the concrete paving during casting operations. Should Fabric come loose from the chairs, pull Fabric into position as the concrete is placed by means of hooks. Concrete shall be worked under the steel to insure that it is at the proper distance in the middle of the slab.
- H. Consolidate concrete by mechanical vibrating equipment supplemented by hand-spading, rodding, or tamping. Use equipment and procedures to consolidate concrete according to recommendations in ACI 309R.
 - 1. Consolidate concrete along face of forms and adjacent to transverse joints with an internal vibrator. Keep vibrator away from joint assemblies, reinforcement, or side forms. Use only square-faced shovels for hand-spreading and consolidation. Consolidate with care to prevent dislocating reinforcement, dowels, and joint devices.
- I. Screed pavement surfaces with a straightedge and strike off. Commence initial floating using bull floats or darbies to form an open textured and uniform surface plane before excess moisture or bleed water appears on the surface. Do not further disturb concrete surfaces before beginning finishing operations or spreading dry-shake surface treatments
- J. When adjoining pavement lanes are placed in separate pours, do not operate equipment on concrete until pavement has attained eighty-five-percent (85%) of its fully hydrated compressive strength.
- K. Cold-Weather Placement: Comply with ACI 306.1, and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
 - 1. When air temperature has fallen to or is expected to fall below 40 deg. F. (4.4 deg. C.), uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg. F. (10 deg. C.) and not more than 80 deg. F. (27 deg. C.) at point of placement.
 - 2. Do not use calcium chloride, salt, or other materials containing anti-freeze agents or chemical accelerators, unless otherwise specified and approved in mix designs.
- L. Hot-Weather Placement: Place concrete according to recommendations in ACI 305R and as follows when hot-weather conditions exist:
 - 1. Cool ingredients before mixing to maintain concrete temperature at time of placement below 90 deg. F. (32 deg. C.). Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
 - 2. Cover reinforcement steel with water-soaked burlap so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.
 - 3. Fog-spray forms, reinforcement steel, and sub-grade just before placing concrete. Keep sub-grade moisture uniform without standing water, soft spots, or dry areas.

3.06 JOINTS

- A. General: Refer to ACI 302 *"Guide for Concrete Floor and Slab Construction"* for work under this Article. Construct construction, isolation, expansion, and contraction joints and tool edgings true to line with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline, unless otherwise indicated.

1. When joining existing paving, place transverse joints to align with previously placed joints, unless otherwise indicated.
- B. Construction Joints: Set construction joints at side and end terminations of paving and at locations where paving operations are stopped for more than one-half (1/2) hour, unless paving terminates at isolation joints.
 1. Continue reinforcement across construction joints, unless otherwise indicated. Do not continue reinforcement through sides of pavement strips, unless otherwise indicated on the Contract Drawings.
 2. Provide tie bars at sides of paving strips where indicated.
 3. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
- C. Expansion Joints: Form expansion joints of preformed joint-filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, walks, buildings, foundations, walls, other fixed objects, and in other locations as indicated on the Contract Drawings. Provide Expansion Joints at full depth of concrete paving where paving meets the vertical faces of buildings, structures, foundations, walls, etc.
 1. Locate expansion joints at maximum intervals of twenty (15) feet, unless otherwise indicated on the Contract Drawings.
 2. Extend joint fillers full width and depth of joint.
 3. Provide Construction Joint Dowel Bars at the spacing distances indicated in the Contract Drawings.
 4. Terminate Joint Filler less than 1/2 inch or more than one-inch (1") below finished surface if joint sealant is indicated.
 5. Place top of Joint Filler flush with finished concrete surface if joint sealant is not indicated.
 6. Furnish joint fillers in one (1)-piece lengths. Where more than one (1) length is required, lace or clip joint-filler sections together.
 7. Protect top edge of joint filler during concrete placement with metal, plastic, or other temporary preformed cap. Remove protective cap after concrete has been placed on both sides of joint.
- D. Contraction Joints and Isolation Joints: Form weakened-plane contraction joints and isolation joints, sectioning concrete into areas as indicated on the Construction Drawings, or at spacing intervals as recommended by the PCA.
 1. General Methodology: Contraction Joints shall be placed in Concrete Paving to minimize the occurrence of random cracking on the surface due to drying shrinkage or stress loading and to reduce the width of concrete cracks should they occur. When not indicated on the Contract Drawings, Contraction Joints shall be placed at 24x the thickness of the concrete paving.
 2. Saw-Cut Contraction Joints:
 - a). Construct Saw-Cut Contraction Joints with a circular power saw, equipped with a new, shatterproof abrasive or diamond-tipped blade. Cut 3/16-inch-wide joints (maximum width of saw-blade) into concrete surface. Cutting action shall not tear, abrade, spall, shatter, or otherwise damage the surface.
 - b). Saw-cut concrete surface when successful jointing results can be achieved and prior to uncontrolled random contraction cracking of concrete occurs.
 - 1). Early-entry Sawcuts: When used, provide sawcuts into fresh concrete at 1" to 1-1/4" depth, or as indicated on the Contract Drawings.
 - c). Perform saw-cut joints cleanly and smoothly, to a constant and equal depth, in a continuous consistent line, with no over-cutting.
 - d). Depth:
 - 1). Contraction Joints: Construct depth equal to a minimum of one-fourth (1/4) of the concrete slab thickness.
 - 2). Isolation Joints: Construct depth equal to the full depth of the concrete thickness.

- e). Perform in as continuous an operation as possible, to avoid misalignment of joints. Use chalk lines, forms, or templates as required, to achieve consistent lines)
 - f). Use a hand grinder with a 4-inch diamond blade to saw-cut up to vertical edges such as walls, steps, curbs and columns. Do not over-cut into vertical surfaces or adjacent concrete surfaces.
- E. Edging: Tool edges of pavements, gutters, headers, curbs, joints in concrete, and other locations, as required, after initial floating, with an edging tool to the following radius. Repeat tooling of edges after applying surface finishes. Eliminate tool marks on concrete surfaces.
- 1. Radius: 1/8 inch (aka "Carpet Edger").

3.07 CONCRETE FINISHES

A. General:

- 1. Finished pavement surfaces indicated herein this Section shall be "slip-resistant", per the requirements outlined in CBC, Section 1124B.1, and per ADAAG 4.5.1.
 - a). The minimum coefficient of friction shall meet or exceed 0.8 on exterior and 0.6 on interior surfaces.
 - b). Pavement surfaces shall have the following finish on all surfaces less than six percent (6%) slope:
 - 1). Medium Broom Textured Finish, or a textured finish as specified which is equivalent to the finished texture of a Medium Broom Textured Finish.
 - c). Pavement surfaces shall have the following finish on all surfaces greater than six percent (6%) slope:
 - 1). Heavy Broom Textured Finish, or a textured finish as specified which is equivalent to the finished texture of a Heavy Broom Textured Finish.
 - d). Color(s) and finish(es) specified herein shall match referee samples and field-constructed mock-up samples as approved by the Landscape Architect.
 - e). WETTING OF CONCRETE SURFACES DURING SCREEDING, INITIAL FLOATING, OR FINISHING OPERATIONS IS STRICTLY PROHIBITED.

B. Acid-Etch Textured Finish: Match Referee Sample, as acquired by the Landscape Architect, and the approved Field Constructed Mock-up, to compare for color, texture, finish, and other characteristics relating to aesthetic effects.

- 1. Applications: Refer to the Cast-in-Place Concrete Paving Schedule indicated herein this Section for requirements. Provide in areas as indicated on Contract Drawings.
- 2. Float-finish the concrete surface to provide a uniform, consistent texture.
- 3. Provide contraction jointing and edging, as required, in the locations indicated in the Contract Drawings, and of the type(s) indicated herein this Section. Early-entry jointing of concrete may be required to prevent premature cracking of finished surfaces. Do not use curing compounds.
- 4. Approximately one (1) to two (2) days after the concrete has been cast, evenly spray-apply a muriatic acid wash (a diluted solution of approximately a 10:1 ratio of water to acid) or a top-cast solution to the concrete surface. Prevailing weather conditions will affect timing and strength of the acid-wash solution, and in cold and rainy conditions, more time may be needed for the concrete to start the hydration process before the acid-wash solution can be applied.
- 5. Handle acid and acid wash solution with care to avoid spillage and staining. Protect areas adjacent to the Work from over-spray of the acid solution. Provide neutralizing solution(s) to the acid solution, as needed, to prevent chemicals from damaging or contaminating adjoining planting areas.
- 6. After acid has adequately etched the concrete surface, gently flush the surface with fresh water to remove the acid solution. DO NOT USE A HIGH PRESSURE WASHER TO APPLY WATER OR TO REMOVE THE ACID SOLUTION FROM THE SURFACE.

7. After concrete is fully hydrated (approx. 30-days), seal acid etched concrete finished surface with two (2) coats of Sealer as specified herein this Section, per the Manufacturer's latest printed instructions.
- C. Top Cast/Retarded Sand Textured Finish: Match Referee Sample, as acquired by the Landscape Architect, and the approved Field Constructed Mock-up, to compare for color, texture, finish, and other characteristics relating to aesthetic effects.
1. Applications: Refer to the Cast-in-Place Concrete Paving Schedule indicated herein this Section for requirements. Provide in areas as indicated on Contract Drawings.
 2. Once concrete has been floated, bleed-water sheen has disappeared, and the concrete surface has stiffened sufficiently, evenly spray-apply the Top Cast Chemical Surface Retarder to the concrete surface. Apply the Top Cast Chemical Surface Retarder according to the Manufacturer's written instructions for applying the chemical. Do not use curing compounds.
 3. Handle the chemical Top Cast Chemical Surface Retarder with care to avoid spillage and staining. Protect areas adjacent to the Work from over-spray of the chemical. Provide neutralizing solution(s) to the chemical solution, as needed, to prevent chemicals from damaging or contaminating adjoining planting areas.
 4. Immediately after applying the Top Cast Chemical Surface Retarder, damp-cure the sprayed concrete surface accordingly to the manufacturer's written instructions.
 5. After the Top Cast Chemical Surface Retarder has adequately etched into the surface and the concrete has hardened sufficiently (generally overnight, or when the concrete has hardened adequately to support the weight of a person), check a small area to determine if the proper retarded depth has been achieved. If the depth appears too shallow wait a few hours to check again.
 6. With a hose, lightly spray the top surface of the concrete surface with water. Remove the Top Cast Chemical Surface Retarder matrix through a process of gently brushing surface with a stiff, nylon bristle broom and flushing with water to remove the surface paste, exposing the fine aggregates integral to the concrete mix. Repeat the water flushing and brushing cycle, as needed, until the retarded matrix has been removed and the surface texture is acceptable. DO NOT USE A HIGH PRESSURE WASHER TO APPLY WATER OR TO REMOVE THE CHEMICAL SOLUTION FROM THE SURFACE.
 7. After concrete is sufficiently hydrated, provide jointing in the locations indicated in the Contract Drawings. Early-entry jointing of concrete may be required to prevent premature cracking of finished surfaces.
 8. After concrete is fully hydrated (approx. 30-days), seal the Top Cast Chemical Surface Retarded (Sand) texture finished concrete surface with two (2) coats of Sealer as specified herein this Section, per the Manufacturer's latest printed instructions.
- D. Seeded Exposed-Aggregate Textured Finish: Match Referee Sample, as acquired by the Landscape Architect, and the approved Field Constructed Mock-up, to compare for color, texture, finish, and other characteristics relating to aesthetic effects.
1. Applications: Provide in areas as indicated on Contract Drawings.
 2. Immediately after floating concrete surface, uniformly broadcast a single layer of aggregates onto the pavement surface. Tamp seeded aggregates into plastic concrete, and gently float to entirely embed aggregates, with mortar cover of 1/16 inch.
 3. Spray-apply a chemical Surface Retarder to the surface of the pavement once the surface water has disappeared from the freshly floated concrete surface (usually in approximately 30 minutes, depending on weather conditions). Apply the Surface Retarder according to Manufacturer's written instructions for applying the Retarder. Protect areas adjacent to the Work from over-spray of the retarder.
 4. Immediately after applying the Surface Retarder, damp-cure the sprayed concrete surface with moisture-retaining cover, adequately securing around the edges of the pavement to prevent "ballooning" of the sheeting. The sheeting should be in direct contact with the top surface of the freshly poured concrete.

5. After the Surface Retarder has adequately etched into the surface and the concrete has hardened sufficiently (generally overnight, or when the concrete has hardened adequately to support the weight of a person), remove the moisture-retaining cover in sections, checking a small area to determine if the proper depth has been achieved. If the depth appears too deep, wait a few hours to check again.
6. With a hose, lightly spray the top surface of the concrete with water. Remove the retarded matrix through a process of gently brushing surface with a stiff, nylon bristle broom and flushing with water to expose the seeded surface aggregates. Repeat the water flushing and brushing cycle, as needed, until the retarded matrix has been removed and the surface texture is acceptable, being careful not to dislodge the seeded surface aggregates. **DO NOT USE A HIGH PRESSURE WASHER TO APPLY WATER OR TO REMOVE THE ACID SOLUTION FROM THE SURFACE.**
7. After concrete is sufficiently hydrated, provide jointing in the locations indicated in the Contract Drawings. Early-entry jointing of concrete may be required to prevent premature cracking of finished surfaces.
8. After concrete is fully hydrated (approx. 30-days), seal seeded exposed aggregate finished concrete surface with two (2) coats of Sealer as specified herein this Section, per the Manufacturer's latest printed instructions.

3.08 CONCRETE PROTECTION AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and follow recommendations in ACI 305R for hot-weather protection during curing.
- B. Evaporation Retarder: Apply Evaporation Retarder to concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.
- C. Begin curing after finishing concrete, but not before free water has disappeared from concrete surface.
- D. Curing Methods: Cure concrete by moisture curing, moisture-retaining-cover curing, curing compound, or a combination of these, as follows:
 1. Moisture Curing: Keep surfaces continuously moist for not less than seven (7) days with the following materials:
 - a). Water.
 - b). Continuous water-fog spray.
 - c). Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.
 2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with Moisture-Retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least twelve inches (12") and sealed by waterproof tape or adhesive. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
 3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to Manufacturer's written instructions. Re-coat areas subjected to heavy rainfall within three (3) hours after initial application. Maintain continuity of coating and repair damage during curing period.

3.11 PAVEMENT TOLERANCES

- A. Comply with tolerances of ACI 117, and as follows:
 1. Elevation: 1/4 inch.
 2. Thickness: Plus 3/8 inch, minus 1/4 inch.

3. Surface: Gap below 10-foot-long, unleveled straightedge not to exceed 1/4 inch. Variation from the Level or from the Grades shown, per Civil Engineer Drawings:
 - a). In pavements:
 - 1). In any ten-feet (10'): 1/4 inch.
 - 2). In twenty-feet (20'): maximum 3/8 inch.
 - 3). In forty-feet (40') or more: 3/4 inch.
 - b). Variation in Radii:
 - 1). In radii of less than ten-feet (10'):
 - a). In any five-feet (5'): 1/8 inch.
 - b). In any ten-feet (10'): 1/4 inch.
 - 2). In radii of twenty feet (20'):
 - a). In any ten-feet (10'): 1/4 inch.
 - b). In any twenty-feet (20'): 3/8 inch.
 - 3). In radii of thirty-feet (30'), or more:
 - a). In any twenty-feet (20'): 1/2 inch.
 - b). In any thirty-feet (30'): 1 inch.
4. Lateral Alignment and Spacing of Tie Bars and Dowels: 1 inch.
5. Vertical Alignment of Tie Bars and Dowels: 1/4 inch.
6. Alignment of Tie-Bar End Relative to Line Perpendicular to Pavingt Edge: 1/2 inch.
7. Alignment of Dowel-Bar End Relative to Line Perpendicular to Paving Edge: Length of dowel 1/4 inch per 12 inches.
8. Joint Spacing: Three inches (3").
9. Contraction Joint Depth: Plus 1/4 inch, no minus.
10. Joint Width: Plus 1/8 inch, no minus.

3.12 FIELD QUALITY CONTROL

A. Testing Agency:

1. Engage a qualified independent testing and inspection agency to sample materials, perform tests, and submit test reports during concrete placement according to requirements specified in this Section.

B. Testing Services: Testing shall be performed according to the following requirements:

1. Sampling Fresh Concrete: Representative samples of fresh concrete shall be obtained according to ASTM C172, except modified for slump to comply with ASTM C94.
2. Slump: Per ASTM C143; one (1) test at point of placement for each compressive-strength test, but not less than one (1) test for each day's pour of each type of concrete. Additional tests will be required when concrete consistency changes.
3. Air Content: Per ASTM C231, pressure method; one (1) test for each compressive-strength test, but not less than one (1) test for each day's pour of each type of air-entrained concrete.
4. Concrete Temperature: Per ASTM C1064; one (1) test hourly when air temperature is 40 deg F. and below and when 80 deg. F. and above, and one (1) test for each set of compressive-strength specimens.
5. Compression Test Specimens: Per ASTM C31; one (1) set of four (4) standard cylinders for each compressive-strength test, unless otherwise indicated. Cylinders shall be molded and stored for laboratory-cured test specimens unless field-cured test specimens are required.
6. Compressive-Strength Tests: Per ASTM C39; one (1) set for each day's pour of each concrete class exceeding five (5) cu. yd. but less than 25 cu. yd., plus one (1) set for each additional 50 cu. Yd. One (1) specimen shall be tested at seven (7) days and two (2) specimens at twenty-eight (28) days; one (1) specimen shall be retained in reserve for later testing, if required.

7. When frequency of testing will provide fewer than five (5) compressive-strength tests for a given class of concrete, testing shall be conducted from at least five (5) randomly selected batches or from each batch if fewer than five (5) are used.
 8. When total quantity of a given class of concrete is less than 50 cu. yd., the Landscape Architect may waive compressive-strength testing if adequate evidence of satisfactory strength is provided.
 9. When strength of field-cured cylinders is less than eighty-five-percent (85%) of companion laboratory-cured cylinders, current operations shall be evaluated and corrective procedures shall be provided for protecting and curing in-place concrete.
 10. Strength level of concrete will be considered satisfactory if averages of sets of three (3) consecutive compressive-strength test results equal or exceed specified compressive strength and no individual compressive-strength test result falls below specified compressive strength by more than 500 PSI.
- C. Test results shall be reported in writing to the Owner, concrete manufacturer, and Contractor within 24-hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing agency, concrete type and class, location of concrete batch in pavement, design compressive strength at 28-days, concrete mix proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
- D. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by the Owner, but will not be used as the sole basis for approval or rejection.
- E. Additional Tests: Testing Agency shall make additional tests of the concrete when test results indicate slump, air entrainment, concrete strengths, or other requirements have not been met, as directed by the Owner. Testing Agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C42, or by other methods, as directed.

3.13 REPAIRS AND PROTECTION

- A. Remove in its entirety (from joint to joint) and replace concrete pavement that is broken, cracked, damaged, or defective, or concrete which does not meet requirements of this Section.
- B. Drill test cores where directed by the Landscape Architect, when necessary, to determine magnitude of cracks or defective areas. Fill drilled core holes in satisfactory pavement areas with Portland cement concrete bonded to pavement with epoxy adhesive.
- C. Protect concrete from damage. Exclude traffic from pavement for at least fourteen (14) days after placement. When construction traffic is permitted, maintain pavement as clean as possible by removing surface stains and spillage of materials as they occur.
- D. Maintain concrete pavement free of stains, discoloration, dirt, and other foreign material. Sweep concrete pavement not more than two (2) days before date scheduled for Substantial Completion inspections.

3.14 CAST-IN-PLACE CONCRETE PAVING SCHEDULE

			See drawings					

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SECTION 02810

LANDSCAPE IRRIGATION

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes irrigation system complete as shown and as specified.

1.3 QUALITY ASSURANCE:

- A. Permits and Fees: Obtain and pay for all permits required.
- B. Manufacturer's Specifications: Follow Manufacturer's current printed specifications and drawings in all cases where the manufacturers of articles used in the Contract furnish directions covering points not specified or shown in the Drawings.
- C. Ordinances and Regulations: All local, municipal and state laws, codes, and regulations governing or relating to all portions of this work are hereby incorporated into and made a part of these Specifications. Anything contained in these Specifications shall not be construed to conflict with any of the above codes, regulations, or requirements of the same. However, when these Specifications and Drawings call for or describe materials, workmanship, or construction of a better quality, higher standard, or larger size than is required by the above codes and regulations, the provisions of these Specifications and Drawings shall take precedence.
- D. Explanation of Drawings:
 - 1. Due to the scale of the Drawings, it is not possible to indicate all offsets, fittings, sleeves, etc., which may be required. Carefully investigate the conditions affecting all of the work and plan accordingly, and furnish all required fittings. Install system in such a manner to avoid conflicts with planting, utilities, and architectural features.
 - 2. Do not install the irrigation system as shown on the Drawings when it is obvious in the field that obstructions, grade differences or discrepancies in are dimensions exist that might not have been considered in engineering. Bring such obstructions or differences to the attention of the Landscape Architect. In the event this notification is not given, the Contractor shall assume full responsibility for any revision necessary.

1.4 SUBMITTALS

- A. Materials List:
 - 1. Within ten (10) days after the award of the Contract, submit three (3) copies of the complete lists of materials proposed for installation, and obtain the Landscape Architect's written approval thereof before proceeding. Use only accepted materials and items of equipment.

2. List all materials by manufacturer's name and model number.

B. Manuals:

1. Prior to the final acceptance of the irrigation system, furnish three (3) individually bound Service Manuals to the Landscape Architect for use by the Owner. The manuals shall contain complete enlarged drawings, diagrams and spare parts lists of all equipment installed showing manufacturer's name and address. In addition, each Service Manual shall contain the following:
 - a. Index sheet indicating the Contractor's name, address and phone number.
 - b. Copies of equipment warranties and certificates.
 - c. List of equipment with names, addresses and telephone numbers of all local manufacturer's representatives.
 - d. Complete operating and maintenance instructions in sufficient detail to permit operating personnel to understand, operate and maintain all equipment.

C. Record Drawings:

1. Dimension from two (2) permanent points of reference, building corners, sidewalk, or road intersections, etc., the location of the following items:
 - a. Connection to existing water lines.
 - b. Connection to electrical power.
 - c. Gate valves.
 - d. Routing of sprinkler pressure lines.
 - e. Remote control valves.
 - f. Routing of control valves.
 - g. Quick coupling valves.
 - h. Other related equipment as directed by Landscape Architect.
 - i. All sleeve locations.
2. Deliver a reproducible Record Drawing to the Landscape Architect within seven (7) working days before the date of Final Inspection. Delivery of the record drawings shall not relieve the Contractor of the responsibility of furnishing required information in the future.

D. Controller Plan:

1. Permanently install one 'bubble diagram' controller plan in each controller housing. The plan shall show the area controlled by each valve and any major permanent structure, such as buildings and roads.
2. These charts to be waterproof and install as accepted by the Landscape Architect at the coverage test of the irrigation system.

E. Maintenance Material - Supply the following tools to the Owner;

1. Three (3) sets of specialized tools required for removing, disassembling and adjusting each type of sprinkler, valve or other equipment supplied on this project.
2. Two (2) quick-coupler keys and matching hose swivels for each type of quick coupling valve installed.
3. Two (2) five foot valve keys for operation of gate valves.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Furnish and deliver materials in manufacturer's packaging, bearing and original legible labeling.
- B. Handle and store all equipment in accordance with manufacturer's current printed specifications.

1.6 PROJECT/SITE CONDITIONS

- A. Protection of Existing Plants to Remain: See Division 2, Section "Tree Protection and Trimming"
- B. Existing Irrigation System:
 - 1. Verify operating pressure prior to connecting to existing irrigation system. Adjust layout as necessary where it abuts the existing system.
 - 2. Repair damages caused by Contractor to existing systems at no additional cost to Owner.
 - 3. Remove all heads in repaired circuits so that lines can be cleared of all dirt and foreign matter after each repair.

1.7 SEQUENCING AND SCHEDULING

- A. Acceptance: Do not install main line trenching prior to acceptance by Landscape Architect of rough grades completed under another Section.
- B. Coordination: Coordinate with the work of other sections to insure the following sequence of events.
 - 1. Sleeves and Conduits: Installation of all sleeves and conduits to be located under paving (and through walls) prior to placement of those materials.
 - 2. Bubbler Heads in Tree Planter Pockets: Install after placement of tree, but prior to backfill with planter soil mix.
 - 3. On-Structure Equipment: Install piping and risers after waterproofing is accepted.
 - 4. Sprinkler Heads in Pots: Install riser, and seal the penetration of the pot prior to backfill of pot with drainage materials and planter soil mix.

1.8 WARRANTY

- A. Provide a Warranty for the irrigation system in accordance with the attached warranty form, and file with the Owner or his representative prior to acceptance of the irrigation system.
- B. Include a copy of the warranty form in the Operations and Maintenance Manual.
- C. Retype the warranty form onto the Contractor's letterhead and contain the following information:

1.9 MAINTENANCE

- A. Routine: Inspect and adjust all spray valves and control valves including raising or lowering of spray valve heights to accommodate plant growth, to achieve uniform irrigation at all times. Verify correct operating pressure.
- B. Controller: Inspect regularly for power interruption and reset clock as required. Adjust station timing to accommodate changes in plant growth.
- C. Drip Irrigation: All of above, plus keep strainer clean. Flush lines as required. Inspect emitters for proper flow, and check moisture level at plant rootball weekly for the first month of operation, and monthly thereafter.

- D. System Failure: Perform all repairs within one (1) operating period. Replacements to match removed products and materials in all respects. Report promptly all damage not resulting from Contractor's operations. Repair all damage caused by Contractor at no expense to Owner.
- E. Climate Change: Do not run the irrigation system during the rainy season. Set and program automatic controllers in response to seasonal requirements and requirements of newly - planted materials.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Use only new materials of brands and types noted on Drawings or substitutes accepted by Landscape Architect.
- B. Water Meters: Provided and installed by others according to the codes of the utility. Costs will be paid by the Owner and are not part of this Contract.

2.2 PIPE

- A. Pressure Main Line Pipe and Fittings: All PVC fittings shall bear the manufacturer's trademark name, material designation, size, applicable I.P.S. schedule and NSF seal of approval.
 - 1. PVC pressure rated pipe: ASTM D2241 NSF approved Type I, Grade I, PVC. All pipe must meet Federal Specifications pS-22-70, with an appropriate standard dimension ratio (S.D.R.)
 - 2. PVC scheduled pipe: ASTM D1785 NSF approved Type I, Grade I, PVC. All pipe must meet Federal Specifications PS-21-70.
 - 3. PVC solvent-weld fittings: ASTM D2466 Schedule 40, 1-2, II-I NSF approved.
 - 4. Solvent cement and primer for PVC solvent-weld pipe and fittings: Type and installation methods prescribed by the manufacturer.
 - 5. Connections between main lines and RCVs: Schedule 80 PVC (threaded both ends) nipples and fittings.
 - 6. Galvanized pipe: ASTM A-53 and A120-84, ANSI B1.20.1 and B36.10 Seamless standard weight steel.
 - 7. Copper pipe: ASTM B 42-84 or as specified by local plumbing code, Type L or K copper water pipe.
- B. PVC Non-Pressure Lateral Line Piping and Sleeving:
 - 1. PVC pressure rated pipe: ASTM D2241 NSF approved Type I Grade I, PVC and Federal Specification PS-22-70, with an appropriate standard dimension ratio (S.D.R.).
 - 2. PVC scheduled pipe: ASTM D1785 NSF approved Type I Grade I, PVC and Federal Specification PS-21-70.
 - 3. PVC solvent - weld fittings: ASTM D2466 Schedule 40, 1-2, II-I NSF approved.
 - 4. Flexible PVC: ASTM D-2287 Algae-resistant flexible PVC.
 - 5. Polyethylene: ASTM D2237-83, 80 PSI.
 - 6. Copper: ASTM B-42-84 Type L or K.

2.3 CONTROL WIRES

- A. Type: Copper with UL approval for direct burial, size 14-1. Common ground wire with white insulating jacket; individual control wires with insulating jacket of color other than white.
- B. Splices: 'DBY' by 3M.

2.4 BOXES FOR REMOTE CONTROL VALVES

- A. Type: 14 inch by 19 inch rectangular plastic valve box - Ametek, Brooks, Christy or accepted equal.
- B. Color: Purple.

2.5 ISOLATION VALVES:

- A. Gate valves 2-1/2 inches and larger: 125 point WSP, iron body, bronze mounted, non rising stem, solid wedge disc, operating nut.
- B. Box: 14 inch by 19 inch rectangular plastic, Ametek, Brooks, Christy or accepted equal.
- C. Color: Purple.

2.6 MISCELLANEOUS INSTALLATION MATERIALS:

- A. Solvent cement and primers for solvent weld joints: Christy Red Hot Blue glue and Purple primer. Maintain proper consistency throughout use.
- B. Pipe joint compound: Permatex 51-D. Do not use on sprinkler inlet port.
- C. Coatings for below grade steel pipe and fittings: Koppers Bitumastic #300-M coal tar epoxy and wrapped with 50-mil polyethylene tape to 6" above finish grade.

2.7 MISCELLANEOUS EQUIPMENT/ACCESSORIES

- A. Sleeves and Conduits: See Drawings.
- B. Key(s) for Quick-Coupling Valves:
 - 1. Type: Same manufacturer as Quick-Coupling valve.
 - 2. Quantity: One (1) key per 5 quick-coupling valves.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Sleeves and Conduits: Verify that all installed sleeving and conduits are undisturbed and are free of defects or errors introduced by the work of other sections.

- B. Water Meter/Water Pressure: Test and verify that installation of irrigation water meter by others has generated level of water pressure specified on Drawings.
- C. Stub-outs: Verify that all stub-outs to be provided under another contract are correctly sized, located and installed as noted on Drawings.
- D. Existing Irrigation Systems: Verify that existing irrigation is as represented on Drawings and is properly functioning.
- E. Notification: Submit written notification to Landscape Architect within ten (10) working days of above inspections describing all acceptable and non-acceptable site conditions.

3.2 INSTALLATION

- A. Conduits and Sleeves:
 - 1. Coordination:
 - a. Sleeving will be existing only when installed under another subcontract. Inspect as specified above.
 - b. For all other installations, provide conduit and sleeve materials and coordinate installation with other trades.
 - 2. Extent: Install conduits and sleeves where control wires and pipes pass under paving or through walls. Extend 12 in. beyond edges of paving and walls and cap ends until ready for use.
- B. Excavating and Trenching:
 - 1. Existing Installations: Restore to their original conditions, damaged surfaces and underground installations as a result of the excavations at no cost to Owner.
 - 2. Trenches: Dig trenches wide enough to allow a minimum of 6 in. between parallel pipe lines. Provide a minimum cover from finish grade as follows:
 - a. (18 in.) (24 in.) (30 in.) Deep: Over pipe on pressure side of irrigation control valve, control wires and quick-coupling valves.
 - b. (12 in.) (18 in.) Deep: Over pipe on non-pressure side of irrigation control valve.
 - c. (6 in.) (12 in.) Deep: Over poly pipe on non-pressure side of irrigation control valve.
 - d. On-Structure: Protect fabric with 2 in. layer of planting soil mix.
 - e. Direct Burial PVC Piping Under Pavement: Provide a minimum of 4 in. of sand backfill on all sides and 24 in. cover to bottom of paving.
 - f. 24 in. Deep: Control Wire (and Flow Sensor Cable).
 - g. Sawcutting: Saw cut existing AC paving a minimum 12 in. wide. Compact backfill to 95 percent dry density and legally dispose waste off site. Patch to match existing AC pavement.
- C. Pipe Line Assembly:
 - 1. General:
 - a. Install pipes and fittings in accordance with manufacturer's current printed Specifications.
 - b. Clean all pipes and fittings of dirt, scales and moisture before assembly.
 - 2. Solvent-Welded Joints for PVC Pipes:
 - a. Solvents: Use specified solvent glue and primer.
 - b. Curing Period: Minimum of 1 hour before applying any external stress on the piping and at least 24 hours before placing the joint under water pressure.
 - 3. Threaded Joints for Plastic Pipes:
 - a. Tape: Use Teflon tape on threaded PVC fittings.

- b. Joining: Use strap-type friction wrench only. Do not use metal-jawed wrench.
 - 4. Threaded Joints for Galvanized Steel Pipes:
 - a. General: Use only factory-made nipples.
 - b. Joining Compound: Use pipe joint compound applied to male threads only.
 - 5. Joints for Polyethylene Pipes: Rainbird XFD series insert fittings.
 - 6. Laying of Pipe:
 - a. Bedding On-grade: Remove from trench all rocks or clods. Bed pipes in at least 2 in. of soil excavated from trench. Backfill on all sides of piping to provide a uniform bearing.
 - b. Snaking: Snake pipe from side to side of trench bottom to allow for expansion and contraction. Minimum allowance for snaking is one (1) additional ft. per 100 ft. of pipe.
 - c. Moisture Restrictions: Do not lay PVC pipe when there is water in the trench. Do not assemble PVC pipe unless the pipe is perfectly dry.
- D. Control Valves:
 - 1. Install in valve boxes where shown on Drawings and group together where practical. Install box flush with finish grade, not necessarily level.
 - 2. Where two or more valves are installed adjacent to each other, provide at least twelve (12) in. separation. Align boxes in a row.
 - 3. Permanently mark valve box lid with valve number and controller letter.
- E. Valve Boxes: All valve box lids shall be heat stenciled with valve number or identification of equipment inside: Gate valve, quick coupler, etc.
- F. Sprinkler Heads:
 - 1. Bubblers:
 - a. Coordination: Coordinate installation with planting contractor to insure timely and proper placement of heads at new planting.
- G. Automatic Controller:
 - 1. Connection to Valves: Connect remote control valves to controller in clockwise sequence to correspond with station setting beginning with Stations 1, 2, 3, etc.
 - 2. Irrigation Diagram: Affix a non-fading copy of irrigation diagram to cabinet door below controller name. Irrigation diagram to be sealed between two plastic sheets, 20 mil. minimum thickness. Use a reduced copy of the Record Drawing, for the irrigation diagram clearly showing all valves operated by the controller, station number, valve size, and type of planting irrigated.
- H. Control Wiring:
 - 1. General: Install control wires in common trenches with sprinkler mains and laterals wherever possible. Lay to the bottom side of pipe line. Provide looped slack at valves. Snake wires in trench to allow for contraction of wires. Tie wires in bundles at 10 ft. intervals.
 - 2. Extra Length: Provide 30 in. extra control wire at each remote control valve splice to facilitate the removal of the remote control bonnet to finish grade without cutting wires.
 - 3. Spare: Install two unconnected spare control wires running from the controller through each intermediate control valve box.
 - 4. Size: Minimum size of wire is to be determined strictly by the manufacturer's current printed specifications for remote control valves, but not smaller than # 14.
 - 5. Detection Wire: Install a bare copper wire #12 or greater on top of the PVC supply line for the purpose of possible future mine detection search as the control wires are being installed on the bottom of the PVC supply line with electrical tape every ten (10) feet.

6. Splicing: Crimp control wire splices at remote control valves. Seal with specified splicing materials. In-line splices will be allowed only on runs exceeding 2500 ft.
- I. Mastic and Tape: Install mastic and tape on all below grade metallic piping. Install per manufacturer's current printed specifications extending mastic and tape to 6 inches above finish grade.
- J. Closing of Pipe and Flushing of Lines:
 1. Capping: Cap or plug all openings as soon as lines have been installed to prevent entrance of materials that would obstruct the pipe. Leave in place until removal is necessary for completion of installation.
 2. Flushing: Thoroughly flush out all water lines before installing heads, valves and other hydrants.

3.3 FIELD QUALITY CONTROL

- A. Adjustment of the System:
 1. Flush and adjust all sprinkler heads for optimum performance and to prevent overspray onto walks, roadways, and buildings.
 2. Set all sprinkler heads set perpendicular to finished grades unless otherwise noted on the Drawings.
- B. Testing of Irrigation System:
 1. In the presence of the Landscape Architect test all pressure lines under hydrostatic pressure of 125 pounds per square inch, and prove watertight.
 2. Sustain pressure in lines for not less than two (2) hours. If leaks develop, repair and repeat test until entire system passes.
 3. When the landscape sprinkler system is completed, perform a coverage test in the presence of the Landscape Architect, to determine if the water coverage for planting areas is adequate.
 4. Test controllers individually in the presence of the Owner's Representative and the Landscape Architect. Demonstrate that all control valves operate electrically. Provide vehicles and radio equipment as necessary to expedite this process.
 5. Demonstrate to Landscape Architect that irrigation scheduling programmed into controller is adequate for plant requirements without causing runoff, and that scheduling capacities of controller are utilized.

3.4 BACKFILL AND COMPACTING

- A. All glued fittings shall be inspected by Campus Grounds Department prior to backfill of trenches.
- B. General: After system is operating and required tests and reviews have been made, backfill excavations and trenches with clean soil, free of debris.
- C. Backfill for All Trenches: Regardless of the type of pipe covered, compact to minimum 95 percent density under pavements, and 85 percent under planted areas.
- D. Backfill at Existing Underground Pipes: Use only backfill material which has been screened to eliminate all materials larger than 3/8 in. when backfilling adjacent to existing underground pipe lines.

- E. Compacting: Compact trenches in areas to be planted by thoroughly flooding the backfill. Jetting process may be used in those areas.
- F. Finishing: Dress off all areas to finish grades.

3.5 MAINTENANCE

- A. The entire sprinkler irrigation system shall be under full automatic operation for a period of two (2) days prior to any planting.
- B. The Landscape Architect reserves the right to waive or shorten the operation period.

3.6 CLEAN-UP

- A. Clean-up as each portion of work progresses. Remove refuse and excess dirt from the site. Paving shall be broomed or washed down. Repair damages incurred on the work of others and restore to original conditions.

3.7 REVIEWS PRIOR TO ACCEPTANCE:

- A. Notify the Landscape Architect in advance for the following reviews, according to the time indicated:
 - 1. Pre-construction conference - 7 days.
 - 2. Supply line pressure test and control wire installation - 72 hours.
 - 3. Coverage and controller test - 72 hours.
 - 4. Final review - 7 days.
- B. No reviews will commence without record drawings. In the event the Contractor calls for a review without record drawings, without completing previously noted corrections, or without preparing the system for review, he shall be responsible for reimbursing the Landscape Architect at the rate of two and one-half times the normal office hourly rate per hour portal to portal (plus transportation costs) for the inconvenience. No further reviews will be scheduled until this charge has been paid.

3.8 FINAL REVIEW

- A. Operate each system in its entirety for the Landscape Architect at time of final review. Any items deemed not acceptable by the Landscape Architect shall be reworked to the complete satisfaction of the Landscape Architect.
- B. Provide evidence to the Landscape Architect that the Owner has received all accessories and equipment as required before final review can occur.

END OF SECTION

WARRANTY FOR IRRIGATION SYSTEM

We hereby warrant that the irrigation system we have furnished and installed is free from defects in materials and workmanship, and the work has been completed in accordance with the Drawings and Specifications, ordinary wear and tear and unusual abuse, or neglect expected. We agree to repair or replace all defects in material or workmanship which may develop during the period of one (1) year from date of acceptance and also to repair or replace any damage resulting from the repairing of such defects at no additional cost to the Owner. We shall make such repairs or replacements within a reasonable time, as determined by the Owner, after receipt of written notice. In the event of our failure to make such repairs or replacements within a reasonable time after receipt of written notice from the Owner, we authorize the Owner to proceed to have said repairs or replacements made at our expense and we will pay the costs and charges therefore upon demand.

PROJECT:

LOCATION:

CONTRACTOR:

Company

License #

ADDRESS:

PHONE: ()

DATE OF FINAL ACCEPTANCE:

Name

Signed

Date

END OF SECTION

SECTION 02870 - SITE AND STREET FURNISHINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes site and street furnishings, and install complete, including footings, fittings and materials, as shown, and as specified.
- B. Allowances:
- C. Unit Pricing:

<u>Item</u>	<u>Unit Pricing</u>
Precast Unit	Each
Prefabricated Item	Each
Shop Fabricated Item	(Each) (Lineal Feet)
Sand for Ash Urns	Cubic Yard

1.3 REFERENCES

- A. "Standard Specifications" - Standard Specifications of the State of California, Business and Transportation Agency, Department of Transportation, CALTRANS.
- B. ACI - American Concrete Institute Manual of Concrete Practice
- C. ASTM - American Society for Testing and Materials

1.4 SUBMITTALS

- A. Product Data: Manufacturer's current printed specifications and catalogue cuts of the following:
 - 1. Benches.
 - 2. Bicycle Racks
- B. Shop Drawings:
 - 1. All precast benches and bicycle racks.
 - 2. Show plans, elevations, with dimensions, details of inserts, (joints), and reinforcements (and connections to all adjoining work).
- C. Samples: Color and finish for each type of furnishing.
 - 1. Submit manufacturer's samples of materials, finishes, and colors.
- D. Design Data and Test Reports:

1. Benches
 2. Bicycle rack
- E. Contract Closeout Submittals:
1. Operation and Maintenance Data:
 - a. Bicycle rack.

1.5 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Show not less than five (5) years successful and continuous experience in work of the type(s) shown on the Drawings.
- B. Field Samples and Mock-ups: See - Section 01340.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Packaging and Labeling: Furnish materials in manufacturer's unopened, original packaging, bearing original labels showing quantity, description and name of manufacturer. Verify that all materials and components are adequately padded and securely bound in such a manner that no damage occurs to the product during delivery and unloading at the site.
- B. Storage: Damaged materials will be rejected. Remove damaged materials from the job site immediately, and pay cost of replacement. Determination of damage shall be the sole authority of the Owner.
- C. Handling: Lift materials using lifting inserts provided by manufacturer.
- D. Painted Finishes: Provide non-scratching, non-staining, firmly-bound covering for all shop-painted finishes until installed and accepted.
- E. Wood and Precast Concrete: Protect from all stains.

1.7 SEQUENCING AND SCHEDULING

- A. Acceptance: Do not install site and street furnishings prior to acceptance by Landscape Architect of area to receive such materials.
- B. Coordination: Coordinate with the work of other sections to insure the following sequence of construction.
 1. Benches, Bicycle Racks: Set anchors or sleeves in place and pour footings prior to installation of adjacent paving.
 2. Shop Fabricated Items: Install all sleeves, anchors, bolts and fittings in appropriate formwork prior to installation of adjacent paving or walls.

PART 2 - PRODUCTS

2.1 MANUFACTURED UNITS

- A. Seating / Benches: Model: Plexus II Landscape Forms, Inc., 431 Lawndale Avenue, Kalamazoo, Michigan 49048. Toll Free (800) 521-2546. Phone (269) 381-0396. Fax (269) 381-3455. Website www.landseapeforms.com. E-mail: specify@landscapeforms.com
 - 1. Seats: Straight Seat without Back
 - 2. Component Arrangement: Number of seats = 4
 - 3. Color: 'Storm Cloud'
 - 4. Support Tube: 4 seat support
 - 5. Mounting: Embedded
 - 6. Material: Constructed of a steel wire grid panel welded to a tubular steel frame. Grid panel is constructed of 5/16" diameter and reinforcing wires spaced 2-1/2" apart and 1/8" diameter cross wires spaced 1/2" apart. Frame is constructed of 7/8" outer diameter x 0.120" wall steel tube.
 - 7. Supports:
 - a. Horizontal Supports: Constructed of 3" outer diameter x 0.120" wall steel tube.
 - b. Vertical Supports: Constructed of 2-1/2" outer diameter x 0.120" wall steel tube.
 - 8. Finish: As per manufacturer
- B. Bicycle Rack: 2-bike Inverted U Model # Welle Series Flat Top WSWF02-IG-P , by Palmer Group, LLC, (415) 333-6428.
 - 1. Material: Round Steel Pipe
 - 2. Finish: Powder coated
 - 3. Mount: Inground
 - 4. Color: Black

2.2 ACCESSORIES

- A. Seating: Anchor Bolts: Corrosion resistant recommended, not supplied by manufacturer.
- B. Drainage Material and Soil for Planter Pots: See Division 2, Section "Soil Preparation".
- C. Locks and Keys for Trash Receptacles:

2.3 SHOP FABRICATION

- A. Shop Assembled:

2.4 MIX FOR CONCRETE FOOTINGS: See Division 3, Section "Site Concrete".

2.5 PAINT: As per manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Locations: Verify that all site and street furnishings can be installed at locations as shown on Drawings.
- B. Conditions: Verify that no defects or errors exist in the work of other sections which would lead to defective installation or latent defects in workmanship and function of items in this section.

3.2 INSTALLATION

- A. Seating / Benches:
 - 1. See contract drawings.
- B. Bicycle racks:
 - 1. See contract drawings.

END OF SECTION

SECTION 02910 - SOIL PREPARATION

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes materials, labor, apparatus, tools, equipment, temporary construction, transportation, and services necessary for and incidental to performing the proper completion of Work, as required to make a complete and thorough preparation of the planting soil, including soil amendment products, imported topsoil, as required, to make up deficiencies in quantity of soil available on site, as shown in the Contract Drawings, and as specified herein this Section.
- B. Work under this Section consists of, but is not necessarily limited to, furnishing and installing the following:
 - 1. Agronomic Soil Fertility Testing and Soil Percolation Testing.
 - 2. Topsoil.
 - 3. Pre-Plant Weed Control.
 - 4. Soil Conditioners, Amendments, and Fertilizers.
- C. Related Sections: The following Sections contain requirements that relate to Work in this Section:
 - 1. Section 02310 – Finish Grading.
 - 2. Section 02810 – Irrigation Systems.
 - 3. Section 02930 – Exterior Plants.
 - 4. Section 02935 – Landscape Establishment Period.

1.2 DEFINITIONS AND APPLICABLE STANDARDS

- A. References:
 - 1. USDA – United States Department of Agriculture.
 - 2. ASTM – American Society for Testing & Materials.
- B. Definitions:
 - 1. Topsoil:
 - a. *Topsoil* - Shall be friable soil, providing sufficient structure in order to give good till and aeration.
 - b. *Gradation Limits* - Soil shall be a sandy loam, loam, clay loam or clay. The definition of soil texture shall be per the USDA classification scheme. Gravel over ¼-inch in diameter shall be less than 10% by weight.
 - c. *Permeability Rate* - Hydraulic conductivity rate shall be not less than one-inch (1") per hour, nor more than twenty-inches (20") per hour, hen tested in accordance with the USDA Handbook Number 60, Method 34b, or other approved Methods.
 - d. *Fertility* - The range of the essential elemental concentration in soil shall be as follows:

<u>Ammonium Bicarbonate/ DTPA Extraction (PPM)</u>	
<i>Element</i>	<i>(mg/kilogram) dry weight basis</i>
Phosphorous	4 - 40
Potassium	60 - 220
Iron	4 - 35

Manganese	0.6 - 6
Zinc	0.6 - 8
Copper	0.1 - 5
Boron	0.2 - 1
Magnesium	50 - 500
Sodium	0 - 100
Sulfur	25 - 500
Molybdenum	.1 - 30

- e. *Acidity* - The soil pH range measured in the saturation extract (Method 21a, USDA Handbook number 60) shall be 6.0 – 7.9.
- f. *Salinity* - The salinity range measured in the saturation extract (Method 3a, USDA Handbook Number 60) shall be 0.5 – 2.0 dS/m. If calcium and if sulfate ions both exceed 20 milliequivalents per liter in the saturation extract, the maximum salinity shall be 4/0 dS/m.
- g. *Chloride* - The maximum concentration of soluble chloride in the saturation extract (Method 3a, USDA Handbook Number 60) shall be 150 mg/l (parts per million).
- h. *Boron* - The maximum concentration of soluble boron in the saturation extract (Method 3a, USDA Handbook Number 60) shall be 1 mg/l (parts per million).
- i. *Sodium Adsorption Ratio (SAR)* - The maximum SAR shall be 4 measured per Method 20b, USDA Handbook Number 60.
- j. *Soil Organic Matter Content* - Sufficient soil organic matter shall be present to impart good physical soil properties but not be excessive to cause toxicity or cause excessive reduction in the volume of soil due to decomposition of organic matter.
- k. *Calcium Carbonate Content* - Free calcium carbonate (limestone) may be present.
- l. *Heavy Metals* - The maximum permissible elemental concentration in the soil shall not exceed the following:

<u>Ammonium Bicarbonate/DTPA Extraction (PPM):</u>	
<i>Element</i>	<i>(mg/kilogram) dry weight basis</i>
Arsenic	
Cadmium	2
Chromium	10
Cobalt	2
Lead	30
Mercury	1
Nickel	5
Selenium	3
Silver	.5
Vanadium	3

- m. *Elemental Concentration* - If the soil pH is between 6 and 7, the maximum permissible elemental concentration shall be reduced 50%. If the soil pH is less than 6.0, the maximum permissible elemental concentration shall be present at 50% or more of the above values.
- n. *Phytotoxic constituent, herbicides, hydrocarbons, etc.* - Germination and growth of plants shall not be restricted more than 10% compared to standard controls. Standard controls shall be both monocots and dicots. Petroleum hydrocarbons shall not be present.
- o. *Sub Grade* - Soil level resulting from the rough grading work under another Section. Cultivation of sub grade areas prior to placement of Topsoil is included in this Section.
- p. *Stockpiled Topsoil* - Soil stockpiled for spreading over prepared sub-grade.
- q. *Stockpiled Native Topsoil*: Topsoil stripped from the site prior to rough grading Work (under another Section), to be spread and amended as Work under this Section.

- r. *Imported Topsoil*: Off-site Topsoil, imported and stockpiled under this Section, to be spread and amended as Work under this Section.
- s. *On-Structure*: Planted areas to be installed on top of concrete structure built under another Section.

- C. Measurements:
 - 1. PPM: Measurement, in parts per million.

1.3 SUBMITTALS

- A. General: Submit each item in this Article in four (4) bound Submittal Booklets.
- B. Each Submittal Booklet under this Section shall be tabbed into specific sections, containing clearly identified (through yellow highlighter or other identification methods) and legible information on the landscape information indicated in this Article.
- C. Product Data and physical Product Samples: Submit Manufacturer's current catalog cuts, specifications, and physical Product Samples (provided in re-sealable labeled plastic bags for the following (as applicable):
 - 1. Planting Soil (Imported/Amended Topsoil).
 - 2. Soil Amendments (for each type used, for Sand, Perlite, Peat Humus, Gypsum, Soil Sulfur, Iron, etc).
 - 3. Bulk Composted Organic Soil Amendment Material.
 - 4. Granular Soil Conditioning Material.
 - 5. Fertilizers (for each type used).
- D. Approved Testing Laboratory and Procedures for Agronomic Soil Fertility Analyses:
 - 1. Agronomic Soil Fertility Analyses shall be conducted by a reputable, certified, agronomic soils laboratory. Laboratory shall be a member of the Council on Soil Testing and Plant Analysis. The same laboratory shall be used throughout the duration of the Contract:
 - a. Wallace Laboratories, El Segundo, CA. 310-615-0116.
 - b. Soil and Plant Laboratory, Orange, CA. 714-282-8777.
 - c. Fruit Growers Laboratory, Santa Paula, CA. 805-659-0910.
 - 2. Contractor shall verify and confirm the selected Testing Laboratory and specific location(s) of soil sample(s) with the Landscape Architect prior to commencing soil sampling operations.
 - 3. Submit the physical Samples directly to the selected Laboratory for analysis, per the procedures outlined per Part III herein this Section.
 - a. In addition to the physical Soil Samples, Contractor shall also provide the Laboratory with a copy of the Soil Amendment and Fertilizer products indicated herein this Section.
 - 4. Along with the testing data results, the Agronomic Soil Fertility Analysis shall include written recommendations by the Laboratory for amending and/or correcting the sampled soil conditions, utilizing the organic-based Soil Amendments and Fertilizers described herein this Section.
 - a. The Analyses shall also include Maintenance and Post-Maintenance fertilization programs for planted areas within the Contract.
 - 5. Agronomic Soil Fertility Analyses shall be performed on each of the native site soil samples, the imported topsoil (as required) and lightweight soil mix (as required).
 - 6. Agronomic Soil Fertility Analysis shall include testing results for the following:

pH;
Salinity (electro-conductivity);
Measurement of sodicity (Sodium Absorption Ratio);
Estimate of soil texture and soil organic matter;
Presence of lime;
Saturation extracts for nitrate, sulfate, sodium, calcium, magnesium, potassium,

soluble phosphate, and boron;
Parasitic nematodes;
Herbicide contamination;
(For Lightweight Soil Mixes): Test for physical and chemical composition, and saturated weight per cu.ft.

- E. Submit four (4) bound copies of the laboratory's Agronomic Soil Fertility Analysis and Recommendations to Landscape Architect a minimum of fourteen (14) days prior to amending of the soil and ordering soil amendments. The locations of where each of the soil test samples were derived from the Project Site shall be keyed to the site plan and shall be included with the results.
- F. Planting operations shall not commence until the results of the Agronomic Soil Fertility Analysis and Recommendations are reviewed accordingly by the Landscape Architect.
 - I. The quantity or type of amendments may be modified by the Landscape Architect within fourteen (14) days of receipt of the results. The Agronomic Soil Fertility Analysis and Recommendations shall take precedence over the amendment and fertilizer application rates specified herein or on the Contract Documents.
- G. The Agronomic Soil Fertility Report/Recommendation shall take precedence over the amendment and fertilizer application rates specified herein or on the Contract Documents.
- H. Submittals under this Article (including Samples) will be rejected without the benefit of review by the Landscape Architect if they are difficult to read due to insufficient scale, poor image quality, or poor drafting quality; or if the required information is missing or not presented in the format as requested.
- I. No Work shall proceed under this Section until Submittal requirements indicated herein have been reviewed accordingly by the Landscape Architect.

1.4 QUALITY ASSURANCE AND CONTROL

- A. Installer Qualifications for requirements indicated herein this Section:
 - 1. Licensed Landscape Contractor, C-27, in the State of California.
 - a. Engage an experienced, licensed Contractor who has completed landscaping work similar in material, design, and extent to that indicated for this Project and with a record of successful landscape establishment.
 - b. Installer's Field Supervision: Contractor shall maintain an experienced, full-time landscape supervisor/superintendent at the Project Site during times that landscaping operations identified herein the Contract are in progress.
- B. Testing Agency Qualifications: To qualify for acceptance, an independent testing agency must demonstrate to Landscape Architect's satisfaction, based on evaluation of agency-submitted criteria conforming to ASTM E699, that it has the experience and capability to satisfactorily conduct the testing indicated without delaying the Work.
- C. Manufacturer's Directions: Follow Manufacturer's directions and drawings in cases where the Manufacturers of articles used in this Section furnish directions covering points not shown in the Contract Drawings or Contract Specifications.
- D. Permits, Fees, Bonds, Testing, and Inspections: Contractor shall arrange and pay for permits, fees, bonds, testing, and inspections necessary to perform and complete his portion of the Work.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Packaged Materials: Deliver packaged materials in original, unopened packages or containers, with manufacturer's labels intact and legible, showing weight, analysis, and name of manufacturer. Store and secure properly to prevent theft or damage.
- B. Store packaged materials off ground and under cover, away from damp surfaces and inclement weather.
- C. Deliver and install materials so as to not delay Work, and install only after preparations for installation have been completed.
- D. Protect materials during storage and construction against soilage or contamination from earth and other materials.

1.6 COORDINATION, SCHEDULING, AND OBSERVATIONS

- A. Notify the Contractors performing Work related to installation of Work under this Section in ample time so as to allow sufficient time for them to perform their portion of Work and that progress of Work is not delayed. Verify conditions at the Project Site for Work that affects installation under this Section. Coordinate items of other trades to be furnished and set in place.
- B. Utilities: Determine location of above grade and underground utilities and perform Work in a manner which will avoid damage to utilities. Hand excavate, as required. Maintain grade stakes until removal is mutually agreed upon by parties concerned.
- C. Excavation: When conditions detrimental to adequate Soil Preparation operations are encountered, such as rubble fill, adverse drainage conditions, or obstructions, cease operations and notify Landscape Architect for further direction.
- D. Installation: Perform Soil Preparation operations only when weather and soil conditions are suitable in accordance with locally accepted practices.
- E. Construction Site Observations: Periodic site observations shall be made by the Landscape Architect during the installation of Work under this Section for compliance with requirements for type, size, and quality. Landscape Architect retains right to observe Work for defects and to reject unsatisfactory or defective material at any time during progress of Work. Contractor shall remove rejected materials immediately from Project site. The Contractor shall request, in writing, at least one (1) week in advance of the time when mandatory site observation(s) by the Landscape Architect are required.

1.7 SITE CONDITIONS

- A. Project Site shall be free of weeds, native grasses, evasive grasses, (Bermuda Grass, Nut Grass, Kikuyu Grass, etc.) prior to Topsoil distribution or soil amendment placement.
- B. Excessive rock, dead or declining vegetation, trash, debris, or other items that has accumulated throughout the duration of the Project shall be removed from the Project Site by the Contractor, and as directed by the Landscape Architect.
- C. Grading and soil preparation Work shall be performed only during the period when beneficial and optimum horticultural results may be obtained. If the moisture content of the soil should reach such a level that working it would destroy soil structure or cause compaction, spreading and grading operations shall be suspended until, in the opinion of the Landscape Architect, the moisture content is increased or reduced to acceptable levels and the desired results are likely to be obtained.

1. Soil moisture level prior to planting shall be no less than 75% of field capacity. The determination of adequate soil moisture for planting shall be in the sole judgment of the Landscape Architect.
 2. If the soil moisture level is found to be insufficient for planting, planting pits shall be filled with water and allowed to drain before commencing planting operations.
- D. Planting areas which become compacted in excess of 85% relative compaction due to construction activities shall be tilled and thoroughly cross-ripped to a minimum depth of twelve-inches (12") to alleviate the condition, taking care to avoid all existing subsurface utilities, drainage, etc.

1.8 SUBSTITUTIONS

- A. Consideration: Materials to be considered equal to the Materials indicated herein this Section shall be reviewed by the Landscape Architect. Materials with equal performance characteristics produced by other Manufacturer's and/or Distributors may be considered, providing deviations in dimensional size, color, composition, operation, and/or other characteristics do not change the design concept, aesthetic appearance, nor intended performance, as solely judged by the Landscape Architect. The burden of proof on product equality is on the Contractor.
- B. Specific reference to Manufacturer's names and products specified herein are used as standards of quality. This implies no right to the Contractor to substitute other materials without prior written approval by the Landscape Architect for Work under this Section.
- C. Materials substituted and installed by the Contractor, without prior written approval by the Landscape Architect, may be rejected. Contractor shall not be entitled to be compensated by the Owner where the Contractor has installed rejected substitutions without receiving prior written approval.
- D. Contract Price: Substituted Materials under this Section shall not increase the Contract price.

PART 2 - PRODUCTS

2.1 PLANTING SOIL (TOPSOIL)

- A. Topsoil: Meet ASTM D5268, pH range of 5.5 to 7, 4 percent organic material minimum.
1. Topsoil Source: Reuse native surface soil stockpiled on the site. Verify suitability of native surface soil stockpiled on site to produce Topsoil meeting requirements; amend as necessary. Supplement native surface soil stockpiled on site with imported Topsoil when quantities are insufficient.
 - a. Composition: Fertile, friable, well-drained soil, of uniform quality, free of stones over one-inch (1") diameter or larger in any dimension sticks, oils, chemicals, plaster, concrete, roots, plants, sod, and other deleterious or extraneous materials harmful to plant growth.
 - b. Obtain an Agronomic Soil Fertility Report/Recommendation of the stockpiled Topsoil from the approved Testing Laboratory indicated herein this Section.
 - c. Test Results: Request Testing Agency to send one (1) copy of test results direct to the Landscape Architect and one (1) copy to the Owner. Amend as required.

2.2 SOIL MIXES/BLENDS

- A. Soil Conditioner Blend, for amending on-site native soils or imported topsoil: Provide a thoroughly blended composition of Bulk Composted Organic Soil Amendment Material and Granular Soil Conditioning Material & Fertilizer. Any substitution for the "Soil Conditioner Blend" listed herein must

be requested, in writing, by the Contractor and approved, in writing, by the Landscape Architect at least 30 days prior to installation.

1. Bulk Composted Organic Soil Amendment Material:

- a. Material Composition: Bulk Composted Organic Soil Amendment Material shall be produced from a composted, nitrified blend of wood shavings, forest products, and/or rice hulls. Upon completion of the composting process, the Material shall be thoroughly cured for a minimum of 100 days, and shall be free from any trash (glass, metal, plastic, etc.) deleterious materials, bio-solids, and/or toxic chemicals. The Material shall be non-hazardous, and conform to US Environmental Protection Agency 40 CFR503 criteria for "Class A" products. It shall also exceed standards and specifications for unrestricted application as a landscaping and agricultural soil amendment.

- 1) Gradation/Screen Analysis: A minimum of 90% of the material by weight shall pass a 1/2" screen. Material passing the screen shall meet the following criteria:

<u>Percent Passing</u>	<u>Sieve Designation</u>
85 - 100%	9.51 mm (3/8")
50 - 80%	2.38 mm (No. 8)
0 - 40%	500 micron (No. 35)

- 2) Maturity: Physical characteristics suggestive of maturity include shall include:

- a) Color: Dark brown to black.
b) Odor: No odor, soil-like. Grounds for unacceptable Material include sour, putrid, or ammonia-like odors.
c) Particle characterization: Identifiable wood pieces are acceptable but the balance of Material should be soil-like without recognizable grass or leaves.

- b. Analytical Properties: Contractor shall submit proof of the Bulk Composted Organic Soil Amendment Material by providing a sample as identified herein this Section, and a lab analysis that has been performed within 30 days of the installation of the planting. Soil mix shall have (at a minimum) the following properties:

<u>Material</u>	<u>Minimum Targeted Property/Range</u>
Total Nitrogen (N%)	.50-1.0%
Phosphorus (as P ₂ O ₅)	2.0%
Potassium (as K ₂ O)	0.2%
pH (units)	7.0-8.0, as determined in saturated paste.
Organic Content	Minimum 50% based on dry weight and determined by ash method. Minimum 205 lbs. organic matter per cubic yard of compost.
ECe (millimho/cm)	<5.0; based on pre-leaching with equal volume of water.
Carbon-to-Nitrogen Ratio	<25-to-1, nitrogen stabilized.
Bulk Density	1,000 to 1,100 pounds/cubic yard.
Sodium Absorption Ratio (SAR)	Under 20.0
Total Iron	1.5%-3.0%
Moisture Content	35%-60%

- c. Application Rate: As indicated herein this Section under "Planting Soil Amendments Schedule".

- d. Commercial-Grade Products & Manufacturers: Subject to compliance with requirements, provide products by one (1) of the following:

- 1) *Soil Conditioner*, Synagro Professional Organic Soil Products, 800-242-2222.
2) *Agromend*, Agromin Horticultural Products, 800-AGROMIN.
3) *Humic Compost 1/2"*, Greenway Compost/Agri-Service, Inc., 760-723-6648.

- 4) *Superior Blend Compost*, Artesia Sawdust Products, Inc. 909-947-5983.
 - 5) *Compost*, EarthWorks Soil Amendments, Inc. 909-270-0088.
 - 6) *Contractor's Blend*, Recycled Wood Products (RWP), 909-868-0595.
 - 7) *#SSA-CST Supreme Organic Soil Amendment*, Plants Choice Inc., 800-468-8915.
 - 8) or equal, as approved by the Landscape Architect.
2. Granular Soil Conditioning Material & Fertilizer:
- a. Material Composition and Analytical Properties: Granular Soil Conditioning Material & Fertilizer shall be a singular manufacturer-blended combination of soil conditioning material and fertilizer. It shall be granular in form, long-lasting, free flowing, and suitable for application with approved equipment. It shall not contain any sewage sludge or manure-based products, and shall contain the following guaranteed minimum available analysis range:

<u>Element/Material</u>	<u>Targeted Property Range</u>
Nitrogen (N)	5.0% to 6.0%
Phosphoric Acid (as P ₂ O ₅)	2.0% to 3.0%
Potash (as K ₂ O)	1.0% to 4.0%
Humic Acids	15.0 % to 20.0%
Calcium	7.0%
Sulfur	0.0% to 5.0%

- b. Commercial-Grade Products, Manufacturers and Associated Rates of Application: Subject to compliance with requirements, provide products by one (1) of the following:
 - 1) *Tri-C 6-2-4*, Tri-C Enterprises LLC, Chino, CA. 800-927-3311.
 - a) Application Rate at 70 lbs. per 1,000 square feet of planting area.
 - 2) *Gro-Power Plus 5-3-1*, Gro-Power, Chino, CA. 909-393-3744.
 - a) Application Rate at 200 lbs. per 1,000 square feet of planting area.
 - 3) or equal, as approved by the Landscape Architect.
- B. Amended Imported Soil Mix for Raised Planters/On Structure Planters:
1. Submit Mix to Landscape Architect for evaluation.
 2. Recipe:

<u>Mix (per Cubic Yard)</u>	
<u>Amount</u>	<u>Material</u>
1/2 cu. yd.	Sand, as indicated herein this Section
1/4 cu. yd.	Bulk Composted Organic Soil Amendment Material, as indicated herein this Section
1/4 cu. yd.	Peat Humus, as indicated herein this Section
1 lb.	Calcium Nitrate
3 lbs.	Single Superphosphate
2 lbs.	Perlite
3/4 lbs.	Sulfate of Potash
9 lbs.	Gypsum

3. Provide Mix in sufficient quantities which allow for natural settling and compaction of the Mix in the planting vessel prior to installing Plant Materials, Planting vessels shall be compacted to 90% density to minimize settling. Set Mix and compact accordingly in 6" lifts, to within 2" of top of the planting vessel.

C. Amended Imported Soil Mix for Planting Containers:

1. Submit Amended Imported Soil Mix for Planting Containers to Landscape Architect for evaluation.
2. Recipe (Screen size at 3/8" maximum):

<u>Mix (per Cubic Yard)</u>	
<u>Amount</u>	<u>Material</u>
1/2 cu. yd.	Sand, as indicated herein this Section
1/4 cu. yd.	Bulk Composted Organic Soil Amendment Material, as indicated herein this Section
1/4 cu. yd.	Peat Humus, as indicated herein this Section
1 lb.	Calcium Nitrate
3 lbs.	Single Superphosphate
2 lbs.	Perlite
3/4 lbs.	Sulfate of Potash
9 lbs.	Gypsum
Per Manufacturer's recommended rate of application	Wetting Agent/Water Storing Polymer

3. Provide Mix in sufficient quantities which allow for natural settling and compaction of the Mix prior to installing Plant Materials. Mix shall be compacted to 90% density to minimize settling. Set Mix and compact accordingly in six-inch (6") lifts, to within two –inches (2") of top of the Planting Container.

- D. Amended Imported Soil Mix for Backfilling Acid-Loving Plant Materials (azaleas, camellias, ferns, gardenias, etc. and other plant materials, as directed by the Landscape Architect):

1. Submit Mix to Landscape Architect for evaluation.
2. Recipe:

<u>Backfill Mix, per Excavated Plant Pit</u>	
<u>Amount</u>	<u>Material</u>
2 Parts	Excavated Soil from Plant Pit.
1 Part	Bulk Composted Organic Soil Amendment Material, as indicated herein this Section.
2 Parts	Peat Humus, as indicated herein this Section.

2.3 ORGANIC SOIL AMENDMENT COMPONENTS

- A. Washed Plaster Sand: Clean, washed, natural or manufactured sand, sharp, free of toxic materials. Sieve tested in accordance with ASTM C136, with 100% passing through a #8 screen, 0% passing through a #200 screen.
 1. Chemical Properties: (by Saturation Extract Method):
 - a. Soluble Salts/Salinity: Maximum conductivity of 3.0 millimhos/cm at 25 degrees C.
 - b. Boron: Maximum concentration of 1.0 PPM.
 - c. Sodium Absorption Ratio (SAR): Maximum 6.0.
- B. Perlite: Horticultural Perlite, soil amendment grade, 6.5 to 7.5 pH.

1. Unacceptable Materials: Polystyrene beads shall not be used as a substitution for horticultural Perlite.
- C. Vermiculite: Horticultural Vermiculite, gold-brown in color.
1. Size: 2-4mm, 5 mesh to 10 mesh sieve size.
 2. Density: 4.5 to 5.5 lb./cuft.
 3. Grade: #2, Medium Grade.
- D. Peat Humus:
1. Type: Canadian Sphagnum Peat, as derived from the genus Sphagnum, medium-divided, coarse fibrous texture, brown in color.
 2. Measurement: Measure peat in air dry condition, containing not more than 35% moisture by weight on an "as-received" basis.
 3. Physical Properties:
- | Percent Passing | Sieve Size |
|-----------------|---------------------------|
| 95 - 100% | 9.51 mm (3/8 in.) |
| 0 - 40% | 500 micron (#35, 32 mesh) |
4. Organic Content (dry weight basis): minimum 95%.
 5. Fiber Content: Greater than 66%.
 6. Water Holding Capacity: 20x to 30x its dry weight in water.
 7. Range in Ash Content (%): 1.0 to 5.0.
 8. Chemical Properties:
 - a. Nitrogen (dry weight basis): 0.6-3.0%.
 - b. Salinity/Soluble Salts: Saturation extract conductivity 0.0-3.0 millimhos/cm @ 25 degrees C.
 - c. pH range: 3.0 to 4.0.
 9. Unacceptable Materials:
 - a. Coir Dust.
 - b. Sedge Peat.
 - c. Reed Peat.
 - d. Hypnum Peat.

2.4 CHEMICAL SOIL AMENDMENT COMPONENTS

- A. General: Chemical Soil Amendment Components listed herein may or may not be used, depending on the results of the Agronomic Soil Fertility Report. Provide as required:
- B. Gypsum: Commercially-processed and packaged agricultural-grade hydrated calcium sulfate product (CaSO₄), 92.0% minimum, pH at 7.1.
 1. Commercial-Grade Products & Manufacturers: Subject to compliance with requirements, provide products by one (1) of the following:
 - a. Ben Franklin™ No. 1 Agricultural Gypsum, U.S. Gypsum Company.
 - b. 100% Good Stuff Gypsum™, Art Wilson Company.
 - c. or equal, as approved by the Landscape Architect.
- C. Soil Sulfur: Elemental Sulfur (90% min.) commercially manufactured, water degradable, palletized.
 1. Commercial-Grade Products & Manufacturers: Subject to compliance with requirements, provide products by one (1) of the following:
 - a. *Disper-Sul*, Martin Resources, Inc.
 - b. *Soil Sulfur*, Red Top.
 - c. or equal, as approved by the Landscape Architect.

- D. Iron: Non-staining, 40% Fe minimum, complete with micro-nutrients and 2% humic acids, as derived from iron oxide, manganese oxide, or zinc oxide.
1. Commercial-Grade Products & Manufacturers: Subject to compliance with requirements, provide products by one (1) of the following:
 - a. *Gro-Power Iron*, Gro-Power, Chino, CA 909-393-3744.
 - b. *Iron 45 w/ Micronutrients*, Tri-C Enterprises LLC, Chino, CA, 800-927-3311.
 - c. or equal, as approved by the Landscape Architect.
- E. Dolomite Lime: Agricultural-grade mineral soil conditioner containing 35% minimum magnesium carbonate, and 49% minimum calcium carbonate, 100% passing #65 sieve.
- F. Potassium Sulfate (Sulfate of Potash K₂O), (0-0-50 guaranteed analysis N-P₂O₅-K₂O): Agricultural-grade, containing minimum 50% of water-soluble potash and 18% Sulfur (S).
- G. Single Superphosphate P₂O₅ (0-15-0 guaranteed analysis N-P₂O₅-K₂O): Commercial product, containing 15% available phosphoric acid and 14% Sulfur.
- H. Triple Superphosphate P₂O₅, (0-45-0 guaranteed analysis N-P₂O₅-K₂O): Commercial product, containing 45% available phosphate and 15% Calcium (Ca).
- I. Ammonium Sulfate (NH₄)₂SO₄, (21-0-0 guaranteed analysis N-P₂O₅-K₂O): Commercial product containing approximately 21% ammonia.
- J. Ammonium Nitrate NH₄NO₃, (34-0-0 guaranteed analysis N-P₂O₅-K₂O): Commercial product containing approximately 34% ammonia.
- K. Calcium Nitrate CaNO₃, (15.5-0-0 guaranteed analysis N-P₂O₅-K₂O): Agricultural grade containing 15-1/2% nitrogen.
- L. Potassium Nitrate KNO₃, (13-0-45 guaranteed analysis N-P₂O₅-K₂O): Commercial product containing approximately 13% nitrogen and 45% potassium.
- M. Urea CO(NH₂)₂, (46-0-0 guaranteed analysis N-P₂O₅-K₂O): Granular commercial product containing 46% nitrogen.
- N. I.B.D.U. (Iso Butyldiene Diurea): Commercial product containing 31% nitrogen.

2.5 FERTILIZERS

- A. Composition: Nitrogen (N), phosphorous (P₂O₅), and potassium (K₂O) content, plus other elements, as indicated.
- B. Palm Tree Fertilizer (pre-plant 9-3-9):
1. Organic-based, long-lasting, controlled-release, uniform in composition, free flowing, granular-type fertilizer with micronutrients, suitable for application with approved equipment.
 2. Palm Fertilizer shall contain the following minimum available percentages by weight of plant food (pending results of soil analysis):

<i>Element/Material</i>	<i>Targeted Property Range</i>
Nitrogen (N) - Slow Release	9.0% minimum
Phosphoric acid (as P ₂ O ₅)	3.0% minimum
Potash (as K ₂ O)	9.0% minimum
Calcium (Ca)	3.0% minimum

Magnesium (Mg)	4.0% minimum
Sulfur (S)	6.0% minimum
Iron (Fe)	2.0% minimum
Manganese (Mg)	0.05% minimum
Zinc (Z)	0.05% minimum
Humus	25.0% minimum
Humic Acids w/ micronutrients	5.0% minimum

3. Commercial-Grade Products & Manufacturers: Subject to compliance with requirements, provide products by one (1) of the following:
 - a. Gro-Power 9-3-9 Palm & Tropical with Micronutrients, Gro-Power, Chino, CA. 909-393-3744.
 - b. or equal, as approved by the Landscape Architect.
 4. Application Rate: Per Manufacturer's current printed recommendation.
- C. Turf Grass Starter Fertilizer (pre-plant 3-12-12), as required:
1. General: Shall be applied for turf grasses planted from sod or seed (not hydroseed or hydrostolons).
 2. Fertilizer shall be an organic-based, long-lasting, controlled-release, uniform in composition, free flowing granular-type fertilizer with micronutrients, suitable for application with approved equipment. Fertilizer shall be high in potassium and phosphorous elements to aid in strong root development.
 - a. Turf/Lawn Fertilizer shall contain the following minimum available percentages by weight of plant food (pending results of soil analysis):

<u>Element/Material</u>	<u>Targeted Property Range</u>
Nitrogen (N) Slow Release	3.0% minimum
Phosphoric acid (as P ₂ O ₅)	12.0% minimum
Potash (as K ₂ O)	12.0% minimum
Humus	35.0% minimum
Humic Acids w/ micronu- trients and soil enhancers	7.0% minimum

3. Commercial-Grade Products & Manufacturers: Subject to compliance with requirements, provide products by one (1) of the following:
 - a. Gro-Power 3-12-12 Flower & Bloom, Gro-Power, Chino, CA. 909-393-3744.
 - b. or equal, as approved by the Landscape Architect.
 4. Application Rate: Twenty (20) pounds per 1,000 SF.
- D. Hydroseed/Hydrostolon Slow-Release Fertilizer, as required (refer to Section 329200 – Lawns & Grasses):
1. Pelleted- or granular-form fertilizer, organic-based, long-lasting, controlled-release, uniform in composition, free flowing, singular manufacturer-blended combination of soil conditioning material and fertilizer with micronutrients, suitable for application with approved equipment. It shall not contain any sewage sludge or manure-based products, and shall contain the guaranteed minimum available analysis range. Installed in the hydroseed/hydrostolon slurry mix, and consisting of the following minimum available percentages by weight of plant food:

<u>Element/Material</u>	<u>Targeted Property Range</u>
Nitrogen (N)	5.0% to 6.0%
Phosphoric acid (as P ₂ O ₅)	2.0% to 3.0%
Potash (as K ₂ O)	1.0% to 4.0%

Humic Acids	15.0% to 20.0%
Calcium (Ca)	7.0%
Sulfur (S)	0.0% to 5.0%

2. Commercial-Grade Products, Manufacturers and Associated Rates of Application: Subject to compliance with requirements, provide products by one (1) of the following:
 - a. *Tri-C 6-2-4*, Tri-C Enterprises LLC, Chino, CA, 800-927-3311.
 - 1) Application Rate at 70 lbs. per 1,000 square feet of planting area.
 - b. *Gro-Power Plus 5-3-1*, Gro-Power, Chino, CA. 909-393-3744.
 - 1) Application Rate at 200 lbs. per 1,000 square feet of planting area.
 - c. or equal, as approved by the Landscape Architect.

E. Fertilizer Tablet:

1. General: Fertilizer Tablet shall be a 7-gram tablet, organic-based, tightly compressed chip-type commercial grade, 12-month slow-release planting tablets, and shall be composed of the following available percentages by weight of plant food:

<i>Element/Material</i>	<i>Targeted Property Range</i>
Nitrogen (N)	12.0% minimum
Phosphoric acid (as P ₂ O ₅)	8.0% minimum
Potash (as K ₂ O)	8.0% minimum
Humus	20.0% minimum
Humic Acids w/ micronutrients and soil enhancers	4.0% minimum

2. Commercial-Grade Products & Manufacturers: Subject to compliance with requirements, provide products by one (1) of the following:
 - a. *Gro-Power 12-8-8 Planting Tablets*, Gro-Power, Chino, CA 909-393-3744.
 - 1) Application Rate: As indicated herein Part III this Section.
 - b. or equal, as approved by the Landscape Architect.

2.6 ACCESSORIES

- A. Drain Rock/Aggregate: Crushed Stone, conforming to ASTM C33, graded to ¾"-size, clean, hard, durable, free of materials toxic to plant growth, set in bottom of Planters, at depth indicated in Contract Drawings. Provide Geotextile Filter Fabric between Drain Rock/Aggregate and amended planting backfill soil.
 1. Drain Rock/Aggregate for planters containing bamboo plant material species:
 - a. Crushed lava rock cinders, graded to 3/16" size.
 - b. Geo-textile Filter Fabric shall be omitted.
- B. Wetting Agent/Water Storing Polymer: Non-biodegradable, granular, polyacrylamide polymer soil amendment.
 1. Commercial-Grade Products & Manufacturers: Subject to compliance with requirements, provide products by one (1) of the following:
 - a. *Broadleaf P4*, Broadleaf Industries, Inc. Chula Vista, CA 619-424-7880.
 - b. or equal, as approved by the Landscape Architect.
- C. Drainage Mat:
 1. Description: Two (2) -layer composite polyester non-woven filter fabric, bonded to a compression resistant nylon matting of open, three-dimensional construction.
 2. Products & Manufacturers: Subject to compliance with requirements, provide products by one (1) of the following:

- a. #9010, American Enka, as distributed by American Excelsior Co., 916-383-3835.
- b. or equal, as approved by the Landscape Architect.

D. Landscape Mulch Material:

- 1. Organic Wood Mulch: See Section 329400 – Landscape Planting Accessories.

PART 3 - EXECUTION

3.1 AGRONOMIC SOIL FERTILITY REPORT/RECOMMENDATION

- A. Once rough grading has been accomplished, and prior to commencing Soil Preparation operations, (amendments, fertilizers, etc.), soil samples shall be taken from representative areas and below grade depths of the Project Site. Locations and depths to gather the representative soil samples shall be accomplished by the Contractor under the direction of the Landscape Architect.
 - 1. Provide 4 Soil Samples.
- B. Guidelines for Selecting the Soil Samples:
 - 1. Select representative areas to sample. The area needs to be uniform in color, texture, depth, and drainage with the same fertilizing program and type of use. Planting areas to receive lawns, flowerbeds, trees, cut areas, fill areas, etc. should be tested separately. An area containing multiple trees and shrubs can be grouped into one area if the planting is the same.
 - 2. Depths and process of soil sampling:
 - a. Sample as deep as the soil will be amended, generally six-inches (6") deep for groundcover/lawns, eighteen-inches (18") deep for shrub areas, twenty-four-inches (24") deep for small boxed trees, and three-feet (3') to four-feet (4') for large boxed trees.
 - b. Use a soil probe or soil auger to remove a core sample; otherwise, use a shovel to dig a hole to the desired depth. Sample the soil from the side of the excavated hole, scraping the side with a trowel. The tools used for digging shall be clean and not rusty. Avoid sampling when the soil is too wet.
 - 3. In desired areas where multiple sub-samplings are taken from any one (1) area to create a combined sample, mix the sub-samples homogenously together in a clean plastic bucket prior to placing in the plastic bag.
 - 4. Each Sample shall be sent directly to the laboratory in a separate, re-sealable, one (1)-gallon plastic bag. Provide a minimum of four (4) cups of soil within each respective sample to allow for adequate testing.

3.2 SOIL PERCOLATION TESTING

- A. Type/Quantity: During operations of Agronomic Soil Fertility Testing and prior to installing Plant Material, Contractor shall perform Soil Percolation Tests, through the direction of the Landscape Architect, in selected representative areas of the Project Site, to verify acceptable natural drainage, soil structure, and soil composition. Contractor shall verify the locations of the Soil Percolation Tests with the Landscape Architect.
 - 1. Required Number of Soil Percolation Tests: 2
- B. Procedure: Each Soil Percolation Test shall be performed as follows:
 - 1. Dig a hole: 2'-0" wide x 2'-0" long x 2'-0" deep.
 - 2. Fill the hole with water to top and cover with plywood and barricade. Allow hole to drain and fill again to top.
 - 3. Make daily observations, noting the depth of water each day.

4. Report findings, in writing, to the Landscape Architect. Include the length of time the water takes to drain completely from each hole, date of test, location, and other information, which may be useful in providing further recommendations.
- C. Results: Based on the combined results of the Agronomic Soil Fertility Testing and the Soil Percolation Tests, Contractor may be required to install additional tree drainage sumps or other drainage methods at each planting pit for trees larger than 15-gallon container stock. This does not relieve the Contractor's obligation within the Base Bid to provide the required Tree Root Aeration Units. Contractor shall include, as a line-item price within the Base Bid, the price per each additional tree drainage sump, should they be required (based on the testing). Should additional tree drainage sumps or other methods is required, compensation shall be awarded to the Contractor at the line-item price (each) as provided by the Contractor.

3.3 SOIL MOISTURE CONTENT

- A. General: Do not work soil when moisture content is so great that excessive compaction occurs, or when it is so dry that dust will form in air, or that clods will not break readily. Apply water, if necessary, to bring soil to an optimum moisture content for tilling and planting. Soil moisture level prior to planting shall be no less than 75% of field capacity. The determination of adequate soil moisture for planting shall be the judgment of the Landscape Architect. Range: Maintain within two-percent (2%) above or below optimum moisture content at times during Work.

3.4 PROTECTION OF SITE

- A. Contractor shall protect existing and new improvements and systems installed prior to planting installation. Maintain protection in place until completion of Work and contracted Landscape Establishment Period.
- B. Protect concrete paving, headers, and drainage from staining due to contact with wet nitrogen stabilized mulch/sawdust, or contact with chelated iron. Correct any stained concrete.

3.5 CLEARING & CULTIVATION

- A. Clearing: Clear planting areas free of stones two-inches (2") in diameter and larger, weeds, debris, and other extraneous materials prior to soil preparation Work.
- B. Pre-Plant Weed Control:
1. Clear and remove existing weeds by mowing or grubbing to at least one-inch (1") below the soil surface.
 2. Fertilize areas to receive planting with a 46-0-0 NPK commercial fertilizer at the rate of ½ lb. per 1,000 square feet.
 3. After fertilization, irrigate the soil thoroughly and continuously at the equivalent of four inches (4") of water distributed over a fourteen (14)-day period. The application of water shall be applied to the soil as needed to gradually soak through the soil profile and not allowed to run-off the surface. Employ a specific watering duration and frequency program designed to germinate residual weeds.
 - a. Providing full irrigation coverage for the limits of the subject areas under this requirement shall be the responsibility of the Contractor. Contractor shall utilize permanent irrigation system installed under other Sections of the Contract, where available. Should limited coverage or no permanent irrigation system is available, Contractor shall provide temporary irrigation, as required, to fully meet the requirements herein.

4. After sufficient weed germination is present, apply non-selective, post-emergent contact herbicide, in strict accordance to the Manufacturer's directions. Refer to Section 329400 – Landscape Planting Accessories.
5. Protect and buffer surrounding properties, buildings, and vegetation from overspray, as required.
6. Allow for a sufficient time period to ensure that the weeds are dead and the herbicide has dissipated, per the Manufacturer's recommendation.
7. Water planting areas thoroughly and continuously for a period of one (1) week after the application of the herbicide. Discontinue the watering process for one (1) day prior to the second application of the herbicide. Apply a second application of the herbicide. Avoid any irrigation for a minimum of four (4) days after the second application for effective weed kill.
8. After the second application and waiting period, water planting areas thoroughly and continuously for three (3) consecutive days to saturate upper layers of the soil prior to commencing planting operations.
9. Dead weeds shall be cleared and removed prior to planting.
10. Maintain a weed-free Project Site until final acceptance by the Owner, utilizing mechanical, chemical, or manual treatment.

C. Cultivation of Existing Topsoil:

1. Cultivation: Following Pre-Plant Weed Control operations, in planting areas where Topsoil will NOT be applied, rip or cultivate areas of existing soil to receive planting to the following depth, prior to applying soil amendments:
 - a. Less Than 2:1 Slopes: Ten-inches (10").
 - b. 2:1 Slopes and Greater: Six-inches (6").
2. Trees to Remain: Hand cultivate within the drip-line of existing trees to remain. Depth of cultivation shall not exceed two-inches (2"). Cultivate immediately prior to amending existing soil.
3. Following initial cultivation of Topsoil, uniformly broadcast and cultivate/blend the materials indicated in the following Planting Soil Amendments Schedule, with the Topsoil, to a minimum six-inch (6") depth:
4. Planting Soil Amendment Schedule:

<u>Soil Amendment/Fertilizer</u>	<u>Ratio</u>
First Component of Soil Conditioner Blend: Bulk Composted Organic Soil Amendment	Four (4) cu. yds. / 1,000 square feet of planting area.
Second Component of Soil Conditioner Blend: Granular Soil Conditioning Material & Fertilizer	At indicated ratio, per selected Manufacturer.
Gypsum	200 pounds / 1,000 square feet.
Commercial Fertilizer	At indicated ratio, per selected Manufacturer.
Soil Sulfur	8 pounds / 1,000 square feet of planting area.

Iron (non-staining)	10 pounds / 1,000 square feet of planting area.

- a. Modifications: The Planting Soil Amendment Schedule may be modified, based on the combined results of the Agronomic Soil Fertility Tests and Percolation Tests.
 - 1) Contractor shall be provided with fair and adequate compensation by the Owner should additions or increases to the specified ratios are required to the Planting Soil Amendment Schedule due to the Agronomic Soil Fertility Test results and/or recommendations by the Landscape Architect.
 - 2) Contractor shall provide the Owner fair and adequate credit should subtractions or decreases to the specified ratios are required to the Planting Soil Amendment Schedule due to the Agronomic Soil Fertility Test results and/or recommendations by the Landscape Architect.
 5. Complete finish grading operations per Section 312219 – Landscape Grading.
- D. Cultivation of Sub-Grade and Spreading of Imported Topsoil:
1. Verification: In planting areas where Imported Topsoil will be applied, verify that sub-grades prior to installation of Imported Topsoil have been established under rough grading. Do not spread Imported Topsoil prior to acceptance of sub-grade Work.
 - a. Depth: Verify that sub-grades are twelve-inches (12") minimum below finished grades, +/- one-inch (1"). Report variations to Owner.
 2. Cultivation: Following Pre-Plant Weed Control operation, rip or cultivate sub-grade in planting areas to a depth of six-inches (6") prior to spreading Imported Topsoil.
 3. Spread Imported Topsoil in planting areas, as required to meet finished landscape grades. Once Imported Topsoil has been spread, uniformly broadcast and blend materials indicated in the Planting Soil Amendments Schedule (indicated above) with the Imported Topsoil to a six-inch (6") depth.
 4. Complete finish grading operations per Section 312219 – Landscape Grading.
- E. Fertilizer Tablet(s) Application Rate:
1. Fertilizer Tablets shall be spread equidistantly around the perimeter within the Amended Planting Backfill Mixture, up to within three-inches (3") of the finished grade of the Mixture, and at the following rates:

<u>Size of Plant Material</u>	<u>Total Quantity of 7-gram Fertilizer Tablets</u>
Liner, Plug, Flat-Size Plant, or 4" Pot.	One (1) Tablet
One (1)-gallon Container stock.	Three (3) Tablets
Five (5)-gallon Container stock.	Nine (9) Tablets
Fifteen (15)-gallon container stock	Fifteen (15) Tablets
24" Box Container Stock	Sixteen (16) Tablets
30" Box Container Stock	Eighteen (18) Tablets
36" Box Container Stock	Twenty (20) Tablets
42" Box Container Stock	Twenty-two (22) Tablets
48" Box Container Stock	Twenty-four (24) Tablets
60" Box Container Stock	Thirty-six (36) Tablets
For Container Stock larger than 60" Box.	Six (6) Tablets for each ½" of tree caliper size.
For each 1'-0" of Palm Tree (apical meristem) height	Two (2) Tablets.

2. Contractor shall not provide Fertilizer Tablets for designated native plant species, as indicated in the Contract Drawings or as directed by the Landscape Architect. Contractor shall verify with the

Landscape Architect, in writing, as to which plants are subject to not receive the Fertilizer Tablets.

3.6 DRAINAGE OF PLANTING AREAS

- A. Surface Drainage:
 - 1. Discrepancies: Provide proper surface drainage of planted areas. Submit in writing all discrepancies in the Contract Drawings or Specifications, or prior Work done by others, which Contractor feels precludes establishing proper drainage.
 - 2. Correction: Include description of work required for correction or relief of said condition.
- B. Detrimental Drainage, Soils and Obstructions:
 - 1. Notification: Submit in writing all soils or drainage conditions considered detrimental to growth of plant materials. State condition and submit proposal and cost estimate for correcting condition.
 - 2. Correction: Submit for acceptance a written proposal and cost estimate for the correction before proceeding with Work.
 - 3. Obstructions: If rock, underground construction Work, tree roots, or other obstructions are encountered in the performance of Work under this Section, submit cost required to remove the obstructions to a depth of not less than six-inches (6") below the required soil depth.

3.7 CLEAN UP AND PROTECTION

- A. For Work under this Section, keep Work area in a clean, orderly, and safe condition. Contractor shall remove trash caused from his Work on a weekly basis throughout the duration of the Work.
- B. Protect site from damage due to landscape operations, operations by other Contractors and trades, and trespassers. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged Soil Preparation areas as directed.
- C. Upon completion of his Work under this Section, the Contractor shall remove rubbish, waste, debris, excess construction materials, and other items resulting from construction operations offsite as described herein this Section, as directed by the Landscape Architect.

END OF SECTION

SECTION 02930 – EXTERIOR PLANTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes materials, labor, apparatus, tools, equipment, temporary construction, transportation, and services necessary for and incidental to performing the proper completion of Work, as required to make a complete Exterior Landscape Planting installation, as shown in the Contract Drawings, and as specified herein this Section.
- B. Work under this section consists of, but is not necessarily limited to, furnishing and installing the following:
 - 1. Trees.
 - 2. Shrubs.
 - 3. Ground Covers.
 - 4. Vines.
 - 5. Annuals.
 - 6. Perennials.
- C. Related Sections: The following Sections contain requirements that relate to Work in this Section:
 - 1. Section 02231–Tree Protection and Trimming
 - 2. Section 02310 – Finish Grading.
 - 3. Section 02810 – Irrigation Systems.
 - 4. Section 02910 – Soil Preparation.
 - 5. Section 02935 – Landscape Establishment Period.

1.3 DEFINITIONS AND APPLICABLE STANDARDS

- A. References:
 - 1. ASTM – American Society for Testing Materials.
 - 2. USDA – United States Department of Agriculture.
 - 3. ANSI – American National Standards Institute.
- B. Definitions:
 - 1. *Plant Material(s)*: Refers to living plant species, inclusive of trees, shrubs, groundcovers, vines, ornamental grasses, cacti/succulents, espaliers, annuals, perennials, etc., as indicated in the Contract Drawings.
 - 2. *Planting Area (PA)*: As denoted on the Contract Drawings, shall refer to areas to be installed with Plant Material(s), or areas where existing vegetation shall be protected.
 - 3. *Plant Height*: Measurement of main body height, not measurement to branch tip.
 - 4. *Plant Spread*: Measurement of main body diameter, not measurement from branch tip to branch tip.
 - 5. *Amended Planting Backfill Mixture*: Refer to Section 02910 – Soil Preparation.

6. *Balled and Burlapped Stock*: Healthy, vigorous exterior plants with firm, natural balls of earth in which they are grown, with ball size not less than diameter and depth recommended by ANSI Z60.1 for type and size of tree or shrub required; wrapped, tied, rigidly supported, and drum laced as recommended by ANSI Z60.1.
7. *Balled and Potted Stock*: Healthy, vigorous exterior plants dug with firm, natural balls of earth in which they are grown and placed, unbroken, in a container. Ball size is not less than diameter and depth recommended by ANSI Z60.1 for type and size of exterior plant required.
8. *Bare-Root Stock*: Healthy, vigorous exterior plants grown with a well-branched, fibrous-root system developed by transplanting or root pruning, with soil or growing medium removed, and with not less than minimum root spread according to ANSI Z60.1 for type and size of exterior plant required.
9. *Clump*: Where three or more young trees were planted in a group and have grown together as a single tree having three or more main stems or trunks.
10. *Container-Grown Stock*: Healthy, vigorous, well-rooted exterior plants grown in a container with well-established root system reaching sides of container and maintaining a firm ball when removed from container. Container shall be rigid enough to hold ball shape and protect root mass during shipping and be sized according to ANSI Z60.1 for type and size of exterior plant required.
11. *Fabric Bag-Grown Stock*: Healthy, vigorous, well-rooted exterior plants established and grown in-ground in a porous fabric bag with well-established root system reaching sides of fabric bag. Fabric bag size is not less than diameter, depth, and volume required by ANSI Z60.1 for type and size of exterior plant.
12. *Finish Grade*: Elevation of finished surface of planting soil.
13. *Manufactured Topsoil*: Soil produced off-site by homogeneously blending mineral soils or sand with stabilized organic soil amendments to produce topsoil or planting soil.
14. *Multi-Stem*: Where three (3) or more main stems arise from the ground from a single root crown or at a point right above the root crown.
15. *Sub-grade*: Surface or elevation of subsoil remaining after completing excavation, or top surface of a fill or backfill, before placing planting soil.
16. *Subsoil*: All soil beneath the topsoil layer of the soil profile, and typified by the lack of organic matter and soil organisms.

C. Reference Standards:

1. *An Annotated Checklist of Woody Ornamental Plants of California, Oregon, and Washington*, (Number 4091), McClintock and Leiser, Division of Agricultural Sciences, University of California, 1979.
2. *American National Standard for Nursery Stock (ANSI Z60.1)*. American National Standards Institute, and American Association of Nurserymen, Latest edition,
3. *American Joint Committee on Horticultural Nomenclature*, 1942 Edition of Standardized Plant Names.
4. *Hortus III*, 1976 Edition, Liberty Hyde Bailey Hortorium, Cornell University.
5. *The Hillier Gardener's Guide to Trees and Shrubs*, 4th Edition, 1978.
6. *Manual of Cultivated Conifers*, Den Ouden & Boon, 1978.
7. *Datascape Guide to Commercial Nomenclature*, American Nurserymen Publishing Co., Chicago, IL, 1994.
8. *American National Standard for Tree Care Operation, Tree, Shrub, and Other Woody Plant Maintenance (ANSI A300)*, American National Standards Institute, Latest Edition.

D. Measurements:

1. SQ/FT: Measurement, in square-foot.
2. O.C.: Measurement used for On-Center spacing.

1.4 SUBMITTALS

- A. General: Submit each item in this Article in four (4) bound Submittal Booklets.

- B. Each Submittal Booklet under this Section shall be tabbed into specific sections, containing clearly identified (through yellow highlighter or other identification methods) and legible information on the following landscape information indicated in this Article:
1. Alphabetized List of Plant Material.

2. Description of Plant Material, for each species indicated in the Contract Drawings, submitted in the following format:

(Provide Color Photograph of Plant Material here)	
(Note: Photograph shall include a person, tape measurer, or other scaled reference).	
<i>Project Name:</i>	
<i>Botanical Name:</i>	
<i>Common Name:</i>	
<i>Form (Multi, Standard, etc.):</i>	
<i>Container Size (as applicable):</i>	
<i>Overall Height (provide Apical Meristem Height for Palms):</i>	
<i>Spread:</i>	
<i>Caliper (as applicable):</i>	
<i>Quantity Required (per Contract Drawings):</i>	
<i>Quantity Available (at supplying Nursery):</i>	
<i>Supplying Nursery Name:</i>	
<i>Contact Name at Nursery:</i>	
<i>Nursery Address:</i>	
<i>Nursery Phone Number:</i>	
<i>Date of Nursery Photo:</i>	
<i>Comments/Remarks:</i>	

3. The Alphabetized List of Plant Material and Description of Plant Material shall not be construed as to acceptance of the Plant Material. All Plant Material shall be subject to review and approval by the Landscape Architect upon delivery to the Project Site.
- C. Qualification data for firms and persons specified in the "Quality Assurance and Control" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and address of architects and owners, and other information specified.
- D. Planting installation schedule, indicating anticipated locations and dates for each type of planting.
- E. Submittals under this Article will be rejected without the benefit of review by the Landscape Architect if they are difficult to read due to insufficient scale, poor image quality, or poor drafting quality; or if the required information is missing or not presented in the format as requested.

- F. No Work shall proceed under this Section until Submittal requirements indicated herein have been reviewed accordingly by the Landscape Architect.

1.5 QUALITY ASSURANCE AND CONTROL

A. Installer Qualifications:

1. Requirement: Valid California C-27 (Landscaping Contractor) License.
2. Engage an experienced Installer who has demonstrated completed landscaping work similar in material, design, and extent to that indicated for this Project and with a record of successful landscape establishment.
3. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on the Project site during times that landscaping installations under this Section are in progress.

B. Plant Material: Provide quality, size, genus, species, and variety of Plant Material indicated, complying with applicable requirements of ANSI Z60.1 "American Standard for Nursery Stock."

1. Selection of Plant Material purchased under allowances will be made by the Owner, who has the option to tag Plant Material stock at their place of growth before they are prepared for transplanting.
2. At least one (1) plant of each Plant Material species delivered to the Project Site shall have an identification tag from supplying nursery showing botanical and common name of the plant as identified in the Contract Drawings. Landscape Architect shall be provided the opportunity for an on-site debriefing by the Contractor that identifies the size and specific type of Plant Material upon delivery.
3. Incorrect Planting Materials:
 - a). Replace, at no cost to Owner, Plant Material that is revealed during the course of the Contract as to being untrue to the species indicated in the Contract Drawings and reviewed accordingly under this Section.
 - b). Provide replacements equal to the size and quality to match the planted materials at the time the untrue species is discovered.
4. Replacement of Plant Material: Refer to the Guarantee Article indicated herein this Section.

C. Observation: Landscape Architect may observe Plant Materials at either their place of growth or at the site before or after planting, for compliance with requirements for genus, species, variety, size and quality. Landscape Architect also retains right to observe Plant Material further for size and condition of root balls, trunks, branches, and crowns; insects; pests; disease; weeds; injuries, and latent defects. Landscape Architect reserves the right to reject unsatisfactory and/or defective Plant Material at any time during progress of Work. Contractor shall remove rejected Plant Material immediately from Project site.

D. Regulatory Requirements:

1. Contractor shall meet the requirements of applicable laws, codes, and regulations as required by the authorities having jurisdiction over the Work.
2. Provide for inspections and permits by Federal, State, and Local authorities in furnishing, transporting, and installing materials.

E. Permits, Fees, Bonds, and Inspections: Contractor shall arrange and pay for permits, fees, bonds, and inspections necessary to perform and complete Work under this Section.

F. Plant Material Review and Selection (Tagging):

1. At the discretion of the Landscape Architect and CSULB Grounds Manager, Plant Material will be subject to review, photographed, and selected/tagged by the Landscape Architect or CSULB Grounds Manager at the nursery, or other place of growth, prior to delivery to the Project Site. Contractor shall verify with the Landscape Architect if tagging operations are required.

2. Selecting/Tagging of Plant Materials at the nursery or place of growth does not cancel the right of the Landscape Architect to reject Plant Materials at the Project Site, if damaged or unacceptable conditions are found that were not detected at the nursery, place of growth, or in the submitted photographs.
 3. CSULB Grounds Manager or campus representative shall help in selection of the trees from the nursery.
 4. Photos of groundcovers and shrubs must be submitted to CSULB Grounds Manager for review.
- G. Plant Material Delivery: All plant material must be approved by Campus Grounds Department prior to delivery. Plant Material shall be delivered with original Plant Material tagging materials set in place, as selected and marked by the Landscape Architect at the nursery or place of growth. Contractor shall notify Landscape Architect upon delivery of Plant Material for review of stock and tagging materials. Plant Materials delivered without original tagging materials, or with broken, damaged, or altered tagging materials, shall be subject to rejection by the Landscape Architect. Rejected Plant Material shall be removed immediately.
- H. Pre-installation Conference: Conduct conference at Project Site to comply with requirements of Division 1 Section "Project Meetings".
- I. Protection of Existing Plant Material:
1. Refer to Requirements specified in Section 02231 – Tree Protection and Trimming.
 2. It is the intent of the Contract Documents that certain existing Plant Materials shall be retained. Prior to the removal of any Plant Materials, the Contractor shall confer with the Landscape Architect to determine which Plant Materials are to remain.
 3. All existing Plant Materials which are to remain in the project shall be tagged and identified by the Contractor prior to start of Work.
 4. Contractor shall be responsible for Plant Materials that are designated to remain. Damage to any Plant Materials which results in death or permanent disfiguration of said Materials shall result in compensation outlined in Section 02231 – Tree Protection and Trimming. The Landscape Architect shall be the sole judge of the condition of the Plant Materials.
 5. Existing Plant Materials designated to remain shall be protected at all times from damage by construction activity (tools, materials, equipment, personnel, etc.). Damage by the Contractor to existing Plant Materials shall be repaired at the Contractor's expense to the satisfaction of the Owner, as directed by the Landscape Architect.
 6. Contractor shall insure that no foreign material and/or liquid, such as paint, concrete, cement, oil, turpentine, acid or the like, be deposited or allowed to be deposited on soil within the drip line (the outside edge of the foliage overhang) of any Plant Material. Do not store construction materials, debris, or excavated material within drip line of existing Plant Material. Should any such poisoning of the soil occur, the Contractor shall thoroughly remove said soil as directed by the Landscape Architect and replace with acceptable soil at no additional cost to Owner.
 7. Excavation adjacent to existing Plant Materials: Where it is necessary to excavate in close proximity to the drip lines of existing Plant Materials, all possible caution shall be exercised to avoid injury to roots and trunk. Excavation close to Plant Materials shall be done by hand, with narrow-tine spading forks or other approved tools to comb soil to expose roots. Tunnel under roots two-inches (2") and larger in diameter. Cutting of roots two-inches (2") and larger shall be only on the approval of the Landscape Architect.
 8. Replacement of Damaged Plant Material: Replace existing Plant Material to remain as required, that are damaged by Contractor during construction with accepted Plant Material of the same species, size, and quantity as those damaged, at no additional cost to Owner. Owner shall be the sole judge as to the extent of the damage and the value of said damaged Plant Material.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. General: Do not prune Plant Material before delivery, except as approved by the Landscape Architect. Protect bark, branches, and root systems from sun scald, drying, sweating, whipping, and other handling and tying damage. Do not bend or bind-tie Plant Material in such a manner as to destroy natural shape.
 - 1. Immediately after digging field-grown Plant Materials, pack root systems in wet straw, hay, burlap, or other suitable material to keep root system moist until final planting installation.
 - 2. Deliver freshly dug field-grown Plant Materials with firm, natural balls of earth of sufficient depth to include fibrous and feeding roots, meeting or exceeding requirements of ANSI Z60.1 for root ball diameter.
- B. Handling Plant Materials:
 - 1. Handle balled and burlap Plant Material stock by the root ball.
 - 2. Handle container-grown Plant Materials only by their containers.
 - 3. DO NOT handle Plant Materials by their trunks or stems.
 - 4. DO NOT drop any Plant Materials.
 - 5. DO NOT bind or handle Plant Materials with wire or rope.
 - 6. Pad trunk and branches of Plant Materials whenever using hoisting cables, chains, or straps.
 - 7. Should the Contractor engage in handling any Plant Material(s) by any unacceptable method(s), the Landscape Architect shall reserve the right to reject any of the mishandled Plant Material(s). The Contractor shall replace rejected Plant Material(s) with approved Plant Material(s), at no additional cost to the Owner.
- C. Delivery: Provide protective covering during delivery. Deliver Plant Material only after preparations for planting have been completed and install immediately. If planting is delayed more than six (6) hours after delivery, set Plant Materials in shade, protect from weather and mechanical damage, and keep roots moist. Anchor plants to prevent damage from winds.
 - 1. Heel-in bare-root Plant Material stock. Soak roots in water for two (2) hours prior to planting.
 - 2. Set balled Plant Material stock on ground and cover ball with soil, peat moss, sawdust, or other acceptable material.
 - 3. DO NOT remove container-grown Plant Material stock from containers before time of planting.
 - 4. Water root systems of Plant Material stored on site with a fine-mist spray. Water as often as necessary to maintain root systems in a moist condition.

1.7 COORDINATION, SCHEDULING, AND OBSERVATIONS

- A. Acceptance: Do not install Plant Materials prior to acceptance of finish grades and installation of irrigation system.
- B. Utilities: Determine location of above grade and underground utilities and perform Work in a manner which will avoid damage to utilities. Hand excavate, as required. Maintain grade stakes until removal is mutually agreed upon by parties concerned.
- C. Excavation: When conditions detrimental to plant growth are encountered, such as rubble fill, adverse drainage conditions, or obstructions, cease planting operations and notify Landscape Architect for further direction.
- D. Construction Site Observations: Landscape Architect may observe installation Work herein this Section at Project Site for compliance with requirements for type, size, and quality. Landscape Architect retains right to observe installation of products and materials for defects and to reject unsatisfactory or defective product, material, or installation at any time during progress of Work. Contractor shall remove rejected Work immediately from Project site. The Contractor shall request, in writing, at least one (1) week in advance of the time when mandatory site observation(s) by the Landscape Architect are required.

1.8 PROJECT SITE CONDITIONS

- A. General: Installation of Plant Materials shall be performed only during the time of day and during seasons when satisfactory results can be expected, unless authorized by the Landscape Architect.
- B. Climate Restrictions: Do not install Plant Materials during rainy or inclement weather.

1.9 SUBSTITUTIONS

- A. Consideration: Plant Materials to be considered equal to the Plant Materials indicated herein this Section shall be reviewed by the Landscape Architect. Plant Materials with equal performance characteristics may be considered, providing deviations in dimensional size, color, composition, operation, and/or other characteristics do not change the design concept, aesthetic appearance, or intended performance, as solely judged by the Landscape Architect. The burden of proof on product equality is on the Contractor.
 - 1. Substituted Plant Materials shall be true to species and variety and shall conform to measurements specified, except that plants larger than specified may be used if accepted. If larger Plant Materials are accepted, increase the ball of earth in proportion to the size of the plant, as required. Plant Materials overgrown for their container size will be rejected.
- B. Specific reference to Manufacturer's names and products specified herein are used as standards of quality. This implies no right to the Contractor to substitute other materials without prior written approval by the Landscape Architect for Work under this Section.
- C. Plant Materials substituted and installed by the Contractor, without prior written approval by the Landscape Architect, may be rejected. Contractor shall not be entitled to be compensated by the Owner where the Contractor has installed rejected substitutions without receiving prior written approval.
- D. Contract Price: Substituted Plant Materials under this Section shall not increase the Contract price.

1.10 WARRANTY

- A. General: The Warranty indicated herein in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract, and shall be in addition to, and run concurrent with, other guarantees or warranties made by the Contractor under requirements of the Contract Documents.
- B. Warranty: Contractor shall warrant living Plant Materials under this Section for a period of one (1) year after date of Substantial Completion. Warrant against defects including death and unsatisfactory growth, except for defects resulting from lack of adequate maintenance, neglect, or abuse by the Owner; abnormal weather conditions unusual for the Warranty Period; or incidents which are beyond the Contractor's control.
- C. Replacement of Plant Material:
 - 1. Replace Plant Materials exhibiting conditions which are determined to be unacceptable due to workmanship by the Contractor, at no cost to the Owner, per the direction of the Landscape Architect.

2. Remove and replace dead or dying Plant Material immediately unless required to plant in the succeeding planting season.
3. Contractor shall be held responsible for a maximum of two (2) replacement of each failed Plant Material after Final Acceptance during the Warranty Period.
 - a). Closely match replacements to adjacent specimens of the same species. Apply requirements of this Specification to replacements.

1.11 FINAL ACCEPTANCE AND LANDSCAPE ESTABLISHMENT PERIOD

- A. Refer to Section 329813 – Landscape Establishment Period.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PLANT MATERIAL

- A. Immediately upon award of Contract for Work in this Section, the Contractor shall locate and purchase or hold for purchase plant material as required.
 1. Contractor shall verify with Landscape Architect of Plant Material that has been nursery “contract grown” by the Owner for use of Work under this Contract.
 2. Contractor shall review the condition of the Plant Material with Landscape Architect at the nursery maintaining the Plant Material prior to delivery, and when delivered to the Project Site.
- B. Quality: Plant Materials shall have a growth habit typical for each variety and species indicated in the Plant List (as detailed on the Contract Drawings).
 1. All Plant Materials shall be superior grade nursery stock, symmetrical, with tightly knit branching, so trained or favored in development and appearance in form, number of branches, compactness and symmetry, healthy, and vigorous in growth, as reviewed and determined by the Landscape Architect.
 2. Plant Materials shall be free from insect pests, eggs and larvae, plant diseases, sun scalds, fresh bark abrasions, excessive abrasions, windburn, salt burn, weeds, or other disfigurements or conditions, as reviewed and determined by the Landscape Architect.
 3. Plant Material shall be subject per the California State Department of Agriculture’s Regulations for Nursery Inspections of Rules and Grading.
 4. Growing Conditions: Plant Materials shall be nursery-grown in accordance with good horticultural practices under climatic conditions similar to those of project unless otherwise specifically authorized.
- C. Container Stock (excluding annuals) shall be grown in boxes or containers in which delivered for at least one (1) growing season, but not over two (2) years. Plant Material grown in boxes or containers shall be cultivated during this time to permit full rooting within the specified box or container to bind the planting soil, but not so long as to create a “root-bound” condition.
 1. Plant Material shall be completely free of circling, kinked or girdling trunk surface and center roots, and show no evidence of a pot-bound condition.
 2. No boxed nor container Plant Material shall be planted which have cracked or broken balls of earth when separated from their boxes or containers.
 3. No Plant Material shall be planted with damaged roots, broken root balls, or which are found to be “root-bound” when separated from their containers.
- D. Pruning:
 1. Do not prune Plant Materials unless directed by the Landscape Architect.
 2. Pruning of Plant Material as grown at the nursery shall conform to ANSI A300 standards.
 3. Consult with Landscape Architect for pruning Plant Materials after delivery and installation.

- E. Measurements: Measure Plant Material according to ANSI Z60.1 with branches and trunks or canes in their normal position. Do not prune to obtain required sizes.
 - 1. Take caliper measurement at a point on the trunk six-inches (6") above natural ground line for trees up to four-inches (4") in caliper (at a point twelve-inches (12") above the natural ground line for trees over four-inches (4") in caliper).
 - a. Measure foliage across mean foliage dimension when branches are in their normal upright position.
 - b. For trees to be supplied in "raised up" condition, foliage origin along main trunk shall be measured from soil line after installation.
 - c. Height and spread dimensions specified refer to main body of plant and not branch tip to tip. Properly trimmed plants shall measure the same in any direction. If a plant is unevenly grown, it shall be classified in the size category of the smallest dimension.
 - 2. Size Range: If a range of size is given, do not use Plant Materials less than the minimum size. The measurements specified are the minimum size acceptable and are the measurements after pruning, where pruning is required. Plant Materials that meet the measurements specified, but do not possess a normal balance between height and spread shall be rejected.
- F. Field Dug Stock: Prior to digging of field-grown Plant Materials, insure that excess loose fill resulting from cultivation around trunks/stems and over roots be removed down to natural finish grade at crown of Plant Materials. During digging, verify that size of tree spade or other equipment is adequate to encompass the actively growing root zone of all Plant Materials. Plant Materials which, after digging, show mostly large fleshy roots and few fibrous roots, will be rejected.
- G. Condition of Root Systems: Plant Materials must prove to be completely free of circling, kinked or girdling trunk surface and center roots and show no evidence of a root-bound condition. Upon inspection by Landscape Architect at the job site, if five-percent (5%) or more of the plants of each species are found to contain kinked, circling or girdling roots, all plants of that species shall be rejected.
- H. Unacceptable Trees: Trees that have damaged, broken, pruned, or crooked leaders will be rejected. Trees having a main leader shall not have been headed back. Trees with abrasions of the bark, sunscalds, disfiguring knots, or fresh cuts of limbs over 3/4 in. which have not completely callused will be rejected.

2.2 SHADE AND FLOWERING TREES

- A. Shade and Flowering Trees: Single-stem trees with straight trunk, well-balanced crown, and intact leader, of height and caliper indicated, conforming to ANSI Z60.1 for type of trees required, subject to review and acceptance by the Landscape Architect. Container-grown trees will be acceptable and shall be subject to meeting ANSI Z60.1 limitations for container stock.
 - 1. Branching Height: 1/2 of tree height, unless otherwise indicated on Contract Drawings.
- B. Small Trees: Small upright or spreading type, branched or pruned naturally according to species and type, and with relationship of caliper, height, and branching recommended by ANSI Z60.1, subject to review and acceptance by the Landscape Architect. Container-grown trees will be acceptable and shall be subject to meeting ANSI Z60.1 limitations for container stock.
 - 1. Form: As indicated on the Contract Drawings for individual selected species.
- C. Field Dug Specimen Trees:
 - 1. Form and Size: As specified on the Contract Documents for height, spread, and/or caliper, subject to review and acceptance by the Landscape Architect at the supplying nursery prior to delivery and installation. Provide superior quality, full, symmetrical, well-rooted, upright, spreading, with well-balanced crown.
 - 2. Subject to compliance with requirements, provide trees by one (1) of the following supplying Nurseries:
 - a. Valley Crest Tree Company – Specimen Tree Division, 818-899-1100.

- b. Senna Tree Company, 818-957-5755.
- c. or equal, as approved by the Landscape Architect.

2.3 SHRUBS

- A. Form and Size: Shrubs with not less than the minimum number of canes required by and measured according to ANSI Z60.1 for type, shape, and height of Shrub, subject to review and acceptance by the Landscape Architect. Container-grown Shrubs will be acceptable in lieu of balled and burlapped.
 - 1. Container-grown Shrubs shall be subject to meeting ANSI Z60.1 limitations for container stock, and other requirements as indicated on the Contract Drawings.

2.4 CONIFEROUS EVERGREENS

- A. Form and Size: Normal-quality, well-balanced, well-rooted, coniferous evergreens, of type, height, spread, and shape required, subject to review and acceptance by the Landscape Architect.
 - 1. Boxed or container-grown coniferous evergreens will subject to meeting ANSI Z60.1 limitations for container stock, and other requirements as indicated on the Contract Drawings.

2.5 BROADLEAF EVERGREENS

- A. Form and Size: Normal-quality, well-balanced, well-rooted , broadleaf evergreens, of type, height, spread, and shape required, subject to review and acceptance by the Landscape Architect.
 - 1. Container-grown broadleaf evergreens shall be subject to meeting ANSI Z60.1 limitations for container stock, and other requirements as indicated on the Contract Drawings.

2.6 GROUND COVERS

- A. Provide ground covers full, established, and well-rooted in removable flats, containers, or integral peat pots, and with not less than the minimum number and length of runners required by ANSI Z60.1 for the container size indicated, and other requirements as indicated on the Contract Drawings, subject to review and acceptance by the Landscape Architect.

2.7 VINES

- A. Form and Size: Normal-quality, established, full, well-balanced, well-rooted, nursery staked, of type, height, spread, and shape required, subject to review and acceptance by the Landscape Architect.
 - 1. Container-grown vines shall be subject to meeting ANSI Z60.1 limitations for container stock.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. NO WORK UNDER THIS SECTION SHALL COMMENCE UNTIL SUBMITTALS UNDER THIS SECTION HAVE BEEN REVIEWED ACCORDINGLY BY THE LANDSCAPE ARCHITECT.

- B. Prior to commencing Work under this Section, Contractor shall examine previously installed Work from other trades and verify that such Work is complete and to the point where Work herein may commence properly. Do not proceed with Work until unsatisfactory conditions have been corrected.
- C. Installation practices of the Plant Materials shall be performed during those periods when weather and soil conditions are suitable and in accordance with locally accepted horticultural practices, as judged by the Landscape Architect.
 - 1. Soil moisture levels prior to planting shall be no less than seventy-five-percent (75%) of field capacity. The determination of adequate soil moisture for planting shall be in the sole judgment of the Landscape Architect, and their decision shall be final.
 - a. If the soil moisture level is found to be insufficient for planting installation, planting pits shall be filled with water and allowed to drain before commencing planting operations.
 - b. Any planting area that may become compacted in excess of eighty-five-percent (85%) relative compaction (due to construction operations or other activities during the Contract) shall be tilled and thoroughly cross-ripped to a minimum depth of nine-inches (9") to alleviate the condition, taking care to avoid all existing subsurface utilities, drainage, etc.
 - c. Do not commence planting installation prior to acceptance of Section 02910 – Soil Preparation.
- D. Contractor shall notify the Landscape Architect, in writing, on the anticipated commencement date and length of duration of the landscape installation.
- E. Preparation of Planting Installation: Lay out individual Plant Material locations and areas for multiple plantings. Stake locations, outline areas, and gain the Landscape Architect's acceptance prior to commencing physical planting installation. Contractor shall make minor adjustments to the planting layout as required, per the direction of the Landscape Architect.
- F. No more Plant Materials shall be distributed in the planting area on any day than can be installed and watered on that day. Plant Materials shall be planted and watered immediately after the removal of their containers, as applicable.
- G. Contractor shall protect existing and new improvements and systems installed prior to planting installation. Maintain protection in place until completion of Work and Landscape Establishment Period.
- H. Finish Grades for planting areas shall have been established (per Section 02310 – Finish Grading) prior to Work under this Section. Verify that grades are within one-inch plus or minus (1" +/-) of the required finish grade, and that all proper soil amendments and fertilizers have been furnished and installed accordingly as specified (per Section 02910 – Soil Preparation).
 - 1. Maintain positive surface drainage of all planted areas throughout the duration of the Contract.
- I. Pre-Planting: Where Plant Materials are to be pre-planted to permit site improvements to be installed around them, Contractor shall be responsible for the accurate layout and placement of those Plant Materials, as measured to their centerlines. Confirm designated pre-planting operations with Landscape Architect prior to commencing Work. Contractor shall also be responsible for the protection of pre-planted Plant Materials while other Work is taking place around them. Provide regular irrigation, as necessary, prior to installation and functioning of irrigation systems (per Section 02810 – Irrigation Systems).

3.2 EXCAVATION FOR PLANT MATERIAL

- A. General: Upon completion of applicable pre-planting soil preparation requirements indicated in Section 02910 – Soil Preparation, excavate planting hole(s) for Plant Material with scarified vertical sides, with the bottom of the excavated hole slightly raised and compacted at the center to assist drainage and to minimize settlement of the Plant Material. Excavate holes according to the spacing alignment (i.e. hedge

spacing, grid spacing, triangular spacing, etc.) and the on-center (O.C.) spacing intervals (i.e. 24" O.C. etc.) indicated on the Contract Drawings. Loosen any hard subsoil in the bottom of the excavation where evident, and remove all rocks greater than one-half-inch (1/2") in diameter, trash, debris, etc. Retain the excavated soil for use as part of the Amended Planting Backfill Mixture (as indicated in Section 02910 – Soil Preparation).

1. Bare-Root Plant Material:

- a. Excavate at least twenty-four-inches (24") wider than the perimeter of the bare root spread, and deep enough to allow setting of the roots on a compacted layer of native planting soil, where the top of the plant's root collar is one-inch (1") higher than finished grade or as further directed by the Landscape Architect:
- b. Compacted Setting Layer: Provide a crown of a minimum six-inch (6") depth of native planting soil.
- c. Where Tree Root Aeration Units are indicated, provide further excavation in the planting hole by auger to the required minimum depth allowing for installation of the Tree Root Aeration Unit assembly.

2. Balled and Burlap Plant Material:

- a. Excavate the planting hole to the width and depth indicated in the Contract Drawings. Depth of the planting hole includes the depth indicated for the compacted setting layer at the bottom of the excavation, where the top of the plant's root collar is one-inch (1") higher than finished grade or as further directed by the Landscape Architect:
- b. Compacted Setting Layer: Provide a crown of a minimum six-inch (6") depth of native planting soil.
- c. Where Tree Root Aeration Unit(s) are indicated provide further excavation in the planting hole by auger to the required minimum depth allowing for installation of the Tree Root Aeration Unit assembly.

3. Container-Grown Plant Material:

- a. Excavate the planting hole to the width and depth indicated on the Contract Drawings. Depth of the planting hole includes the depth indicated for the compacted setting layer at the bottom of the excavation, where the top of the plant's root collar is one-inch (1") higher than finished grade or as further directed by the Landscape Architect:
- b. Compacted Setting Layer: Provide a crown of a minimum six-inch (6") depth of native planting soil.
- c. Where Tree Root Aeration Unit(s) are indicated, provide further excavation in the planting hole by auger to the required minimum depth for installation of the Tree Root Aeration Unit assembly.

4. Field Grown/Specimen Trees:

- a. Excavate the planting hole to the width and depth indicated on the Contract Drawings. Depth of the planting hole includes the depth indicated for the compacted setting layer at the bottom of the excavation, where the top of the plant's root collar is one-inch (1") higher than finished grade or as further directed by the Landscape Architect:
- b. Compacted Setting Layer: Provide a crown of a minimum six-inch (6") depth of native planting soil.
- c. Where Tree Root Aeration Unit(s) are indicated, provide further excavation in the planting hole by auger to the required minimum depth for installation of the Tree Root Aeration Unit assembly.
- d. In areas where special subsurface drainage for planting is indicated, tie drainage pipes, as required, into the drain system.
- c. Excavate planting hole at 3x the diameter of the rootball.

B. Obstructions: Notify the Landscape Architect immediately if unexpected rock, debris, contaminants, obstructions, or other items that are detrimental to the healthy sustained growth of Plant Material is encountered in the excavation process.

1. Hardpan Layer: If encountered, drill six-inch (6") diameter holes into free-draining strata or to a depth of ten-feet (10'), whichever is less, and backfill with free-draining material.

- C. Drainage: Notify the Landscape Architect if subsoil conditions show evidence of unexpected water seepage or retention in planting holes.

3.3 PLANTING PLANT MATERIAL

- A. Bare Root Plant Material: Set Bare Root Plant Material plumb and in center of the excavated hole, with top of root ball set properly at the adjacent finish grade as indicated. Set Bare Root Plant Material in the proper spacing and/or alignment(s) as indicated on the Contract Documents, or as further directed at the Project Site by the Landscape Architect.
1. Thoroughly soak the roots of the Bare Root Plant Material in clean water for a minimum of twelve (12) hours but no more than twenty-four (24) hours to fully hydrate the root mass. Do not soak above the root crown.
 2. Remove wood shavings or other material used to keep the exposed root mass in a moist condition.
 3. Carefully place the Plant Material stock on the specified setting layer of compacted native soil, with the top of root mass set approximately one-inch (1") above the finished grade to allow for settlement of the Plant Material within the excavated planting hole. Provide an orientation of the Plant Material that is confirmed and acceptable by the Landscape Architect. During the process of determining an acceptable orientation of the Plant Material, carefully handle the Plant Material by its trunk.
 4. Prepare the Amended Planting Backfill Mixture: Amend each cubic yard (cu/yd) of native soil excavated from the planting hole by incorporating and thoroughly mixing/blending the following:
 - a. $\frac{1}{4}$ yard of Bulk Composted Organic Soil Amendment Material (per Section 02910 – Soil Preparation).
 - b. $\frac{1}{2}$ pound of Granular Soil Conditioning Material & Fertilizer (per Section 02910 – Soil Preparation).
 - c. Add Mycorrhizal Inoculum to the excavated native soil, (per Section 02910 – Soil Preparation), per the Manufacturer's latest printed instructions.
 - 1) Pending the results of the Agronomic Soil Fertility Report, the Amended Planting Backfill Mixture may be modified accordingly to include additional soil amendments or fertilizers (gypsum, iron, potash, etc.) or the ratios as indicated in the Mixture indicated above may be modified.
 - a) The cost of providing modifications to the Amended Planting Soil Backfill Mixture (as recommended through the Agronomic Soil Fertility Report and as directed by the Landscape Architect) shall be borne by the Contractor.
 5. Install the Tree Root Aeration Unit(s) prior to backfilling operations, as required.
 6. Backfilling the excavated planting hole:
 - a. Place the Amended Planting Backfill Mixture around the Plant Material root mass in the excavated planting hole. Place the Mixture in six-inch (6") lifts, tamping each lift accordingly to settle the Mixture and eliminate voids and air pockets.
 - b. Maintain the Plant Material plumb while working the Mixture around the root mass. When the planting hole is approximately half-backfilled, water thoroughly before placing the remainder of the Mixture.
 - c. Add the Fertilizer Tablets and other amendments, (per Section 02910 – Soil Preparation) as required, at the prescribed application rates (as indicated per Section 02910 – Soil Preparation) or if not indicated, per the Manufacturer's latest printed instructions.
 - d. Place the final layers of the Amended Planting Backfill Mixture, tamping accordingly, to the top of the root mass.
 - e. Dish and tamp top of the Mixture to form a three-inch (3") deep watering basin centered on the Plant Material's trunk to the rim width of the planting hole.
 - f. Thoroughly mix together water and Plant Vitamin/Hormone Stimulant in application ratio as recommended by Stimulant Manufacturer. Apply liquid matrix in sufficient quantity to thoroughly saturate the basin to settle the Mixture, and to eliminate voids and air pockets. Should any portions of the root mass be exposed, add additional Mixture as needed to thoroughly cover the root mass.

7. Mulching: Apply mulch in watering basins as indicated on the Contract Drawings.

B. Balled and Burlapped Plant Material: Set the Balled and Burlapped Plant Material plumb and in center of the excavated hole, with top of the root ball raised above adjacent finish grade as indicated. Set Balled and Burlapped Plant Material in the proper spacing and/or alignment(s) as indicated on the Contract Documents, or as further directed at the Project Site by the Landscape Architect.

1. Carefully place the Balled and Burlapped Plant Material stock on the specified setting layer of compacted native soil, with the top of root ball set one-inch (1") above the finished grade to allow for settlement of the Plant Material within the excavated planting hole. Provide the orientation of the Plant Material that is confirmed and accepted by the Landscape Architect. During the process of determining an acceptable orientation of the Plant Material, handle the Plant Material by its root ball; avoid handling the Plant Material by its trunk.
2. Once orientation is accepted, carefully remove the burlap and wire baskets from the tops of the root ball and partially from the sides, but do not remove from under the root ball. Do not damage the root ball or any part of the plant. Plant Material shall be rejected if the root ball is cracked or broken before or during the planting operation.
3. Prepare the Amended Planting Backfill Mixture: Amend each cubic yard (cu/yd) of native soil excavated from the planting hole by incorporating and thoroughly mixing/blending the following:
 - a. $\frac{1}{4}$ yard of Bulk Composted Organic Soil Amendment Material (per Section 02910 – Soil Preparation).
 - b. $\frac{1}{2}$ pound of Granular Soil Conditioning Material & Fertilizer (per Section 02910 – Soil Preparation).
 - c. Add Mycorrhizal Inoculum to the excavated native soil, (per Section 02910 – Soil Preparation), per the Manufacturer's latest printed instructions.
 - 1) Pending the results of the Agronomic Soil Fertility Report, the Amended Planting Backfill Mixture may be modified accordingly to include additional soil amendments or fertilizers (gypsum, iron, potash, etc.) or the ratios as indicated in the Mixture indicated above may be modified.
 - a) The cost of providing modifications to the Amended Planting Soil Backfill Mixture (as recommended through the Agronomic Soil Fertility Report and as directed by the Landscape Architect) shall be borne by the Contractor.
4. Install the Tree Root Aeration Unit(s) prior to backfilling operations, as required.
5. Backfilling the excavated planting hole:
 - a. Place the Amended Planting Backfill Mixture around the root ball in the excavated planting hole. Place the Mixture in six-inch (6") lifts, tamping each lift accordingly to settle the Mixture and eliminate voids and air pockets.
 - b. Maintain the plant plumb while working the Mixture around the root ball. When the planting hole is approximately half-backfilled, water thoroughly before placing the remainder of the Mixture.
 - c. Add the Fertilizer Tablets and other amendments, (per Section 02910 – Soil Preparation) as required, at the prescribed application rates indicated herein this Article or if not indicated, per the Manufacturer's instructions.
 - d. Place the final layers of the Mixture, tamping accordingly, to the top of the root ball. Do not place the Mixture on top of the root ball.
 - e. Dish and tamp top of the Mixture to form a three-inch (3") deep watering basin centered on the Plant Material's trunk to the rim width of the planting hole. Do not cover the top of the root ball with the backfill mixture.
 - f. Thoroughly mix together water and Plant Vitamin/Hormone Stimulant in application ratio as recommended by Stimulant Manufacture. Apply liquid matrix in sufficient quantity to thoroughly saturate the basin to settle the Mixture, and to eliminate voids and air pockets. Should any portions of the root mass be exposed, add additional Mixture as needed to thoroughly cover the root mass.
6. Mulching: Apply mulch in watering basins as indicated on the Contract Drawings.

- C. Container-Grown Plant Material: Set Container-Grown Plant Material plumb and in the center of the excavated planting hole, with top of the root ball raised above adjacent finish grade as indicated. Set Container-Grown Plant Material in the proper spacing and/or alignment(s) as indicated on the Contract Documents, or as further directed at the Project Site by the Landscape Architect.
1. For plastic container stock (4" pot, 1-gallon, 5-gallon, 15-gallon, etc.), carefully remove the plant container prior to setting the plant in the excavated hole so as not to damage root ball. Tip container to horizontal position and shake carefully to remove Plant Material. Support root ball during installation to prevent cracking or shedding of soil.
 2. Set the Plant Material stock on the specified setting layer of compacted native soil, with the top of root ball set one-inch (1") above the finished grade to allow for settlement of the Plant Material within the excavated planting hole. Provide the orientation of the Plant Material that is confirmed and accepted by the Landscape Architect. During the process of determining an acceptable orientation of the plant material, carefully handle the Plant Material by its container; avoid handling the Plant Material by its trunk.
 - a. Plant Material with a damaged root ball upon removal of the container, or if the root ball fails to thoroughly hold the soil as it is removed from the container, or if the plant is mishandled or damaged during planting operations, shall be rejected.
 3. For wooden boxed container stock, carefully set whole boxed container of the Plant Material stock on the specified setting layer of compacted native soil, with the top of root ball set one-inch (1") above the finished grade to allow for settlement of the Plant Material within the excavated planting hole. Provide the orientation of the Plant Material that is confirmed and accepted by the Landscape Architect. During the process of determining an acceptable orientation, carefully handle the Plant Material by its container; avoid handling the Plant Material by its trunk or branches. Once orientation is accepted, remove the steel strapping and the sides of the wooden container so as not to damage the root ball or any part of the plant. Do not remove the bottom of the wooden container. Discard sides.
 - a. Plant Material with a damaged root ball upon removal of the container, or if the root ball fails to thoroughly hold the soil as it is removed from the container, or if the plant is mishandled or damaged during planting operations, shall be rejected.
 4. Scarification: After removing container from plant, scarify the sides of the root ball to a depth of one-inch (1") at four (4) to six (6) equally-spaced locations around the perimeter of the root ball or at twelve-inch (12") intervals on sides of wooden boxed container stock. Cut and remove circling roots over 3/8 in. diameter.
 5. Prepare the Amended Planting Backfill Mixture: Amend each cubic yard (cu/yd) of native soil excavated from the planting hole by incorporating and thoroughly mixing/blending the following:
 - a. ¼ yard of Bulk Composted Organic Soil Amendment Material (per Section 02910 – Soil Preparation).
 - b. ½ pound of Granular Soil Conditioning Material & Fertilizer (per Section 02910– Soil Preparation).
 - c. Add Mycorrhizal Inoculum to the excavated native soil, (per Section 02910 – Soil Preparation), per the Manufacturer's latest printed instructions.
 - 1) Pending the results of the Agronomic Soil Fertility Report, the Amended Planting Backfill Mixture may be modified accordingly to include additional soil amendments or fertilizers (gypsum, iron, potash, etc.) or the ratios as indicated in the Mixture indicated above may be modified.
 - a) The cost of providing modifications to the Amended Planting Soil Backfill Mixture (as recommended through the Agronomic Soil Fertility Report and as directed by the Landscape Architect) shall be borne by the Contractor.
 6. Install the Tree Root Aeration Unit(s) prior to backfilling operations, as required.
 7. In areas where indicated on the Contract Drawings, install the Deep Watering Bubbler(s) as part of the irrigation system.
 8. Backfilling the excavated planting hole:
 - a. Place the Amended Planting Backfill Mixture around the root ball in the excavated planting hole. Place the Mixture in six-inch (6") lifts, tamping each lift accordingly to settle the Mixture and eliminate voids and air pockets. Foot tamp the backfill, as required.

- b. Maintain the plant plumb while working the Mixture around the root ball. When the planting hole is approximately half-backfilled, water thoroughly before placing the remainder of the Mixture.
 - c. Add the Fertilizer Tablets and other amendments (per Section 02910 – Soil Preparation) as required, at the prescribed application rates indicated herein this Article or if not indicated, per the Manufacturer's instructions.
 - d. Place the final layers of the Mixture, tamping accordingly, to the top of the root ball. Do not place the Mixture on top of the root ball.
 - e. Dish and tamp top of the Mixture to form a three-inch (3") deep watering basin centered on the Plant Material's trunk to the rim width of the planting hole. Do not cover the top of the root ball with the backfill mixture.
 - f. Thoroughly mix together water and Plant Vitamin/Hormone Stimulant in application ratio as recommended by Stimulant Manufacture. Apply liquid matrix in sufficient quantity to thoroughly saturate the basin to settle the Mixture, and to eliminate voids and air pockets. Should any portions of the root mass be exposed, add additional Mixture as needed to thoroughly cover the root mass.
 9. Mulching: Apply mulch in watering basins as indicated on the Contract Drawings.
- D. Field-Dug Specimen Plant Material: Set Field-Dug Specimen Plant Material plumb and in the center of the excavated planting hole, with top of the root ball raised above adjacent finish grades as indicated. Set Field-Dug Specimen Plant Material in the proper spacing and/or alignment(s) as indicated on the Contract Documents, or as further directed at the Project Site by the Landscape Architect.
1. After excavation of the planting hole, provide subsurface piping drainage and/or Tree Root Aeration Units as indicated on the Contract Drawings. Tie subsurface drainage into storm drainage system, where required. Install the Tree Root Aeration Units, where required.
 2. Carefully set the Field-Dug Specimen Plant Material stock on the specified setting layer of compacted native soil, with the top of root ball set one-inch (1") above the finished grade to allow for settlement of the Plant Material within the excavated planting hole. Provide the orientation of the Plant Material that is confirmed and accepted by the Landscape Architect. During the process of determining an acceptable orientation of the Plant Material, carefully handle the Plant Material by a cradle around its root ball mass or by its planting container; avoid handling the Plant Material by its trunk.
 - a. For Field-Dug Specimen Plant Material delivered in a wooden boxed container, do not remove sides or bottom of the container until the Specimen's orientation is accepted by the Landscape Architect. Once orientation is accepted, remove steel strapping and the sides of the wooden container so as not to damage the root ball or any part of the Specimen. Do not remove the bottom of the wooden container. Discard sides.
 - 1) Any Specimen with a damaged root ball upon removal of the container, or if the root ball fails to thoroughly hold the soil as it is removed from the container, or if the plant is mishandled or damaged during planting operations, shall be rejected.
 3. Scarification: After removing container from plant, scarify the sides of the root ball to a depth of one-inch (1") at four (4) to six (6) equally-spaced locations around the perimeter of the root ball or at twelve-inch (12") intervals on sides of wooden boxed container stock. Cut and remove circling roots over 3/8 in. diameter.
 4. Prepare the Amended Planting Backfill Mixture: Amend each cubic yard (cu/yd) of native soil excavated from the planting hole by incorporating and thoroughly mixing and blending in the following:
 - a. ¼ yard of Bulk Composted Organic Soil Amendment Material (per Section 02910 – Soil Preparation).
 - b. ½ pound of Granular Soil Conditioning Material & Fertilizer (per Section 02910 – Soil Preparation).
 - c. Add Mycorrhizal Inoculum to the excavated native soil, (per Section 02910 – Soil Preparation), per the Manufacturer's latest printed instructions.
 - 1) Pending the results of the Agronomic Soil Fertility Report, the Amended Planting Backfill Mixture may be modified accordingly to include additional soil

amendments or fertilizers (gypsum, iron, potash, etc.) or the ratios as indicated in the Mixture indicated above may be modified.

- a) The cost of providing modifications to the Amended Planting Soil Backfill Mixture (as recommended through the Agronomic Soil Fertility Report and as directed by the Landscape Architect) shall be borne by the Contractor.
5. In areas indicated on the Contract Drawings, install the Deep Watering Bubblers as part of the irrigation system (per Section 02810 – Irrigation Systems).
6. Install the Tree Root Aeration Unit(s) prior to backfilling operations, as required.
7. Backfilling the excavated planting hole.
 - a. Place the Amended Planting Backfill Mixture around the root ball in the excavated planting hole. Place the Mixture in six-inch (6") lifts, tamping each lift accordingly to settle the Mixture and eliminate voids and air pockets.
 - b. Maintain the plant plumb while working the Mixture around the root ball. When the planting hole is approximately half-backfilled, water thoroughly before placing the remainder of the Mixture.
 - c. Add the Fertilizer Tablets and other amendments, as required, at the prescribed application rates indicated herein this Article or if not indicated, per the Manufacturer's instructions.
 - d. Place the final layers of the Mixture, tamping accordingly, to the top of the root ball. Do not place the Mixture on top of the root ball.
 - e. Dish and tamp top of the Mixture to form a three-inch (3") deep watering basin centered on the Plant Material's trunk to the rim width of the planting hole.. Do not cover the top of the root ball with the backfill mixture.
 - f. Thoroughly mix together water and Plant Vitamin/Hormone Stimulant in application ratio as recommended by Stimulant Manufacture. Apply liquid matrix in sufficient quantity to thoroughly saturate the basin to settle the Mixture, and to eliminate voids and air pockets. Should any portions of the root mass be exposed, add additional Mixture as needed to thoroughly cover the root mass.
8. Mulching: Apply mulch in watering basins as indicated on the Contract Drawings.
- E. Plant Settling and Orientation: Plant Material that has settled deeper than the surrounding grade shall be excavated and raised to the correct level, to the satisfaction of the Landscape Architect. Plant Material installed without direction and/or approval as to its proper orientation shall be subject to excavation and acceptable orientation, to the satisfaction of the Landscape Architect.
- F. Fertilizer Tablet(s) Application Rate: Refer to Section 02910 – Soil Preparation.

3.4 PLANTING GROUND COVERS AND VINES

- A. General: Upon completion of applicable pre-planting soil preparation requirements indicated in Section 02910 – Soil Preparation, excavate planting hole(s) for Ground Covers and/or Vine Plant Material with scarified vertical sides, with the bottom of the excavated hole slightly raised and compacted at the center to assist drainage and to minimize settlement of the Plant Material. Refer to requirements indicated in Part III of this Section for Excavation.
 1. Plant Settling: Plant Material that has settled deeper than the surrounding grade shall be raised to the correct level.
- B. Excavate holes according to the spacing alignment (i.e. triangular spacing, etc.) and the on-center (O.C.) spacing intervals (i.e. 24" O.C. etc.) indicated on the Contract Drawings. Loosen any hard subsoil in the bottom of the excavation where evident, and remove all rocks greater than one-half-inch (1/2") in diameter, trash, debris, etc.
- C. Obstructions: Notify the Landscape Architect immediately if unexpected rock, debris, contaminants, obstructions, or other items that are detrimental to the healthy sustained growth of Plant Material is encountered in the excavation process.

- D. Ground Covers: Follow applicable planting requirements per Articles 3.02 and 3.03 indicated herein this Section.
1. Carefully set root mass into excavated hole, spreading roots, and backfill with planting soil.
 2. Add Fertilizer Tablets and other amendments, as required, within backfill.
 3. Work soil around roots to eliminate air pockets, and provide a slight saucer indentation around plants to retain surface water.
 4. Water thoroughly after planting, taking care not to cover plant crowns with wet soil.
- E. Vines: Follow applicable planting requirements per Articles 3.02 and 3.03 indicated herein this Section.
1. Carefully set root mass into excavated hole, spreading roots, and backfill with planting soil.
 2. Add Fertilizer Tablets and other amendments, as required, within backfill.
 3. Work soil around roots to eliminate air pockets, and provide a slight saucer indentation around plants to retain surface water.
 4. Water thoroughly after planting, taking care not to cover plant crowns with wet soil.
 5. After planting, remove nursery training stakes, tags, and ties. Carefully secure Vines to adjacent surface as indicated on Contract Drawings or as directed by the Landscape Architect.
 6. "Fan out" the Vine canes/branches in a symmetrical/radiating pattern from the root crown of the vine. Secure canes/branches to the adjacent surface (wall, fence, etc.) with specified ties, minimum of three (3) ties per vine, or in an adequate quantity to satisfactorily train/support the vine.
 7. Backfill and tamp the nursery stake void(s) with planting soil.
- F. Espaliers: Follow applicable planting requirements per Articles 3.02 and 3.03 indicated herein this Section.
1. Orient Espaliers with most attractive side of Espalier set facing outwards (i.e. when placed against a building or fence, orient with most attractive side away from building or fence, as acceptable to the Landscape Architect.
 2. Espaliers shall be set with the wooden framing structure lying parallel to the face of the building, wall, fence, etc., and close enough to allow growth of the espalier to adequately fill to the face of the building, wall, fence, etc. Do not remove wooden framing structure unless otherwise directed by the Landscape Architect.
 3. Carefully set root mass into excavated hole, spreading roots, and backfill with planting soil.
 4. Add Fertilizer Tablets and other amendments, as required, within backfill.
 5. Work soil around roots to eliminate air pockets, and provide a slight saucer indentation around plants to retain surface water.
 6. Water thoroughly after planting, taking care not to cover plant crowns with wet soil.

3.5 PRUNING PLANT MATERIAL

- A. At no time shall Plant Material be pruned, trimmed, thinned, shaped, or topped prior to delivery. Pruning, trimming, thinning, shaping, or topping of Plant Material shall be only conducted on the Project Site, and under the presence and direction of the Landscape Architect or approved Certified Arborist. Plant Material that has been pruned and delivered to the Project Site without prior approval by the Landscape Architect or an approved Certified Arborist will be rejected.
- B. When directed by the Landscape Architect or an approved Certified Arborist, Contractor shall prune, thin, and shape plant material, according to standard horticultural practice, to preserve the natural character of the Plant Material.
1. Pruning and remedial work shall be done per ANSI A300.
 2. Prune trees to retain required height and spread. Do not cut tree leaders; remove only injured or dead branches from trees.
 3. Prune shrubs accordingly to retain natural character.
 4. Provide pruning, cabling and bracing, irrigation, pest and disease control and other remedial treatments as recommended to assure the long-term health of the trees and existing vegetation, and the safety of persons and property.

5. Newly planted trees shall be pruned near the termination of the Landscape Establishment Period, per the direction of the Landscape Architect, as required.

3.6 CLEAN UP AND PROTECTION

- A. During installation operations, keep Work area in an orderly and safe condition. Contractor shall remove trash caused from his Work on a weekly basis throughout the duration of the Work.
- B. Protect landscaping from damage due to landscape operations, operations by other Contractors and trades, and trespassers. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged landscape work as directed.
- C. Upon completion of his Work under this Section, the Contractor shall remove rubbish, waste, debris, excess construction materials, surplus soil and other items resulting from construction operations and legally dispose of it off the Owner's property.
- D. Scars, ruts, or other marks in the ground caused by the Contractor's Work shall be repaired.
- E. Remove equipment and implements of service, and leave the entire Project Site area in a neat, clean, and Owner-approved condition.
- F. Labels: Remove all nursery-type labels, flags, and or identification markings from Plant Materials.

3.7 FINAL REVIEW

- A. A.Final Review under this Section shall be performed upon completion of the Landscape Establishment Period. Refer to Section 02935 – Landscape Establishment Period, for requirements.

END OF SECTION

SECTION 02935 - LANDSCAPE ESTABLISHMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes materials, labor, apparatus, tools, equipment, temporary construction, transportation, and services necessary for and incidental to performing the proper completion of Work, as required to make a complete Landscape Establishment Period, as specified during progress of the Work, after installation, for a designated period after Preliminary Acceptance, as shown in the Contract Drawings, and as specified herein this Section.
- B. Work under this Section consists of, but is not necessarily limited to, furnishing and installing the following:
 - 1. Establishment of Landscape Installation, for a given duration as specified herein this Section.

1.3 DEFINITIONS AND APPLICABLE STANDARDS

- A. References:
 - 1. USDA – United States Department of Agriculture.
 - 2. ASTM – American Society for Testing & Materials.
 - 3. ANSI – American National Standards Institute.
 - 4. ISA – International Society of Arboriculture.
- B. Standards:
 - 1. American National Standard for Tree Care Operation, Tree, Shrub, and Other Woody Plant Maintenance (ANSI A300), American National Standards Institute, Latest Edition.
 - 2. American National Standard for Tree Care Operations (ANSI Z133), American National Standards Institute, Latest Edition.
 - 3. Tree Pruning Guidelines, International Society of Arboriculture, 1995 Edition.
 - 4. Pruning Standards for Shade Trees, National Arborists Association, Latest Edition.

1.4 SUBMITTALS

- A. General: Submit each item in this Article in four (4) bound Submittal Booklets for review by the Landscape Architect.
- B. Submittal Booklets: Each Submittal Booklet under this Section shall be tabbed into specific sections, containing clearly identified and legible (through yellow highlighter or other specific identification methods) information indicated herein this Article.
 - 1. Quality Control Submittals:
 - a. Schedule of maintenance operations and monthly status report, including list of equipment, materials proposed for the job, and watering schedule(s).

- b. Licenses, permits and insurance required by the local jurisdiction, the State, or Federal government, pertaining to Work under this Section.
 - 1) Pesticide Applicator: Valid California Qualified Applicator Certificate (QAC), with "B – Landscape Maintenance" Category, as administered by the California Department of Pesticide Regulation (DPR).
 - 2) Employer of the California Qualified Applicator Certificate (QAC), with "B – Landscape Maintenance" Category:
 - a) The company which employs the person holding the QAC must possess a Maintenance Gardener Pest Control Business License, as administered by the California Department of Pesticide Regulation (DPR).
- c. Monthly record of herbicides, insecticides and disease control chemicals used for the Project.
- d. Written application recommendation by a licensed agricultural pest control advisor for weed, pest and disease controls restricted by the Director of Agriculture proposed for this Work.
- 2. Project Closeout Submittal:
 - a. Include in a single 3-ring binder a Landscape Maintenance Manual for use by the Owner, containing an indexed collection of all schedules, records and permits listed above, including documentation of accepted condition of planting and irrigation at Final Acceptance.

C. Scaled Shop Drawings: Not Required.

D. Field-Constructed Mock-ups: Not Required.

E. Qualification Data: Submit names for firms and persons specified in the "Quality Assurance and Control" Article to demonstrate their capabilities and experience on similar Landscape Planting Accessories installations.

F. Submittals under this Article will be rejected and returned without the benefit of review by the Landscape Architect if they are difficult to read due to insufficient scale, poor image quality, or poor drafting quality; or if all of the required information is missing or not presented in the format as requested. Partial Submittals will not be accepted.

G. No Work shall proceed under this Section until Submittal requirements indicated herein have been reviewed accordingly by the Landscape Architect.

1.5 QUALITY ASSURANCE AND CONTROL

A. Qualifications:

- 1. Valid California C-27 (Landscaping Contractor) License.
- 2. Experience: Contractor or sub-contractor performing Work under this Section shall have a full-time employee assigned to the Project as foreman for the duration of the Contract. Employee shall have a minimum of four (4) years experience in landscape maintenance supervision, with experience or training in entomology, pest control, soils, fertilizers and plant identification. Employee shall speak English fluently.
- 3. Labor Force: Landscape maintenance labor force shall be thoroughly familiar with, and trained in, the Work to be accomplished, and shall perform the task in a competent, efficient manner acceptable to the Owner.

B. Requirements:

- 1. Supervision: Landscape Maintenance Foreman shall directly supervise the Work force during duration indicated herein this Section. Notify Owner of changes in supervision.

2. Identification: Provide proper identification during duration for landscape maintenance firm's vehicles and labor force. Be uniformly dressed in a manner satisfactory to the Owner.

1.6 PROJECT/SITE CONDITIONS

- A. Site Visit: At beginning of the designated Landscape Establishment Period, visit and tour the site with the Owner's Representative, Landscape Architect, and other interested parties, to clarify the scope of Work, and understand existing project/site conditions.
- B. Documentation of Conditions: Document the general condition of installed plant materials, recording those which are healthy and thriving, and unacceptable materials which are damaged, dead, and/or dying and in need of replacement.
- C. Irrigation System: Document general condition of existing irrigation system, making sure that faulty, improper, and/or non-functioning irrigation materials or equipment are reported.

1.7 SEQUENCING AND SCHEDULING

- A. Perform Work under Landscape Establishment Period during hours mutually agreed upon between Owner and Contractor.
- B. Work force shall be present at the Project Site at a minimum duration of at least once per week, and at other times, as necessary, to perform specified Work, in accordance with the approved schedule under the Landscape Establishment Period.

1.8 WARRANTY

- A. Specific Requirements: Refer to the following Sections:
 1. Section 02810 – Irrigation Systems.
 2. Section 02930 – Exterior Plants.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. A. General: Materials and equipment as required to perform Work under this Section shall be provided by Contractor.
- B. Water: Clean, potable and fresh, as available from Owner.
- C. Fertilizers:
 1. Fertilizer Tablets: Tightly compressed, slow-release and long-lasting complete fertilizer tablets, bearing manufacturer's label of guaranteed analysis of chemicals present. Refer to Section 02910 – Soil Preparation, for requirements.
 2. Balanced, once-a-season application, controlled-release Fertilizer(s), with a blend of coated prills which supply controlled-release nitrogen, phosphorus and potassium, and uncoated, rapidly soluble pills containing nitrogen and phosphorus.
- D. Herbicides, Insecticides, and Fungicides:

1. Provide materials with original manufacturers' containers, properly labeled with guaranteed analysis.
 2. Use non-staining materials.
- E. Replacement Tree Guys, Stakes, Ties and Wires: Match originally accepted existing materials installed on the Project.

2.2 EQUIPMENT

- A. A. General: Use only the proper tool(s) required for each task under this Section. Maintain tools in sharp, properly-functioning condition. Clean and sterilize pruning tools prior to usage.
- B. Insect/Disease Prevention: Provide measures to prevent introduction of insect or disease-laden materials onto the Site. Refer to Section 02930 – Exterior Plants.

PART 3 - EXECUTION

3.1 DURATION OF LANDSCAPE ESTABLISHMENT PERIOD

- A. Following satisfactory completion of all items included on the Landscape Punch List, the contracted Landscape Establishment Period shall commence and progress.
- B. Duration:
1. A minimum of 120 calendar days.

3.2 COMMENCING THE LANDSCAPE ESTABLISHMENT PERIOD

- A. Preliminary Review: As soon as landscape installation is substantially completed per the Contract Documents, Contractor shall arrange to hold a preliminary review on-site with the Landscape Architect, Owner, and other interested parties to evaluate the condition and execution of the completed Work. Evaluation of the Work shall be executed by the Landscape Architect through a "Landscape Punch List".
- B. Date of Review: Notify Landscape Architect at least five (5) working days prior to anticipated Date of Review.
- C. Commencing the Landscape Establishment Period: The date on which the Landscape Architect determines that the landscape installation is substantially-complete, whereas outstanding Work included on the Landscape Punch List is addressed and satisfactorily completed to the satisfaction of the Landscape Architect.

3.3 PREPARATION

- A. Protection:
1. Protect new landscape planting areas from damage during duration of Landscape Establishment Period, until Final Acceptance.
 2. Provide temporary protection fences, barriers and signs, as required, for protection.
- B. Replacements:

1. Immediately treat or replace plant materials as directed, which become damaged or injured as a result of Contractor's operations or negligence, per the Landscape Architect, at no additional cost to Owner.
2. Replacement plant materials shall match size and variety of plant material being replaced.

3.4 PLANTING ESTABLISHMENT

A. Watering Basins:

1. Maintain watering basins around the perimeter of the installed plant materials so that enough water can be applied to establish and maintain adequate soil moisture through the root zone of the plant materials. Re-dish and tamp basins accordingly which have become damaged or have failed since installation.
2. For supplemental hand watering of watering basins, use a water wand to break the water force. Do not permit use of "jet" type watering equipment. Do not permit crown roots to become exposed to air through dislodging of soil and mulch.
3. Mulch: Maintain originally specified thickness of mulch material to reduce evaporation and frequency of watering.
4. During rainy season, open basins to allow surface drainage away from the root crown where excess water may accumulate. Restore watering basins at end of rainy season.
5. At the end of the rainy season, re-dish and tamp watering basin at trees and shrubs.

B. Settlement of Plant Materials: Reset/replant sunken or settled plant materials to proper grades and in upright position.

C. Weed Control:

1. Planting areas throughout site shall be weed-free at all times, including areas between plants and along watering basins.
2. Use only recommended and legally-approved herbicides to control and maintain weed growth.
3. Avoid frequent soil cultivation that destroys shallow roots and breaks the seal of pre-emergent herbicides.

D. Pruning:

1. Prune trees to select and develop permanent scaffold branches that are smaller in diameter than the trunk or branch to which they are attached, and which have vertical spacing of eighteen-inches (18") to forty-eight-inches (48") and radial orientation so as not to overlay each another.
2. Prune trees to eliminate diseased or damaged growth, and narrow "V-shaped" branch forks that lack strength. Reduce toppling and wind damage by thinning-out crowns.
3. Prune trees to maintain growth within space limitations, maintaining a natural appearance and balancing crown with roots.
4. No stripping of lower branches of young trees shall be permitted.
5. Retain lower branches in a "tipped back" or pinched condition to promote caliper trunk growth. Do not cut back to fewer than six (6) buds or leaves on such branches. Only cut lower branches flush with the trunk after the tree is able to stand erect without staking or other support.
6. Thin out and shape evergreen trees when necessary to prevent wind and storm damage. Do primary pruning of deciduous trees during the dormant season. Do not permit any pruning of trees prone to excessive "bleeding" during growth season.
7. Prune damaged trees or those that constitute health or safety hazards at any time of year as required.
8. Make pruning cuts clean and close to the trunk, without cutting into the branch collar. "Stubbing" will not be permitted. Cut smaller branches flush with trunk or lateral branch. Make larger cuts one-inch (1") diameter or larger parallel to shoulder rings, with the top edge of the cut at the trunk or lateral branch.

9. Branches too heavy to handle shall be precut in three (3) stages to prevent splitting or peeling of bark. Make the first two (2) cuts eighteen inches (18") or more from the trunk to remove the branch. Make the third cut at the trunk to remove the resulting stub.
 10. Do not prune or clip shrubs into balled or boxed forms unless specifically called for by design.
 11. Clip shrubs to be hedged when branches project two-inches (2") beyond limit of clipped hedge shown on the Contract Drawings.
 12. Take extreme care to avoid transmitting disease from one infected plant to another. Properly sterilize pruning tools before going from one infected plant to other plant materials.
- E. Staking and Guying of Trees:
1. Adjustments: Inspect stakes and guys periodically (minimum once per month) throughout duration of Landscape Establishment Period to check for rubbing of staking materials on trunks or branches causing bark wounds.
 2. Repair and replace faulty staking and guying materials as shown and as specified.
- F. Maintenance of Existing Plant Materials to Remain:
1. General: Conform to applicable paragraphs regarding pruning, watering, spraying and fertilizing of new plant materials as indicated herein this Section.
 2. Symptoms: Be alert to symptoms of construction damage to existing plantings as evidenced by wilting, un-seasonal or early flowering or loss of leaves, and insect or disease infestation due to declining vigor.
 3. Notification: Submit in writing of evidences of declining vigor immediately upon discerning the problem. Take appropriate interim measures to mitigate the severity of the problem as specified in this Section.
 4. Proposal: Submit written proposal and cost estimate for the correction of all conditions before proceeding with permanent correction Work.

3.5 GROUNDCOVER ESTABLISHMENT

- A. Irrigation:
1. Check for moisture penetration throughout the root zone at least twice a month.
 2. Water as frequently as necessary to maintain healthy growth of groundcovers.
- B. Weed Control:
1. Control weeds, preferably by hand removal, with pre-emergent herbicides and with selective systemic herbicides.
 2. Minimize hoeing of weeds in order to avoid plant damage.
- C. Fertilization:
1. Recently installed plant materials: Verify with Owner actual completion date of planting installation and rate of prior application of fertilizers.
 2. New Plant Materials: Place Planting Tablets (per Section 02910 – Soil Preparation) beside the root ball about one-inch (1") from root tips.
 3. Established Plant Materials: Do not use complete fertilizers unless soil test shows specific nutrient deficiencies.
- D. Mowing and Edging:
1. Edge groundcovers to keep in bounds. Trim top growth as necessary to achieve an overall even appearance.
 2. Ground covers which lend themselves to mowing shall be mowed to specified height above finished grade in order to renew growth, improve density and attractiveness.
- E. Replacements:
1. Replace dead and missing plants after obtaining Owner's agreement to pay for replacement.

2. Damages due to Contractor's negligence shall be paid for without charge to Owner.

3.6 TURF GRASS ESTABLISHMENT

A. Irrigation:

1. Irrigate Turf Grass at such frequency as weather conditions require, to replenish soil moisture to six inches (6") below root zone.
2. Provide a total of one-one-half inches (1-1/2") of water weekly, during hot summer weather, in three (3) applications per week, minimum.
3. Water at night if irrigation system is electrically controlled. Otherwise, watering shall be done during early mornings.

B. Weed Control:

1. Control broadleaf weeds with selective herbicides.
2. In areas where crabgrass has infested the turf grass, apply a selective post-emergent herbicide as soon as possible, and prior to flowering.
3. Apply pre-emergent herbicides prior to crabgrass germination.
4. Do not irrigate for forty-eight (48) hours after application of herbicidal sprays.
5. Coordinate application of herbicides with thatch control and reseeding schedule as described below.

C. Mowing and Edging:

1. Mow Turf Grass areas when they reach two-inches (2") in height.
2. Trim edges at least twice a month or as needed for neat appearance. Vacuum clippings.
3. Reseeding of Lawn Areas: Match existing seed mix of adjacent areas.
4. Renovating of Existing Lawns (where applicable):
 - a. Thatch Control: Maintain thatch layer at 1/2 in. depth or less. Verticut as required.
 - 1) Three (3) weeks before verticutting turf grass, apply nitrate fertilizers.
 - 2) Perform verticutting operations preferably in the fall months, but otherwise during the spring months. Remove all debris from verticutting. Overseed as needed.
 - 3) Overseeding must not be followed by application of pre-emergent herbicides for at least four (4) to six (6) weeks. Normally this means that turf grasses invaded by weeds shall be renovated and overseeded in the Fall, and treated for weed control in the following late Winter.

D. Aeration:

1. Do not perform aeration work during season of active weed germination.
2. Aerify compacted areas to improve water penetration when needed, using a piston-driven aerifier with hollow tines. Rake up and remove all resulting soil cores. Fertilize and irrigate immediately after clean up of cores.

E. Fertilization:

1. Recently seeded/sodded Turf Grass areas: Verify with Owner previous applications of fertilizer(s).
2. Established Turf Grass areas: Apply a slow-release (3 to 5 months) fertilizer (21-8-8; N-P-K) once in spring and again in the fall at the following rates:

Program	1000 sq. ft.	Acre
Optimum	15 lbs.	650 lbs.
Medium	12 lbs.	500 lbs.
Low	8 lbs.	350 lbs.

3. Apply fertilizer when turf grass is dry and preferably after mowing. Do not apply during hot weather or when turf grass is under stress. Water immediately after application.
4. Apply only nitrogen unless a soil test shows a specific nutrient deficiency.

5. If soil pH gets below 6.0, then a basic fertilizer such as calcium nitrate may be preferable to an acidic fertilizer. Follow the soil chemist's recommendation when deficiencies appear.

3.7 INSECTS, PESTS, AND DISEASE CONTROL

- A. Inspection: Inspect plant materials for signs of stress, damage and potential trouble from the following:
 1. Presence of insects, moles, gophers, ground squirrels, snails and slugs in planting areas.
 2. Discolored or blotching leaves or needles.
 3. Unusually light green or yellowish green color inconsistent with normal green color of leaves.
- B. Personnel: Only licensed, qualified, trained personnel shall perform spraying for insect, pest and disease control.
- C. Application: Spray with extreme care to avoid all hazards to any person or pet in the area or adjacent areas.

3.8 IRRIGATION SYSTEM

- A. General:
 1. Repair without additional charge to Owner damages to Irrigation System caused by Contractor's operations. Perform repairs within one (1) watering period.
 2. Report promptly to Owner accidental damage not resulting from Contractor's negligence or operations.
 3. Twice a month, use a probe or other acceptable tool to check the rootball moisture of representative plants as well as the surrounding soil.
- B. Cleaning and Monitoring the System:
 1. Continually monitor the irrigation systems to verify that they are functioning properly as designed. Make program adjustments required by changing field conditions.
 2. Prevent spraying on windows, building walls, by balancing the throttle control on the remote control valves and the adjustment screws on the sprinkler heads. Do not allow water to atomize and drift.

3.9 TERMINATION OF THE LANDSCAPE ESTABLISHMENT PERIOD

- A. Final Acceptance Procedure:
 1. Work will be accepted by the Landscape Architect upon satisfactory completion of all Work, including Landscape Establishment Period, but exclusive of replacement of materials under the Warranty Period.
 2. Submit a written request to Landscape Architect for review for Final Acceptance at least five (5) working days prior to anticipated Final Review date, which is at the end of the Landscape Establishment Period.
- B. Corrective Work:
 1. Work requiring corrective action or replacement shall be performed within ten (10) calendar days after the Final Review.
 2. Perform corrective Work and materials replacement in accordance with the Contract Documents, Work shall be made by the Contractor at no cost to the Owner.
 3. After corrective Work is completed, the Contractor shall again request a Final Review for Final Acceptance as outlined above.

- a. Continue maintenance of all landscaped areas until such time as all corrective measures have been completed and accepted.
 - C. Conditions for Acceptance of Work at End of Landscape Establishment Period:
 - 1. Each plant shall be alive and thriving, showing signs of growth and no signs of stress, disease, or any other weaknesses.
 - 2. Replace plant materials not meeting these conditions. An additional Warranty Period equal in length to the original shall be commenced for all such plants and planted areas.
 - D. Final Acceptance Date: The date on which the Landscape Architect issues a Letter of Final Acceptance. Upon Final Acceptance, the Owner will assume responsibility for maintenance of the Work beyond the Landscape Establishment Period.
- 3.10 CLEANING
- A. General: Dispose of pruned plant materials, vacuum turf grass clippings and leaves, sweep walkways and rake smooth mulched areas. Remove from the site containers and other evidence of maintenance activities.
- 3.11 CLOSE OUT
- A. Landscape Maintenance Record:
 - 1. Submit binder to Owner with documentation and records required and utilized during the Landscape Establishment Period.
 - B. Keys and Identification: Return keys and identification materials supplied by Owner for the purpose of site access.

END OF SECTION

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SECTION 03100
CONCRETE FORMWORK

PART 1 – GENERAL

1.1 SECTION INCLUDES

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

1.2 REFERENCES

- A. CBC - California Building Code, (CCR) California Code of Regulations, Title 24, Part 2, Chapter 19
- B. ACI 301 - Specifications for Structural Concrete for Buildings.
- C. PS 1-95 - Construction and Industrial Plywood.

1.3 SYSTEM DESCRIPTION

- A. Design, engineer, and construct formwork, shoring, and bracing to meet design and code requirements, so that resultant concrete conforms to required shapes, lines, and dimensions.

1.4 QUALITY ASSURANCE

- A. Construct and erect concrete formwork in accordance with ACI 301.

1.5 REGULATORY REQUIREMENTS

- A. Conform to CBC - California Building Code, (CCR) California Code of Regulations, Title 24, Part 2.

PART 2 - PRODUCTS

2.1 FORM MATERIALS

- A. Plywood: PS1-95, BB Plyform grade, Class I, Exterior classification.
- B. Lumber: Douglas Fir species; construction grade; with grade stamp clearly visible.
- C. Tubular Column: Round, smooth, fiber reinforced tube with plastic coated paper lining, of sizes required.
- D. Form Liner: Pattern No. Vinylok as manufactured by Fitzgerald Formliners, www.formliners.com

2.2 FORMWORK ACCESSORIES

- A. Form Ties: Snap-off metal of adjustable length; cone type; 1 inch break backdimension; free of defects that will leave holes no larger than one inch diameter in concrete surface.
- B. Form Release Agent: Colorless material which will not stain concrete, absorb moisture, or impair natural bonding or color characteristics of coating intended for use on concrete.
- C. Fillets for Chamfered Corners: Wood strips type; 3/4 x 3/4 inch size; maximum possible lengths.
- D. Dovetail Anchor Slots: Minimum 22 gage galvanized steel; foam filled; release tape sealed slots; bent tab anchors; securable to concrete formwork; manufactured by Heckmann Building Products Co., www.heckmannbuildingprods.com.
- E. Flashing Reglets: 26 gage thick galvanized steel; longest possible lengths; release tape sealed slots; with alignment splines for joints; securable to concrete formwork; Type CO reglet manufactured by Fry Reglet www.fryreglet.com.
- F. Nails, Spikes, Lag Bolts, Through Bolts, Anchorages: Sized as required; of strength and character to maintain formwork in place while placing concrete.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Verify lines, levels, and measurements before proceeding with formwork.

3.2 PREPARATION

- A. Obtain Architect's approval for use of earth forms for footings.
- B. Minimize form joints. Symmetrically align joints and make watertight to prevent leakage of mortar. Arrange and assemble formwork to permit stripping, so that concrete is not damaged during its removal.
- C. Arrange forms to allow stripping without removal of principal shores, where required to remain in place.

3.3 ERECTION

- A. Erect formwork, shoring and bracing to achieve design requirements, in accordance with requirements of ACI 301.
- B. Provide bracing to ensure stability of formwork. Strengthen formwork liable to be overstressed by construction loads.
- C. Provide chamfer strips on external corners of beams, joists, columns, and walls.
- D. Obtain approval before framing openings in structural members which are not indicated on Drawings.
- E. Do not displace or damage vapor barrier placed by Section 03300.
- F. Construct formwork to maintain tolerances in accordance with ACI 301.

3.4 APPLICATION OF FORM RELEASE AGENT

- A. Apply form release agent on formwork in accordance with manufacturer's instructions. Apply prior to placing reinforcing steel, anchoring devices, and embedded items.
- B. Do not apply form release agent where concrete surfaces are scheduled to receive applied coverings which may be affected by agent. Soak contact surfaces of untreated forms with clean water. Keep surfaces wet prior to placing concrete.

3.5 INSERTS, EMBEDDED PARTS, AND OPENINGS

- A. Provide formed openings where required for work embedded in or passing through concrete.
- B. Coordinate work of other Sections in forming and setting openings, slots, recesses, chases, sleeves, bolts, anchors, and other inserts.
- C. Install accessories in accordance with manufacturer's instructions, level and plumb. Ensure items are not disturbed during concrete placement.

3.6 FORM REMOVAL

- B. Do not remove forms and bracing until concrete has sufficient strength to support its own weight and imposed loads.
- C. Do not damage concrete surfaces during form removal.
- D. Store reusable forms for exposed architectural concrete to prevent damage to contact surfaces.

3.7 CLEANING

- A. Clean forms to remove foreign matter as erection proceeds.
- B. Ensure that water and debris drain to exterior through clean-out ports.

3.8 EARTH FORMS

- A. Construct wood edge strips at top sides of excavations as indicated on drawings.
- B. Provide forms for footings and foundation walls wherever concrete cannot be placed against solid earth.
- C. Remove loose dirt and debris from form area prior to concrete placement.
- D. Concrete for foundations may be placed directly into neat excavations provided the foundation trench walls are stable as determined by the Structural Engineer subject to the approval of The Division of the State Architect.
- E. When earth formed foundations are used, the minimum formwork shown on the drawings is mandatory to insure clean excavations prior to and during concrete placement.

END OF SECTION

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SSECTION 03200

CONCRETE REINFORCEMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Reinforcing steel bars, welded steel wire fabric fabricated steel bar or rod mats for cast-in-place concrete.
- B. Support chairs, bolsters, bar supports, and spacers, for supporting reinforcement.

1.2 REFERENCES

- A. CBC - California Building Code, (CCR) California Code of Regulations, Title 24, Part 2, Chapter 19 (ACI 318).
- B. ACI 301 - Specifications for Structural Concrete for Buildings.
- C. ACI 315 (SP-66) - Details and Detailing of Concrete Reinforcement.
- D. ACI 318 - Building Code Requirements for Reinforced Concrete.
- E. ASTM A185 - Welded Steel Wire Fabric for Concrete Reinforcement.
- F. ASTM A615 - Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
- G. ASTM A706 - Standard Specification for Low Alloy Steel Deformed Bars for Concrete Reinforcement.
- H. CRSI - Manual of Practice.
- I. CRSI - Placing Reinforcing Bars.

1.3 QUALITY ASSURANCE

- A. Perform concrete reinforcement work in accordance with CRSI Manual of Standard Practice.
- B. Conform to ACI 301 and ACI 315 (SP-66).
- C. Conform to CBC California Building Code, (CCR) California Code of Regulations, Title 24, Part 2.

1.4 CERTIFICATES

- A. Submit mill test certificates of supplied concrete reinforcing, indicating physical and chemical analysis.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Reinforcing Steel: ASTM A615, Grade 60 for all reinforcing bars. Billet-steel deformed bars, uncoated finish.

2.2 ACCESSORY MATERIALS

- A. Tie Wire: Minimum 16 gage annealed type.
- B. Chairs, Bolsters, Bar Supports, Spacers: Sized and shaped for strength and support of reinforcement during installation and placement of concrete including load bearing pad on bottom to prevent vapor barrier puncture.

2.3 FABRICATION

- A. Fabricate in accordance with ACI 315 (SP-66), providing concrete cover specified in Section 03300.
- B. Locate reinforcing splices not indicated on Drawings at points of minimum stress.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Before placing concrete, clean reinforcement of foreign particles or coatings.
- B. Place, support, and secure reinforcement against displacement. Do not deviate from alignment or measurement.
- C. Do not displace or damage vapor barrier required by Section 03300.

3.2 FIELD QUALITY CONTROL

- A. Field inspection and testing will be performed under provisions of Section 01458 and as required by the Division of the State Architect and District Inspector.

.END OF SECTION

SECTION 03300

CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Cast-in-place concrete foundation walls, and footings.
- B. Floors and slabs on fill on vapor barrier.
- C. Control, expansion, and contraction joint devices associated with concrete work.
- D. Curing and sealing compound.

1.2 REFERENCES

- A. CBC - California Building Code, (CCR) California Code of Regulations Title 24, Part 2, Chapter 19.
- B. CBC - California Building Code, (CCR) California Code of Regulations, Title 24, Part 2, California State Accessibility Standards.
- C. ADAAG - Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and 0
- D. ACI 301 - Specifications for Structural Concrete for Buildings.
- E. ACI 302.1R - Guide for Concrete Floor and Slab Construction.
- F. ACI 305R - Hot Weather Concreting.
- G. ACI 306.1 - Standard Specification for Cold Weather Concreting.
- H. ASTM C33 - Concrete Aggregates.
- I. ASTM C94 - Ready-Mixed Concrete.
- J. ASTM C109 - Standard Test Method for Compressive Strength of Hydraulic Cement Mortars.
- K. ASTM C150 - Portland Cement.
- L. ASTM C289 - Potential Reactivity of Aggregate.
- M. ASTM C309 - Liquid Membrane Forming Compound.
- N. ASTM C494 - Standard Specifications for Chemical Admixtures for concrete.
- O. ASTM C618- Standard Specification for Coal Fly Ash and Raw or Calcined
- P. Natural Pozzolan for Use as a Mineral Admixture for Concrete.
- Q. ASTM C932 - Surface-Applied Bonding Agents.

- R. ASTM C1315 - Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete.
- S. ASTM D1751 - Preformed Expansion Joint Filler for Concrete Paving and Structural Construction.
- T. ASTM E96 – Standard Test Methods for Water Vapor Transmission of Materials.
- U. ASTM E154 - Standard Test Methods for Water Vapor Retardants used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover.
- V. ASTM E1643 - Installation of Water Vapor Retarders used in Contact with Earth or Granular Fill Under Concrete Slab.
- W. ASTM E1155 - Determining Floor Flatness and Levelness Using the F-Number System.
- X. ASTM E1745 - Standard Specifications for Plastic Water Vapor Retarders used in Contact with Soil Or Granular Fill Under Concrete Slabs.
- Y. ASTM F1869 - Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride.
- Z. National Ready Mix Concrete Association - Plant Certification Program.
- AA. Stormwater Best Management Practice Handbook (BMP Handbook), Construction Edition, as published by the California Storm Water Quality Association.

1.3 QUALITY ASSURANCE

- A. Perform work in accordance with ACI 301.
- B. Obtain materials from same source throughout the Work.

1.4 QUALIFICATIONS

- A. Manufacturer: Manufacturer of ready-mix concrete products complying with ASTM C94 requirements for production facilities and equipment. Certified according to National Ready Mix Concrete Associates Plant Certification Program.

1.5 DESIGN MIX

- A. Submit design mix for each class of concrete, prepared by a California Registered Civil Engineer, to Testing Laboratory and Architect for review.

1.6 REGULATORY REQUIREMENTS

- A. Conform to CBC - California Building Code, (CCR) California Code of Regulations, Title 24, Part 2.
- B. Conform to CBC - California Building Code, (CCR) California Code of Regulations, Title 24, Part 2, and ADAAG for access requirements for individuals with disabilities.

1.7 SUBMITTALS

- A. Submit product data and manufacturer's instructions under provisions of Section 01330.

1.8 PRE-INSTALLATION CONFERENCE

- A. Convene a conference two weeks prior to commencing placement of floor slab work of this section, under provisions of Section 01310.

- B. Require attendance of parties directly affecting the work of this Section.

1) Agenda:

- PART 1 - Placement of subgrade beneath floor slab.
- PART 2 - Testing of subgrade beneath floor slab.
- PART 3 - Delivery and placement of concrete.
- PART 4 - Testing and inspection procedures for concrete.
- PART 5 - Submittal of mix design for concrete.
- PART 6 - Hot and cold weather concreting procedures.
- PART 7 - Vapor barrier location and installation.
- PART 8 - Placement of control and expansion joints.
- PART 9 - Steel reinforcement installation.
- PART 10 - Installation of inserts and embedded items.
- PART 11 - Finishes and finishing.
- PART 12 - Forming and form removal limitations.
- PART 13 - Floor slab flatness and levelness requirements.
- PART 14 - Curing process and procedures.
- PART 15 - Protection of finished floor slabs.
- PART 16 - Floor slab joint and crack repair.
- PART 17 - Moisture vapor transmission testing.

1.9 WARRANTY

- A. Provide fifteen year warranty from curing, hardening and vapor barrier compound manufacturer under provisions of Section 01770.
- B. Warranty: Include coverage for removal and replacement of finish floor materials that elaminate from interior floor slabs due to moisture migration and excessive vapor emissions or due to presence of efflorescence and alkali contaminates.

- 1) Subfloor Moisture Conditions: Moisture emission rate of no more than 3 lb/1000 sq. ft./24 hours when tested by Quantitative Anhydrous Calcium Chloride Test, ASTM F1869, with subfloor temperature not less than 65 degrees F.
 - 2) Subfloor Alkalinity Conditions: A pH range of between 5 to 9 when subfloor is wetted with potable water and pHdrion paper is applied.
- C. Warranty to be supported by \$1,000,000.00 product liability insurance policy issued directly to the Owner.
- D. Provide ten year warranty from waterproofing admixture manufacturer that surfaces treated with crystalline waterproofing admixture will remain free from water leakage.

1.10 ENVIRONMENTAL REQUIREMENTS

- A. Provide concrete curing, finishing, and waste management techniques as defined in Section 4 of the Storm Water Best Management Practice Handbook, (BMP Handbook) Construction Edition.

PART 2 PRODUCTS

2.1 FORMWORK

- A. As specified in Section 03100.

2.2 REINFORCEMENT

- A. Reinforcing steel as specified in Section 03200.

2.3 CONCRETE MATERIALS

- A. Cement: ASTM C150, Type I or Type II Portland type; low alkali; grey color.
- B. Fine and Coarse Aggregates Normal Weight Concrete: ASTM C33, nonreactive when tested in accordance with ASTM C289 and Appendix X-1 of ASTM C33.
- C. Fine and Coarse Aggregate, Light Weight Concrete: ASTM C330.
- D. Water: Clean and not detrimental to concrete.

2.4 ADMIXTURES

- A. Fly Ash: ASTM C618, Class F.
- B. Water Reducing Admixture: ASTM C494, Type A.
- C. Crystalline Waterproofing Admixture: Xypex Admix C-1000 as manufactured by Xypex Chemical Corporation, www.xypex.com.
- D. Calcium chloride, or any other admixtures not allowable.

2.5 VAPOR BARRIER

- A. Material: 10 mil thick polyethylene film meeting the requirements of ASTM E1745, Class A, with a minimum permeance of 0.01 perms in accordance with ASTM E96/E154, Section 7.
- B. Accessories: Minimum 4 inch wide polyethylene tape with pressure sensitive adhesive.
- C. Manufacturers:
 - 1) Fortifiber Building Products, www.fortifiber.com.
 - 2) Reef Industries, www.reefindustries.com.
 - 3) Stego Industries, www.stegoindustries.com.
 - 4) Substitutions: Under Provisions of Section 01630.

2.6 ACCESSORIES

- A. Bonding Agent: ASTM C932; Weld-Crete as manufactured by Larsen Products Corp., www.larsenproducts.com.
- B. Non-shrink Grout: Premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents; capable of developing minimum compressive strength of 7000 psi in 28 days.
- C. Joint Filler: ASTM D1751, 1/2 inch thick.
- D. Sand Fill: Manufactured "crusher run" sand free of silt, clay, loam, friable or soluble materials or organic matters, all passing the No. 4 sieve and only 5 percent passing the No. 200 sieve.
- E. Curing, Hardening and Vapor Barrier Compound: ASTM C1315, Type I, Class A and ASTM C309, Type 1, Class A, with maximum volatile organic compound (VOC) content rating as required to suit regulatory requirements. Material to have no less than 34 percent penetrating solids, have no visible sheen and be compatible with floor finish materials and overlayments. Provide the following:
 - 1) 1. CS2000 Sealer Spray manufactured by Creteseal, www.creteseal.com.
 - 2) 2. PMC 3300 Penetrating Sealer manufactured by Curranseal, www.curranseal.com.
- F. Sealing Compound: Ashford Formula manufactured by Curecrete Distribution, Inc., www.ashfordformula.com.
- G. Slip Resistant Aggregate: 95 percent minimum fused homogeneous aluminum oxide.
- H. Chemical Concrete Stain: Penetrating reactive concrete stain and clear sealer of color selected by Architect. Subject to compliance with requirements provide one of the following:
 - 1) Blush-Tone Acid Stain as manufactured by Rafco Products Co., www.brickform.com.
 - 2) Lithochrome Chemstain as manufactured by L.M. Scofield Co., www.scofield.com.
 - 3) ChlorStain as manufactured by Super Stone, Inc., www.superstone.com.
 - 4) Patina Stain System as manufactured by the Symons Corporation, www.symons.com.

- 5) SGS Concrete Stain as manufactured by Solomon Grind Chemical Services,
www.solomoncolors.com.

- I. Concrete Floor Slab, Saw Cut, Joint, Crack, Repair Material: Cementbased, polymer-modified product that can be feathered at edges to match adjacent floor elevations. Compressive strength not less than 4,200 psi at 28 days when tested according to ASTM C109. Equivalent to ARDEX SD-F Feather Finish, www.ardex.com. Epoxy base to be equivalent to Simpson ET-22 semi-rigid epoxy, www.strongtie.com.
- J. Substitutions: Under provisions of Section 01630.

2.7 CONCRETE MIX

- A. Mix concrete in accordance with ASTM C94 and CBC, California Building Code, (CCR) California Code of Regulations, Title 24, Part 2, Section 1905.3.
- B. Footings: Proportion normal-weight concrete mixture as follows:
- 1) Minimum Compressive Strength: 3,000 psi at 28 days.
 - 2) Maximum Water-Cement Materials Ratio: 0.60
 - 3) Aggregate Size: 1-1/2 inch maximum.
 - 4) Slump Limit: 4 inch maximum.
 - 5) Fly Ash: Maximum 15 percent by weight.
 - 6) Waterproofing Admixture: 1.5 percent by weight of cement.
- C. Slabs-On-Grade: Proportion normal-weight concrete mixture as follows:
- 1) Minimum Compressive Strength: 3,000 psi at 28 days.
 - 2) Minimum Cement Materials Content: 540 lb./cu. yd.
 - 3) Maximum Water-Cement Materials Ratio: 0.50.
 - 4) Aggregate Size: 1 inch maximum.
 - 5) Slump Limit: 3 inch minimum, 5 inch maximum.
 - 6) Fly Ash: Maximum 15 percent by weight.
- D. Building Walls: Proportion normal weight concrete mixture as follows:
- 1) Minimum Compressive Strength: 3,000 psi at 28 days.
 - 2) Maximum Water-Cement Materials Ratio: 0.50
 - 3) Aggregate Size: 1-1/2 inch maximum.
 - 4) Slump Limit: 4 inch maximum.
 - 5) Fly Ash: Maximum 15 percent by weight.
 - 6) Waterproofing Admixture: 1.5 percent by weight of cement.

PART 3 EXECUTION

3.1 INSPECTION

- A. Verify anchors, seats, plates, reinforcement, and other items to be cast into concrete are accurately placed, held securely, and will not cause difficulty in placing concrete.

3.2 PREPARATION

- A. At locations where new concrete is dowelled to existing work, drill holes in existing concrete, insert steel dowels, and pack solid with non-shrink grout.
- B. Place 2 inch thick sand fill over subgrade.
- C. Compact sand fill as specified in Geotechnical Report.

3.3 VAPOR BARRIER

- A. Install vapor barrier in compliance with ASTM E1643 under interior slabs over sand subgrade.
- B. Lay vapor barrier with long dimension parallel with long dimension of space.
- C. Lap vapor barrier over footing and seal to vertical surface of foundation wall.
- D. Overlap all joints in vapor barrier 6 inches and seal with tape.
- E. Seal all pipe penetrations of vapor barrier with pipe boot fabricated from vapor barrier material and tape.
- F. Repair damaged areas with vapor barrier, overlapping damaged area by 6 inches and taping all four sides.

3.4 PLACING CONCRETE

- A. Notify Architect minimum 24 hours prior to commencement of concreting operations.
- B. Place concrete in accordance with ACI 301.
- C. Hot Weather Placement: ACI 305R.
 - 7) Maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water.
 - 8) Fog-spray forms, steel reinforcement, and subgrade just before placing concrete in hot weather. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.
- D. Ensure reinforcement, inserts, embedded parts and formed joints are not disturbed during concrete placement.
- E. Do not disturb or damage vapor barrier while placing concrete. Repair damage as required to maintain integrity of barrier.

- F. Place concrete continuously between predetermined construction and control joints. Do not break or interrupt successive pours such that cold joints occur.
- G. Place interior floor slabs on fill in a strip sequence pattern.
- H. Excessive honeycomb or embedded debris in concrete is not acceptable.

3.5 JOINTS

- A. Saw cut control joints at an optimum time after finishing. Use 3/16 inch thick blade, cutting 1/3 into depth of slab thickness.
- B. Provide control joints at 15 feet on center unless otherwise indicated.
- C. Separate slabs from vertical surfaces with joint filler. Extend joint filler from bottom of slab to within 1/4 inch of finished slab surface.

3.6 FLOOR SLAB JOINT FILLING AND CRACK REPAIR

- A. Prepare, clean, and install joint repair material according to manufacturer's written instructions.
- B. Defer joint filling and crack repair until concrete has aged a minimum of 60 days.
- C. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints leave contact faces of joint clean and dry.
- D. Mechanically V-groove as necessary all saw cuts, joints and cracks, to a minimum width of 1/4 inch and a minimum depth of 5/8 inch.
- E. Fill bottom of joint to a depth of at least 3/16 inch with semi-rigid epoxy.
- F. Place silica sand over epoxy filler.
- G. Fill all saw cuts, joints, and cracks with cement based joint repair material to top of concrete surface.

3.7 FINISHING SLABS

- A. Uniformly spread, screed and consolidate concrete. Do not spread concrete by vibration.
- B. Float Finish: Float with hand float or with a powered disc float. High spots to be cut down and low spots to be filled. Use as preparation for further finishing.
- C. Scratched Finish: Mechanically float surfaces. Roughen with stiff brushes before final set. Use for with full bed setting systems and where indicated.
- D. Troweled Finish: After floating, steel trowel to smooth, mark free surface. Use for exposed floors and slabs and where indicated.
- E. Fine Broom Finish: After floating and while the surface is still plastic, provide a fine textured finish by drawing a fine fiber bristle broom uniformly over the surface in one direction only. Use for floors and slabs where indicated.

- F. Slip Resistant Finish: After floating and while the surface is still plastic, uniformly broadcast aluminum oxide particles onto surface at the rate of 25 pounds per 100 sq. ft. Trowel particles into surface to provide embedment but do not force below surface. Use for exposed floors and slabs which constitute ramps with slope of 6 percent or greater, exposed stair treads, and as indicated.
- G. Polished Concrete Finish: As specified in Section 03365.

3.8 SLAB TOLERANCES

- A. Maintain slab tolerance as defined in ACI 302.1R of (SOV) FF35 and FL25 and (MOV) FF24 and FL17 as measured by ASTM E1155.
- B. Correct the slab surface if the actual FF/FL number for the floor installation measures less than required.
- C. In areas of floor drains, maintain floor levels at the walls and slope surface uniformly to drains at 1/8 inch per foot.

3.9 CURING

- A. Apply curing, hardening and vapor barrier compound on all floor slabs that are not exposed and indicated to be sealed.
- B. Cure concrete surfaces in accordance with ACI 301.
- C. Spray apply curing, hardening and vapor barrier compound on finished slab surfaces located below grade, at grade, and above grade in two "wet on wet" flood coats at the total rate of 200 sq. ft./gallon in accordance with manufacturer's instructions.
- D. Application of compound shall be by a trained applicator acceptable to compound manufacturer.
- E. After application of curing, hardening, and vapor barrier compound, moist cure concrete using the following method:
 - 1)1. Spraying: Fog spray clean, potable water over floor slab areas and maintain moist for 10 days.
 - 2. Polyethylene Film: Spread over floor slab areas, lap edges and sides, maintain in place for 10 days.

3.10 SEALING

- A. Apply sealing compound on finished floor slab surfaces that are not to receive a finished floor covering and are indicated to be exposed and sealed.
- B. Apply sealing compound immediately following finishing operation.
- C. Apply sealing compound in sufficient quantities to keep entire surface wet for a minimum of 30 minutes.
- D. Lightly mist surface with water as compound is absorbed into surface.
- E. Flush surface with water and squeegee surface free of excess compound.
- F. Burnish final concrete surface with propane burnisher.

3.11 PATCHING

- A. Notify Architect immediately upon removal of forms to determine areas that will require patching.
- B. Surface defects shall include color and texture irregularities, stains, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections and discolorations in the surface that cannot be removed by cleaning.
- C. Patch imperfections in accordance with ACI 301.

3.12 DEFECTIVE CONCRETE

- A. Modify or replace concrete not conforming to required levels and lines, details, and elevations.
- B. Repair or replace concrete not properly placed or of the specified type.

3.13 FIELD QUALITY CONTROL

- A. Field inspection and testing will be performed under provisions of Section 01458
- B. Owner's Inspector will take cylinders and perform slump and air entrainment tests in accordance with ACI 301 and will arrange for pick-up by Testing Laboratory.
- C. Three cylinders will be taken for every 50 yards, or fraction thereof, for each class of concrete for each day.
- D. Tests of cement and aggregates will be performed by Testing Laboratory to ensure conformance with requirements stated herein.
- E. Slab tolerance as measured by ASTM E1155 shall be performed within 72 hours of floor slab installation.
- F. Maintain records of placed concrete items. Record date, location of pour, quantity, air temperature, and test samples taken.

3.14 PROTECTION

- A. Protect finished work under provisions of Section 01600.
- B. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury.
- C. Maintain concrete with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of concrete.

END OF SECTION

SECTION 03310 - SITE CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes site concrete, including but not limited to walls, footings and sub-slabs, complete, as shown and as specified.
- B. This section applies to concrete items identified on the Landscape Plans.
- C. Products Installed But Not Furnished Under This Section:
 - 1. Division 2, Section "Landscape Irrigation"
- D. Unit Pricing:

<u>Item</u>	<u>Unit Price</u>
Flatwork, Slabs	Square Foot
Walls, Foundations	Cubic Yard

1.2 REFERENCES

- A. Standard Specifications - Standard Specifications of the State of California, Business and Transportation Agency, Department of Transportation, CALTRANS, latest edition.
- B. ASTM - American Society for Testing and Materials
- C. ACI - American Concrete Institute, Manual of Concrete Practice.
- D. UBC - Uniform Building Code

1.3 DEFINITIONS

- A. Percent Compaction: ASTM D1557, percentage of the maximum in-place dry density of the same material as determined by Soils Engineer.

1.4 SUBMITTALS

- A. Product Data: Manufacturers' current catalog cuts and specifications for the following:
 - 1. Expansion joint filler, sealant, backer rod and bond breaker.
 - 2. Integral color.
 - 3. Glare-reducing agent.
 - 4. Damp proofing material.
 - 5. Air-entrainment.
 - 6. Curing Compound.

- B. Samples:
 - 1. Aggregate for Exposed Aggregate Finish: Half a pound.
 - 2. Rock Salt: Half a pound.
 - 3. Joint Sealant: Color chart.
- C. Certificates:
 - 1. Reinforcing Steel: Certificate of compliance
 - 2. Concrete Mix Design: Ticket for each batch delivered showing the following:
 - a. Mix identification.
 - b. Weight of cement, aggregate, water, and admixtures, aggregate sizes/proportion, and air entrainment.

1.5 QUALITY ASSURANCE

- A. Mock-up: One [1] 3 ft. x 3 ft. x 4 in. for each type of concrete finish and color to serve as standard of quality for all work. Mock-up shall include all jointing details [and insets] for acceptance.
- B. Lines and Levels: To be established by a licensed Surveyor or registered Civil Engineer.
- C. Mix Standards: Conform to the ACI Manual and the Portland Cement Association's "Design and Control of Concrete Mixes".
- D. Design of Concrete Mix: Employ approved commercial testing laboratory to design concrete mixes as follows:
 - 1. Minimum Compressive Strength at 28 Days:
 - a. Slabs On-grade: 2500 psi
 - b. Walls and Foundations: 3000 psi
 - 2. Concrete Slump:
 - a. Minimum: Two [2] inches
 - b. Maximum: Four [4] inches
 - 3. Maximum Water-Cement Ratio:
 - a. Slabs On-grade: 8.75 gallons per sack of cement
 - b. Foundations: 6.75 gallons per sack of cement
- E. Colored Concrete (**on ENTRY MONUMENTS, WALLS, AND SEAT WALLS only- see drawings**): Achieve color by integrally mixing coloring agent with concrete. Color shall be *Davis Color 'Mesa Buff' 5447*.
- F. Glare-Reduced Concrete: Add necessary proportion of accepted colorant at the mixer. Use identical proportions in batches for adjacent pours.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Delivered Mixes: Coordinate delivery so that mixes may be immediately poured upon arrival at site.
- B. Components and Accessories:
 - 1. Fittings and Reinforcements: Protect from rust, soil and oil contamination at all times. Store on pallets above ground.
 - 2. Templates: Protect from damage. Test accuracy prior to each use.

1.7 PROJECT/SITE CONDITIONS

- A. Existing Conditions: For protection of existing plants to remain, see Division 2, Section "Tree Protection and Trimming".
- B. Water and Dust Control: Maintain control of concrete dust and water at all times. Do not permit adjacent planting areas to be contaminated. Clean up all debris resulting from this work at the end of each day's work.

1.8 SEQUENCING AND SCHEDULING

- A. Coordination: Coordinate all items of other trades to be furnished and set in place. Coordinate proper installation of all accessories embedded in the concrete and for the provision of holes, openings, etc., necessary to the execution of the work of the trades in ample time that progress of the work is not delayed.
- B. Cutting/Patching: Perform as necessary to comply with above injunction.

1.9 MAINTENANCE

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Portland Cement Aggregates and Reinforcements: Except as modified herein, conform to all applicable requirements of Section 25 "Aggregate Subbases", Section 26 "Aggregate Bases", Section 52 "Reinforcement" and Section 90, "Cement Concrete" of the Standard Specifications.

2.2 MATERIALS

- A. Cement: ASTM C150, Type II, low alkali Portland Cement. Use only one brand and type for entire job. Supplement with:
 - a. Pozzolan: ASTM C618, Class F or N Fly Ash, 100 pounds maximum per cubic yard, containing one percent or less carbon. Fly ash shall not be used in excess of 15 percent by weight of total cement quantity.
- B. Aggregate Base for On-grade Slabs:
 - 1. Description: Class II aggregate base shall be free from vegetable matter and other deleterious substances, and shall be of such nature that it can be compacted readily under watering and rolling to form a firm, stable base.
 - 2. Grading Requirements:

<u>Percent Passing</u>	<u>Sieve Size</u>
100	1 in.
90-100	3/4 in.
0- 10	#4
0- 3	#100
 - 3. Quality Requirements:

a.	Minimum "R" value	40	
b.	Max. Expansion Pressure; Calif. Test Method No. 301		100 psf
c.	Maximum Plasticity Index	12	
d.	Sand Equivalent	20 min	

C. Coarse Aggregate:

1. Description: ASTM C33, hard, durable, uncoated, washed, graded, cleaned and screened crushed rock or gravel aggregate for regular weight concrete. Do not use crusher-run stone or bank-run gravel.
2. Grading: Do not use aggregate which has a maximum size exceeding 1/5 of the narrowest dimension between sides of forms of the member for which the concrete is to be used, nor larger than 3/4 of the minimum clear spacing between reinforcing bars. Do not use coarse aggregate which exceeds 3/4 in. for paving.

D. Fine Aggregate:

1. Description: ASTM C33, clean, hard and durable sand. Do not use sand coated with injurious amounts of silt, loam, clay or other deleterious matter.
2. Grading Requirements:

<u>Percent Passing</u>	<u>Sieve Size</u>
45-70	# 16
15-30	# 50
3- 8	#100

- E. Water: Clean, potable concrete mixing water free from injurious amounts of salts, oils, acids, alkalis, organic materials or other deleterious matter. As available from Owner. Transport as required.

- F. Air Entrainment: ASTM C260.

2.3 SUBGRADE

- A. Subgrade shall be prepared as described in Division 2 Section "Earthwork".

2.4 MIXTURE COMPONENTS

A. Coloring Agent (**on ENTRY MONUMENTS, WALLS, AND SEAT WALLS only**):

1. Type: Commercially pure mineral pigments.
2. Percentage: Maximum 10% of the cement content by weight.
3. Product: Integral color as by Davis Colors [323] 269-7311
4. Color: 'Mesa Buff' 5447.

B. Glare-Reducing Agent:

1. Type: Liquid or semi-paste black colorant intended for use integrally in concrete mixes.
2. Design Mix: One quarter [1/4] lb. per sack of cement.
3. Product: "Hi-Con Black #1195" by Conrad Sovig Co. Inc., [415] 863-3808.

2.5 DRY-SHAKE COLOR HARDENER

- A. Type: Streak-free intergrind of pigments, surface-conditioning and dispersing agents, Portland cement combined with hard, graded granite aggregates and silica carbide.

- B. Rate: Per Manufacturers' current printed specifications.
- C. Product: As recommended by Davis Colors [323] 269-7311
- D. Color: Clear.

2.6 ACCESSORIES

- A. Reinforcements:
 - 1. Reinforcing Bars: ASTM A615 Grade 60 deformed billet-steel bars, clean and free from rust, scale, or coating that will reduce bond.
 - 2. Fiber Reinforcement: Collated, fibrillated, polypropylene fiber, "Fibermesh" by Fibermesh Co., [615] 892-7243.
 - 3. Smooth Dowels for Expansion Joints: ASTM A615, Grade 60 smooth, billet-steel bars, shop painted with iron-oxide zinc-chromate primer.
 - 4. Tic Wires: 18 ga. min. black annealed.
 - 5. Snap Ties: Snap-off metal of fixed length capable of leaving no metal within 1 1/2 in. of surface nor causing fractures, spall or other defects larger than one [1] in. diameter.
- B. Expansion Joint Materials:
 - 1. Premolded Joint Filler: ASTM D1751, non-extruding and bituminous type resilient filler, compatible with sealant, and having a "guide strip" removable depth gauge.
 - 2. Joint Sealant: ASTM C290, non-slag sealant "Dynatred" by Pecora Corporation, [214] 278-8158 or "Sonolastic Sealant Two-Part" by Sonneborn, [415] 889-9899 Bay Area or [612] 835-3434.. Color to match concrete as closely as possible.
 - 3. Bond Breaker: Pressure-sensitive tape as recommended by sealant manufacturer to suit application.
 - 4. Premolded Joint Filler: "Sonoflex-F", a closed cell plastic joint filler by Sonneborn.
- C. Forms:
 - 1. Steel or wood of size and strength to resist movement during concrete placement and to retain horizontal and vertical alignment until removal.
 - 2. Use forms that are straight and free of distortions and defects.
 - 3. Use flexible spring forms or laminated boards to form radius bends as required.
- D. Form Release Agent: Colorless non-staining, free from oils. Chemical agent shall not impair bonding of paint or other proposed coatings.
- E. Form-Facing Materials:
 - 1. All Surfaces: Of sufficient strength to hold concrete properly in place and prevent leakage of water from forms.
 - 2. Exposed Surfaces: A-Matte, Two-step MDO plywood made for forming by Simpson Timber Co., [206] 292-5000 or accepted equal. No wood-textured finish will be permitted on exposed concrete unless specified as such.
 - 3. Textured Form Facings: none
- F. Wood Headers:
 - 1. Wood: Construction Heart grade rough Redwood header and stake or pressure-treated rough Douglas Fir stake.
 - 2. Nails: Hot-dipped galvanized.
- G. Aggregate for Washed Exposed Aggregate Concrete:

1. Diameter: Round 1/4 in. to 3/8 in. dia., gap-graded, water-washed aggregate.
- H. Rock Salt: Very coarse-textured rock salt.
- I. Dampproofing: ASTM C836-81, Fluid-V single component, bitumen-modified, moisture-curing polyurethane "Tremproof 60" by Tremco, [800] 321-7906.
- J. Waterproofing: "Vulkem 450/320 Black. by Mameco International, Inc., [216] 752-4400.
- K. Curing Compound: ASTM C309, Type I-D, Class A.
- L. Chamfer Strips: Rigid PVC, 1/2 in. x 1/2 in in maximum possible lengths, by Burke Co., [415] 658-7942.
- M. Slip Sheet: 40 mil PVC sheet

2.7 SPECIAL PAVING MIX

- A. Aggregate for Exposed Aggregate Concrete:
 1. Aggregate:.
 2. Size: 3/8 in. diameter x No. 4.
 3. Design Mix: 1350 lbs. per cu. yd. concrete.
 4. Supplier:
- B. Glare-Reducing Agent:
 1. Design Mix: One quarter [1/4] lb. per sack of cement.
 2. Manufacturer: "Hi-Con Black #1195" by Conrad Sovig, Inc. or , [415] 863-3803.
- C. Water-Reducing Agent:
 1. Design Mix: Three and a half [3-1/2] ounces/100 lbs. cement.
 2. Manufacturer: W.R. Grace and Co., [800] 527-1893.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verification of Conditions: Verify that subgrade preparation for concrete paving has been completed [including base course] prior to commencement of work.
- B. Surface Drainage:
 1. Report in writing conflicts discovered on the site or prior work done by others, which would prevent positive drainage.
 2. Do not permit finished paving surfaces to vary more than 1/4 in. measured with a 10 ft. metal straightedge, except at grade changes. No "birdbaths" or other surface irregularities will be permitted. Properly correct irregularities.

3.2 PREPARATION

- A. Templates: Use templates for all anchor plates, bolts, inserts and other items embedded in concrete. Accurately secure so that they will not be displaced during placing of concrete.

- B. Piping and Conduit: Do not embed piping, other than electrical conduit, in structural concrete. Locate conduit to maintain strength of structures at maximum. Verify size, length and location of electrical conduit.
- C. Aggregate Base Course: Compact base course to thicknesses shown on Drawings to 95% compaction.

3.3 INSTALLATION

- A. Formwork:
 - 1. Construct forms accurately to dimensions, plumb and true to line and grade. Brace and tie as required to maintain position and shape during placing of reinforcing and concrete.
 - 2. Wavy surfaces and bulged walls or slab surfaces in finished work will be rejected.
 - 3. Extend wood forms for all exposed concrete at least 6 in. below finish grade.
 - 4. Do not disturb earth at bottoms of excavations for footings or foundations. Maintain these areas free of water, properly cleaned and leveled off.
 - 5. Assemble forms so that all construction joints appear only as shown on Drawings and as accepted by Landscape Architect. Incorporate all formwork joints into required reveal and expansion joints. No exposed form joints will be permitted.
 - 6. Install form facings as required.
 - 7. Use PVC chamfer strips to form chamfers at all exposed edges as shown on Drawings.
 - 8. Thoroughly clean all formwork prior to pouring concrete. Where no form coating is used, wet down all wood.
- B. Reinforcements:
 - 1. Placement: Clean, bend and place reinforcements per ACI Manual of Concrete Practice. Do not extend bars through expansion joints.
 - 2. Supports: Accurately and securely fasten or support reinforcements to prevent displacement before or during pouring. Hang footing bars from forms. Support wire mesh with suitable metal cradles.
 - 3. Reinforcement Splices: Reinforcing bars - 24 bar diameter minimum, except as otherwise noted.
- C. Joints:
 - 1. Locations: Provide control joints at locations and intervals shown on the Drawings, and as described below. Provide expansion joints as shown and where concrete paving abuts buildings, curbs, or other structures.
 - 2. Placement: Place expansion joint materials in proper alignment with top edge of concrete. Securely hold in place to prevent movement.
 - 3. Slip Sheet: Where expansion joints in concrete paving cannot be aligned with joints in structural slab, provide a continuous slip sheet between the offset joints.
- D. Placing of Concrete:
 - 1. Notify Landscape Architect 48 hours prior to pour.
 - 2. Place concrete in conformance to the ACI Manual of Concrete Practice.
- E. Removal of Forms: Remove no sooner than at seven [7] days after each pour.
- F. Cleaning:
 - 1. Removal: Remove all projecting fins, bolts, wire, nails, etc., not necessary for the work, or cut them back 1 in. from the surface and patch in an inconspicuous manner.
 - 2. Snap Ties: Immediately after removal of forms, cut off snap ties extending from the face of concrete to at least 1 in. deep in the concrete. Fill or plug as detailed in Drawings.
 - 3. Voids: Fill holes with a 1:3 cement/sand mortar with the same color as the adjoining concrete. Mix and place the mortar as dry as possible and finish flush with the adjacent surface.

- G. Patching of Walls:
1. Corrective Patching: Correct all defects in concrete work. Chip all voids to a depth of at least 1 in. with the edges perpendicular to the surface and parallel to form markings. Fill all voids, surface irregularities, or honeycombing by patching or rubbing. Insure that all concrete surfaces so repaired duplicate the appearance of the unpatched work.
 2. Finishings: Work finish surface texture as specified below.
- H. Defective Work: Remove in its entirety and replace all defective concrete work which after corrective patching, rubbing, etc., fails to duplicate the appearance of unpatched work and/or conform to the standards set forth in these Specifications.

3.4 FINISHES

- A. Floating: Float surface once it has sufficiently stiffened. Check planeness of surface with a 10 ft. straightedge in all directions. Cut down high spots and fill lows. Immediately refloat to a uniform non-directional sandy texture.
- B. Broom Finish:
1. Obtain by drawing a stiff bristled broom across a floated finish.
 2. Direction of brooming to be perpendicular to direction of paving [or as shown on Drawings.]
- C. Washed Exposed Integral Aggregate Finish:
1. Grades: Screed and wood-float paving to a smooth even grade using overhead screeds where necessary to set flow lines and grade breaks.
 2. Depth: Evenly expose aggregates by water washing and brushing to an average depth of 1/8 in. Do not pocket or kick out aggregate.
 3. Finish: Provide uniform color, texture, and degree of exposure of aggregates.
- D. Seeded Exposed Aggregate Finish:
1. Seeding: Immediately after the slab has been screeded and darbied, evenly distribute aggregates over the surface with minimum gaps in between.
 2. Embedding: Hand-float the surface and then steel-trowel so that all aggregates are entirely and evenly embedded just beneath the surface.
 3. Retarding: Spray on surface retardent evenly over surfaces to be exposed. Protect adjacent fresh concrete surfaces, bands, etc., that are not to be exposed.
 4. Depth: At the elapsed time specified by the retardent manufacturer, simultaneously flood and brush to obtain a clean, uniform surface with no aggregate exposed more than 1/16 in.
 5. Exposing of Aggregates: Do not dislodge or unevenly expose the aggregates. Avoid direct hosing of the surface and do not use a pressurized nozzle.
- E. Dry-Shake Color Finish:
1. Concrete Substrate: Screed and wood-float paving to a smooth even grade using overhead screeds where necessary to set flow line and grade breaks. Do not trowel.
 2. While concrete is still plastic throughout and when no excess moisture shows at the surface LITHOCHROME Color Hardener is applied uniformly to the surface by the dry-shake method. No water should be added to the surface.
 3. Apply two-thirds of the specified rate evenly, and thoroughly float the surface, either mechanically or by hand. It should not be troweled.
 4. Reapply remaining one-third evenly, surface float and trowel. Long handled Fresno must not be used.
- F. Sand-Blast Finish:
1. Schedule: Perform sand-blasting no sooner than 10 days after pouring each section of concrete

2. Continuity: Perform in as continuous an operation as possible, utilizing the same work crew to maintain continuity of finish.
 3. Depth of Cut: Use an abrasive grit of the proper type and gradation to expose the aggregate and surrounding matrix surfaces to be approx. 1/16 in. depth. [approx. 1/8 in. to 3/16 in. depth.] [approx. 3/16 in. to 1/4 depth.]
 4. Backup Boards: Blast corners and edge of patterns carefully, using backup boards in order to maintain a uniform corner or edge line.
 5. Uniformity: Use same nozzle, nozzle pressure and blasting technique as used for sample panel.
 6. Control: Maintain control of abrasive grit and concrete dust in each area of blasting.
 7. Clean Up: Remove all expended abrasive grit, concrete dust and debris at the end of each day of blasting operations.
- G. Washed Sand Finish:
1. Provide steel-trowel finish as described above.
 2. Allow concrete to cure and set thoroughly under normal procedures.
 3. After 2-3 days, wash surface with water-diluted muriatic acid [1 part acid to 50 parts water] and scrub using power floor scrubber with non-corrosive brush.
 4. Alternate Method: After minimum of 7 days power wash with water-diluted [1:6] 'Sure-Klean Heavy Duty Concrete Cleaner' by ProSoCo, [800] 255-4255.
 5. Expose concrete fines to provide surface finish similar to medium grit sandpaper.
- H. Steel-Trowel Finish:
1. Float finish as specified above.
 2. After surface water disappears and floated surfaces have sufficiently hardened, power trowel to produce an even smooth surface.
 3. After concrete has set enough to ring trowel, retrowel to a uniform smooth finish, free of trowel marks or other blemishes. Avoid excessive troweling that produces burnished areas.
- I. Rock-salt Finish:
1. Screed, tamp and float concrete in conformance to normal installation procedures.
 2. While concrete is still in a plastic stage, evenly dispense rock-salt over surface at the rate of 10 pounds per 150 square feet.
 3. Carefully float in rock salt to depress it into concrete. Avoid covering rock salt.
 4. Allow concrete to cure and set thoroughly under normal procedures.
 5. After 7-10 days, thoroughly wash any remaining salt from the area. Do not permit salt to contaminate adjacent planting areas.
- J. Mechanically Tooled Finish: Finishes achieved by electric or pneumatic tool used to remove the hardened outer skin of concrete to expose aggregates.
1. General: No mechanical tooling to be applied until concrete has attained full strength and surfaces are thoroughly hardened [27 days minimum].
 2. Mockup: Provide 12" x 12" sample of finish on concrete sample specifically poured at same time as site element to be mechanically finished, or mechanically finish an area of the actual site element that will be buried or otherwise covered up by other construction.
 3. Bush-hammered Finish:
 - a. Use roller-type cutting head [90 cutting points] capable of removing 1/8" of concrete on a single pass.
 - b. Start work with a new cutting head and change as required to maintain finish consistent with approved mockup.
 - c. Complete work in an as continuous manner as possible.
 - d. Clean entire surface with a stiff broom or brush and power wash with clean water at medium pressure.
 4. Point-tooling:

- a. Use a short-drawn pointed bit for 1/4" or less depths and long drawn-drawn bit for depths greater than 1/4".
- b. Start work with a new bit and change as required to maintain finish consistent with approved mockup.
- c. Make points sufficiently close together as to remove entire outer layer of cement paste and maintain finish consistent with approved mockup/sample.
- d. Clean entire surface with a stiff broom or brush and power wash with clean water at medium pressure.

3.5 JOINTS

- A. Sealing of Expansion Joints: After the curing period, strip out all depth gauge strips and carefully clean expansion joints. Fill with joint compound as shown on Drawings. Avoid spilling compound on paved surfaces or overflowing from joint.
- B. Control Joints:
 - 1. Tooled Score Joints:
 - a. Form in fresh concrete using a jointer to cut the groove so that a smooth, uniform impression is obtained. Strike all joints before and after brooming.
 - b. Perform in a continuous operation to avoid misalignment of joints. Use snaplines and forms as required to achieve consistent lines. Reform all crooked or misaligned joints at no cost to Owner.
 - 2. Sawcut Score Joints: 3/16 in. wide [max.] sawcut joints when concrete has cured at least seven [7] days, using accepted mechanical concrete saw. Employ only experienced personnel.
 - a. Cutting: Perform all cuts cleanly and smoothly, to a constant and equal depth. Perform in as continuous an operation as possible, to avoid misalignment of joints. Use chalklines, forms or templates as required to achieve consistent lines.
 - b. Edges: Avoid damage to horizontal improvements at edges of work.

3.6 PROTECTION AND CURING

- A. Conform to all applicable requirements for curing and protection of concrete, Sections 90-7 and 90-8 of the Standard Specifications.

3.7 PROTECTION AND CURING

- A. Protection:
 - 1. Protect concrete against rapid drying and damage by rain [frost].
 - 2. Keep concrete moist for at least 7 days. Protect with liquid curing compound, or a covering that will not stain or discolor finished concrete surfaces. Obtain acceptance of proposed method prior to use.
- B. Spraying: Spray concrete during the curing period as frequently as drying conditions may require.
- C. Curing: Cure concrete in accordance with the ACI Manual of Concrete Practice. During curing period, maintain concrete above 70 degrees F. for at least 3 days or above 50 degrees F. for at least 5 days.
- D. Damage and Defacement: Protect all concrete work against damage and defacement during subsequent construction operations until final acceptance.

3.8 DAMPPROOFING

A. Preparation of Surfaces:

1. Clean all surfaces to be dampproofed. Remove all dirt, grease, and other foreign matter which might interfere with adhesion and penetration. Allow surfaces to dry thoroughly.
2. Carefully repair all cracks, holes, voids, open areas and other defects in concrete surfaces to be dampproofed. Use Portland Cement mortar; strike flush and permit to dry.
3. Thoroughly clean all excess mortar from concrete surfaces after drying.

B. Application of Dampproofing Compound:

1. Cover entire retaining surface of backside of walls from top of footing to finished grade with two brush coats of specified dampproofing. Apply according to manufacturer's current printed instructions.
2. Apply first coat at minimum rate of 80 square feet per gallon of material. Brush into surface thoroughly making sure that coverage is uniform.
3. Allow first coat to dry for 24 hours and apply second coat at minimum rate of 150 square feet per gallon of material. Brush second coat at right angles to first coat to assure thorough coverage of entire surface. Apply dampproofing in a clean line conforming to finished ground grade.
4. Provide a completed dampproofing coating which is a continuous, uniform, unbroken, impervious film, free from pinholes and other surface breaks.

3.9 FIELD QUALITY CONTROL

- A. Samples: Owner will select a qualified testing laboratory to take samples for testing during the course of the work as considered necessary.
- B. Cost of Testing: Paid for by the Contractor.
- C. Rejected Materials: Remove off the site all concrete below specified strength.
- D. Cost of Removal and Retesting: Pay for full costs of removal of rejected concrete and its replacement with concrete of specified strength and retesting.

END OF SECTION

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SECTION 03355 - SPECIAL CONCRETE FINISHES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes mechanically processed special concrete finishes applied to cast-in-place concrete surfaces, as follows:
 - 1. Abrasive-blast finish.
- B. Related Sections: The following Sections contain requirements that relate to this Section:
 - 1. Division 3 Section "Site Concrete" for concrete materials, reinforcing, concrete mixes, formwork, placement procedures, finishes, and testing.

1.3 DEFINITIONS

- A. Reveal: The projection of the coarse aggregate from the matrix after exposure.

1.4 SUBMITTALS

- A. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.
- B. Samples of each type of special concrete finish, approximately 18 by 18 by 2 inches thick, matching quality of finishes, colors, and textures to the design reference sample. Where finishes involve normal color and texture variations, include Sample sets showing the full range of variations expected.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an experienced Installer who has completed special concrete finishes similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.
- B. Regulatory Requirements: Comply with provisions of air-pollution regulations of authorities having jurisdiction.
- C. Mockups: Prior to applying special concrete finishes, construct mockups for each finish required to verify selections made under Sample submittals and to demonstrate aesthetic effects. Build mockups to comply with the following requirements, using materials indicated for final unit of Work.
 - 1. Locate mockups on-site in the location and of the size indicated or, if not indicated, as directed by Architect.

2. Notify Architect one week in advance of the dates and times when mockups will be constructed.
3. Demonstrate the proposed range of aesthetic effects and workmanship.
4. In presence of Architect, demonstrate the repair of a blemished or damaged portion of an exposed-face surface.
5. Obtain Architect's approval of mockups before start of final unit of Work.
6. Retain and maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
 - a. When directed, demolish and remove mockups from Project site.
 - b. Approved mockups in an undisturbed condition at the time of Substantial Completion may become part of the completed Work.

PART 2 - PRODUCTS

2.1 CONCRETE MATERIALS

- A. Cement, aggregates, coloring agents, admixtures, and water are specified in Division 3 Section "Site Concrete"
- B. Use other materials and accessories for the Work, including surface retarders when required, to reproduce design reference sample or mockup of special concrete finishes.

2.2 CONCRETE MIX

- A. Concrete proportions and design requirements are specified in Division 3 Section Site Concrete."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting application of special concrete finishes. Do not proceed with application until unsatisfactory conditions have been corrected.

3.2 PLACING CONCRETE

- A. Concrete placement is specified in Division 3 Section "Site Concrete."

3.3 FINISHES, GENERAL

- A. Coordinate form removal with Division 3 Section "Site Concrete."
- B. Maintain uniformity of special finishes over construction joints, unless otherwise indicated.
- C. Special Finish: Match Architect's design reference sample, identified and described as indicated.

3.4 ABRASIVE-BLAST FINISH

- A. Perform abrasive blasting 24 to 72 hours after casting when concrete strength ranges between 1000 and 1500 psi. Coordinate with formwork construction, concrete placement schedule, and formwork removal to ensure that surfaces to be abrasive blasted are treated at the same age for uniform results.
- B. Surface Continuity: Perform abrasive-blast finishing in as continuous an operation as possible, utilizing same work crew to maintain continuity of finish on each surface or area of Work. Maintain required patterns or variances in depths of blast to match design reference sample or mockup.
- C. Depth of Cut: Use an abrasive grit of proper type and gradation to expose aggregate and surrounding matrix surfaces to match design reference sample or mockup, as follows:
 - 1. Brush: Remove cement matrix to eliminate surface sheen and expose face of fine aggregate. No reveal.
 - 2. Light: Expose fine aggregate with occasional exposure of coarse aggregate and uniform color. Maximum reveal 1/16 inch.
- D. Abrasive Blasting: Abrasive blast corners and edges of patterns carefully, using back-up boards, to maintain uniform corner or edge line. Determine type of nozzle, nozzle pressure, and blasting techniques required to match design reference sample or mockup.
- E. Acid Cleaning: After abrasive blasting to required depth is completed, apply a 5 to 10 percent concentration of hydrochloric acid wash to clean surfaces to match sample or mockup. Thoroughly neutralize and flush acid from finished surfaces with water under pressure. Protect adjacent materials and finishes from acid wash.

3.5 REPAIRS AND CLEANING

- A. Repair damaged special concrete-finished surfaces to match color, texture, and uniformity of surrounding surfaces and to match repairs to approved mockups.
- B. Clean surfaces given special concrete finishes after treatment to remove stains, markings, dust, and debris.
- C. Wash and rinse surfaces according to special concrete finish applicator's recommendations. Protect other Work from staining or damage due to cleaning operations.
 - 1. Do not use cleaning materials or processes that could change the appearance of concrete finishes.

END OF SECTION

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SECTION 04813
MASONRY VENEER

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Brick veneer units.
- B. Reinforcement, anchorage and accessories.
- C. Mortar.
- D. Related flashings.

1.2 RELATED SECTIONS

- A. Section 06100 - Rough Carpentry: Wall framing; plywood sheathing.
- B. Section 07620 - Sheet Metal Flashing and Trim.
- C. Section 07900 - Joint Sealers.

1.3 REFERENCES

- B. ASTM A153 - Specification for Zinc Coating (Hot Dip) on Iron and Steel Hardware.
- C. ASTM A525 - Specification for Steel Sheet, Zinc Coated, (Galvanized) by the Hot-Dip Process.
- D. ASTM C144 - Specification for Aggregate for Masonry Mortar.
- E. ASTM C150 - Specification for Portland Cement.
- F. ASTM C207 - Specification for Hydrated Lime for Masonry Purposes.
- G. ASTM C216 - Specification for Facing Brick (Solid Masonry Units Made from Clay or Shale).
- H. ASTM C270 - Specification for Mortar for Unit Masonry.
- I. ASTM C404 - Specifications for Masonry Grout.
- J. ASTM C476 - Specification for Grout for Reinforced and Non-Reinforced Masonry.
- L. CBC - California Building Code, 2010 edition.

1.4 SYSTEM DESCRIPTION

- A. Masonry Veneer System: Anchored brick assembly consisting of brick facing applied over felt underlayment with air space between facing and felt underlayment and secured through plywood sheathing to metal stud framing.
- B. Utilize salvaged brick from partial building demolition. Color, surface texture and dimensions of face brick provided under this section are to match the color, surface texture and dimensions of brick on the existing building.
- D. Color of mortar provided under this section is to approximate the color of brick mortar on existing buildings on campus.
- E. Color of mortar provided under this section is to match the color of brick mortar used in the existing building. If the color cannot be matched, contractor shall stain mortar to Architects approval.

1.5 SUBMITTALS

- A. Product Data: Submit product data for brick units, mortar and grout materials, reinforcing anchorage components and underlayment.
- B. Samples:
 - 1. Brick Units: Provide full-sized samples of brick veneer units salvaged and cleaned of all mortar. Chipped or mismatched units will be rejected.
 - 2. Mortar: Provide samples, minimum 3 inches long, of mortar set in plastic channel illustrating color. Architects approval of samples shall not relieve Contractor from final Architect's or Campus representative's approval of insitu approval of color match.
- C. Mix Designs: Submit mix design for mortar. Indicate names and brands of each material, proportions, slump, strength and location used in job.
- D. Test Reports: Submit laboratory test reports for mix designs specified. Include name of testing laboratory, date of testing and signature of agent of testing laboratory.
- E. Certifications: Certify that each type of aggregate, cement and admixture used in mortar meets or exceeds specified requirements.

1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacture of type of face brick units specified in this section with minimum 10 years documented experience.
- B. Installer: Company specializing in performing the work of this section with minimum five years documented experience and approved by manufacturer.

1.7 REGULATORY REQUIREMENTS

- A. Conform to requirements of CBC Section 1403A.

1.8 MOCK-UP

- A. Erect brick veneer panel, minimum 3 x 4 feet size; include specified underlayment brick, reinforcement, anchorage, mortar and grout for complete assembly.
- B. Rebuild mock-up as required until accepted by Architect.
- C. When accepted, mock-up will demonstrate minimum standard for the work.
- D. Retain and protect accepted mock-up panel in undisturbed condition during work of this section.
- E. Mock-up may remain as part of the work.

1.9 PREINSTALLATION CONFERENCE

- A. Convene preinstallation conference minimum one week prior to beginning work of this section.
- B. Attendance: Contractor, installer, related subcontractors, Construction Manager and Architect.
- C. Agenda: Review installation procedures and coordination required with related construction. Conduct inspection of substrate conditions.

1.10 DELIVERY, STORAGE AND HANDLING

- A. Deliver products to site, store, handle and protect in accordance with manufacturer's instructions and recommendations.
- B. Schedule deliveries to ensure uninterrupted progress of construction.
- C. Accept salvaged brick units on site; inspect for damage.
- D. Handle and store brick in manner to avoid chipping, breakage, or intrusion of foreign matter.
- E. Keep reinforcement, anchors and ties free from rust.
- F. Deliver cement and lime in unbroken bags, barrels, or other acceptable containers plainly marked and labeled with manufacturers' names and brands.
- G. Store cementitious materials in dry weathertight sheds or enclosures or under water-tight tarpaulins.

1.11 ENVIRONMENTAL REQUIREMENTS

- A. Maintain materials and surrounding air temperature between minimum 40 degrees F and maximum 90 degrees F prior to, during and 48 hours after completion of masonry work.

1.12 SEQUENCING AND SCHEDULING

- A. Coordinate the installation of underlayment with the installation of underlayment under honeycomb core composite building panels and under fiber cement siding. Ensure underlayments are properly lapped at transitions.
- B. Coordinate installation of items furnished under other sections to be embedded in masonry work.
 - 1. Obtain information and instructions from suppliers so that provisions can be made for their work without delaying project.
 - 2. Perform cutting and patching required due to failure to obtain information in timely manner at no additional cost to District.

1.13 EXTRA MATERIALS

- A. Provide 10 of each type and color of brick unit used.
- B. Wrap, crate and label extra materials.

PART 2 PRODUCTS

2.1 FACE BRICK UNITS

- A. Face Brick: ASTM C216, Type FSB, Grade SW; solid clay brick to approximate appearance of existing brick on adjacent buildings.
 - 1. Size: As installed in existing building.
 - 2. Texture: As installed in existing building.
 - 3. Color: Minimum 5 color blend with flash.

2.2 REINFORCEMENT AND ANCHORAGE

- A. Horizontal Joint Reinforcement: ASTM A82; cold drawn annealed steel wires; minimum 9 gauge; galvanized to ASTM A153 Class B2 finish.
- B. Anchor Ties: Adjustable veneer anchors conforming to CBC Section 1403A.6.4.2.1; two-piece assembly consisting of channel slots with adjustable anchors; minimum 14 gauge galvanized steel.

1. Channel Slots: Minimum 6 inches long; drilled for screw attachment; Dur-O-Wal, Inc. #D/A 901, Heckmann Building Products, Inc. #132, Hohmann & Barnard, Inc. #362 or equal product substituted under provisions of Section 01630.
 2. Anchors: Adjustable; T-head to fit channel slots; shear lug locks to retain joint reinforcement; Dur-O-Wal, Inc. #D/A 931, Heckmann Building Products, Inc. #362, Hohmann & Barnard, Inc. #364 SV, or equal product substituted under provisions of Section 01630.
- C. Fasteners: 10-16 HWH T/3 wood screws; steel with galvanized or copolymer corrosion resistant coating; length sufficient to penetrate wood framing minimum 1-1/2 inches.

2.3 FLASHING

- A. Galvanized Steel: As specified in Section 07620.
- B. Flexible Through Wall Flashing System:
1. Flexible Membrane Flashing: Self-adhesive cold-applied composite sheet consisting of 32 mils rubberized asphalt and 8 mils of cross-laminated high density polyethylene film requiring no special adhesive or heat necessary to form laps; 40 mil total thickness; self healing; release paper; W. R. Grace and Company "Perm-A-Barrier" Wall Flashing.
 2. Surface Conditioner: Water based formula designed to prepare dusty and dirty substances for flashing; VOC compliant; W. R. Grace and Company "Perm-A-Barrier" Surface Conditioner.
 3. Mastic: Rubberized asphalt-based mastic; W. R. Grace and Company "Bituthene" Mastic.
 4. Substitutions: Under provisions of Section 01630.
- C. Lap Sealant: Type specified in Section 07620.

2.4 ACCESSORIES

- A. Underlayment: ASTM D226; #15 unperforated asphalt saturated felt.
- B. Weep Vents: Recycled polyester mesh; 90 percent open; 2.5 x 5 x 5 inch size; color to match mortar; Sandell Manufacturing Company, Inc Mortar Net Weep Vents, Mortar Net USA, Ltd. Mortar Net Weep Vents or equal product substituted under provisions of Section 01630.
- C. Mortar Nets: High density polyethylene, nylon or polyester mesh; 90 percent open; dovetail shape; 1 inch thick; 10 inches high x 5 feet long; Sandell Manufacturing Company, Inc Mortar Net, Mortar Net USA, Ltd. Mortar Net or equal product substituted under provisions of Section 01630.
- D. Control Joint Materials:
1. Joint Filler: Type specified in Section 07900.

2. Sealant: Sealant Type 1 as specified in Section 07900; color to match mortar.
- E. Joint Filler: Closed cell polyethylene; oversized 50 percent to joint width; self-expanding.
 - F. Cleaning Solution: Non-acidic, not harmful to masonry work or adjacent materials.
- 2.5 MORTAR
- A. Materials:
 1. Cement: ASTM C150, Type II, low alkali.
 2. Hydrated Lime: ASTM C207, Type S.
 3. Mortar Aggregates: ASTM C144; fine granular sand composed of hard, strong, durable material particles free from injurious amounts of saline, alkaline, organic or other deleterious substances.
 4. Water: Clean; free from injurious amounts of acids, salts, alkali, organic and other deleterious materials.
 - B. Mix: ASTM C270, Type M; minimum compressive strength of 1800 psi in 28 days; freshly prepared and uniformly mixed in the following ratio by volume:

Portland Cement: 1 part
Hydrated Lime: 1/4 part
Damp Loose Sand: Minimum 3-1/2 to maximum 4 times sum of volume of cement and lime

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that field conditions are acceptable and are ready to receive work.
- B. Verify items provided by other sections of work are properly sized and located.
- C. Notify Construction Manager, in writing, of conditions detrimental to proper installation of masonry veneer.
- D. Do not begin installation until unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Install underlayment over plywood sheathing shingle fashion with minimum 2 inch horizontal and minimum 6 inch vertical laps. Coordinate with installation of underlayment under adjacent finishes.

- B. Install channel slots for anchor ties over underlayment.
 - 1. Place at 12 inches oc vertically and 16 inches oc horizontally.
 - 2. Place at maximum 8 inches oc each way around openings within 12 inches of opening.
 - 3. Secure to framing with screws.
- C. Provide temporary bracing during installation of masonry work. Maintain in place until building structure provides permanent bracing.

3.3 COURSING

- A. Establish lines, levels, and coursing indicated. Protect from displacement.
- B. Align brick courses and maintain to uniform dimension. Form vertical and horizontal joints of uniform thickness.
- C. Bond: Running.
- D. Coursing: Three units and three mortar joints equal to 8 inches.
- E. Mortar Joints: Concave.

3.4 PLACING AND BONDING

- A. Lay brick in configurations shown on Drawings.
 - 1. Use units free from chipped edges or other imperfections distracting from appearance of finished work.
 - 2. Wherever possible, use full units of proper size in lieu of cut units.
- B. Lay masonry units in full bed of mortar, with full head joints, uniformly jointed with other work.
- C. Buttering corners of joints or excessive furrowing of mortar joints are not permitted.
- D. Remove excess mortar as work progresses.
- E. Interlock intersections and external corners.
- F. Do not shift or tap masonry units after mortar has achieved initial set. Where adjustment must be made, remove mortar and replace.
- G. Perform jobsite cutting of masonry units with proper tools to provide straight, clean, un-chipped edges. Prevent broken masonry unit corners or edges.
- H. Isolate top joint of masonry walls from horizontal framing members with compressible joint filler.

3.5 WEEPS

- A. Install weeps in veneer at 32 inches oc horizontally above through wall flashing at bottoms of walls.

3.6 CAVITY BEHIND VENEER

- A. Do not permit mortar to drop into or accumulate in cavity air space.

3.7 REINFORCEMENT

- A. Prior to placement, thoroughly clean reinforcing of mill scale, rust, mortar, oil, dirt and coatings which may reduce proper bond of reinforcing with grout and mortar.
- B. Set veneer anchors into each channel slot at 12 inches oc; embed into veneer. Ensure anchors support a maximum of 2 sq ft of veneer.
- C. Install horizontal joint reinforcing in accordance with manufacturer's instructions and recommendations.
 - 1. Place at 12 inches oc vertically maximum; set in seismic lug of veneer anchor.
 - 2. Lap ends minimum 6 inches; locate laps in middle third of width of brick.
 - 3. At openings, place in first and second horizontal joints above and below openings; extend minimum 16 inches each side of opening.
 - 4. In addition, place joint reinforcement continuous in first and second joint below top of walls and infill.
- D. Spot bed each anchor tie in mortar.

3.8 MASONRY FLASHING

- A. Extend flashings horizontally at foundation walls, under parapet caps, below window sills and where indicated on Drawings. Coordinate with flashings installed under other sections.
- B. Turn flashing up minimum 8 inches and seal to sheathing over wood framed back-up.
- C. Lap end joints minimum 6 inches and seal watertight.
- D. Turn flashing, fold and seal at corners, bends and interruptions.
- E. Install flexible flashing in accordance with manufacturer's instructions; prime substrates in accordance with manufacturer's recommendations.

3.9 CONTROL JOINTS

- A. Do not continue horizontal joint reinforcement through control joints.

- B. Form control joint with backer rod and sealant; tool sealant concave to match mortar joint

3.10 TOLERANCES

- A. Variation from Plane of Wall: 1/4 inch in 10 feet and 3/8 inch in 20 feet and more.
- B. Variation from Plumb: 1/4 inch per story non-cumulative; 1/2 inch in two stories and more.
- C. Variation from Level Coursing: 1/8 inch in 3 feet, 1/4 inch in 10 feet; 1/2 inch maximum.
- D. Variation of Joint Thickness: 1/8 inch in 3 feet.

3.11 CUTTING AND FITTING

- A. Cut and fit for conduit and sleeves. Coordinate with other sections of work to provide correct size, shape, and location.
- B. Obtain Architect's authorization prior to cutting or fitting masonry work not indicated or where appearance or strength of masonry work may be impaired.

3.12 CLEANING

- A. Remove excess mortar and smears.
- B. Clean soiled surfaces with a non-acidic solution which will not harm masonry and adjacent materials. Consult brick manufacturer for acceptable cleaners.
- C. Use non-metallic tools in cleaning operations.

3.13 PROTECTION

- A. Maintain protective boards at exposed external corners which may be damaged by construction activities.
- B. Provide protection without damaging completed work.
- C. At day's end, cover unfinished walls to prevent moisture infiltration.

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SECTION 05120
STRUCTURAL STEEL

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Structural steel framing members and support members.
- B. Baseplates, and anchor bolts.
- C. Grouting under baseplates.

1.2 REFERENCES

- A. CBC - California Building Code, (CCR) California Code of Regulations, Title 24, Part 2.
- B. ASTM A36 - Carbon Structural Steel.
- C. ASTM A53 - Pipe, Steel, Black and Hot-Dipped, Zinc Coated, Welded and Seamless.
- D. ASTM A108 - Steel Bars, Carbon, Cold-Finished, Standard Quality.
- E. ASTM A307 - Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength
- F. ASTM A325 - High Strength Bolts for Structural Steel Joints.
- G. ASTM A490 - Structural Bolts, alloy Steel, Heat Treated, 150 ksi Minimum Tensile Strength.
- H. ASTM A500 - Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Round and Shapes.
- I. ASTM A992 - Standard Specification for Steel for Structural Shapes for Use in Building Framing.
- J. ASTM C1107 - Packaged Dry, Hydraulic Cement Grout (non shrink).
- K. ASTM F1554 - Standard Specification for Anchor Bolts, Steel, 36, 55, and 105 KSI Yield Strength.
- L. AWS A2.4 - Standard Welding Symbols.
- M. AWS D1.1 - Structural Welding Code - Steel.
- N. AISC - Specification for the Design, Fabrication and Erection of Structural Steel for Buildings.
- O. AISC - Specification for Architectural Exposed Structural Steel.
- P. SSPC - The Society for Protective Coatings.

1.3 SUBMITTALS

- A. Submit under provisions of Section 01330.
- B. Shop Drawings: Indicate profiles, sizes, spacing, and locations of structural members, connections, cambers and loads. Indicate welded connections with AWS A2.4 welding symbols. Indicate net weld lengths.
- C. Manufacturer's Mill Certificate: Submit under provisions of Section 01330 certifying that products meet or exceed specified requirements.
- D. Mill Test Reports: Submit under provisions of Section 01330 Manufacturer's Certificates, indicating structural strength and destructive and nondestructive test analysis.
- E. Welders' Certificates: Submit under provisions of Section 01330, certifying welders employed on the Work, verifying AWS qualification within the previous 12 months.

1.4 QUALITY ASSURANCE

- A. Fabricate structural steel members in accordance with AISC-Specification for the Design, Fabrication and Erection of Structural Steel for Buildings.

1.5 QUALIFICATIONS

- A. Design connections not detailed on the Drawings under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed in the State of California.
- B. Design connections in accordance with CBC California Building Code, (CCR) California Code of Regulations, Title 24, Part 2, Chapter 22.
- C. Any details not detailed on drawings and designed by fabricator shall be identified on the shop drawings as such for review and approval.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Structural Steel Members: ASTM A36. W and WT shapes, ASTM A992.
- B. Structural Tubing: ASTM A500, Grade B.
- C. Steel Pipe: ASTM A53, Grade B.
- D. Shear Stud Connectors: ASTM A108, Grade 1015, forged steel, headed, unfinished.
- E. Threaded Bolts, Nuts, and Washers: ASTM A307, A325 and A490
- F. Anchor Bolts: ASTM A307. ASTM F1554 if over 9-1/2 inches long.
- G. Welding Materials: AWS D1.1; type required for materials being welded.
- H. Grout: ASTM C1107, non-shrink type, pre-mixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing additives, capable of developing a minimum compressive strength of 7,000 psi at 28 days.

2.2 FABRICATION

- A. Fabricate structural steel members in accordance with AISC Specification.
- B. Where steel is exposed to weather, continuously seal joined members by continuous welds. Grind exposed welds smooth.

2.3 FINISH

- A. Prepare structural component surfaces in accordance with SSPC SP-2.
- B. Shop and Touch-Up Primer: SSPC 15, Type 1, Red Oxide.
- C. Shop prime structural steel members. Do not prime surfaces that will be fireproofed, field welded or in contact with concrete or masonry.
- D. Finish: Site paint exposed to view structural steel members under provisions of Section 09900.

2.4 SOURCE QUALITY CONTROL AND TESTS

- A. Testing and analysis of components will be performed under provisions of Section 01458.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that field conditions are acceptable and are ready to receive work.
- B. Beginning of installation means erector accepts existing conditions.

3.2 ERECTION

- A. Allow for erection loads, and for sufficient temporary bracing to maintain structure safe, plumb, and in true alignment until completion of erection and installation of permanent bracing.
- B. Field weld components indicated on Drawings.
- C. Field connect members with threaded fasteners indicated; torque to required resistance.
- D. Do not field cut or alter structural members without approval of Architect.
- E. After erection, prime welds, abrasions, and surfaces not shop primed, except surfaces to be in contact with concrete.

3.3 GROUTING

- A. Clean concrete on masonry bearing surfaces.
- B. Roughen bearing surface prior to setting base and bearing plates.
- C. Set base and bearing plates on wedges, shims, or setting nuts.
- D. Tighten anchor bolts after members are positioned and plumb.
- E. Cut off protruding wedges or shims flush with edge of base or bearing plate.
- F. Pack grout solidly between bearing surfaces and plates so no voids remain.

G. Finish exposed surfaces, protect installed materials, and allow to cure.

3.4 ERECTION TOLERANCES

A. Erect structural steel members in accordance with AISC Specification.

3.5 RECYCLING CONSTRUCTION WASTE

A. Recycle excess materials waste under the provisions of Section 01524.

3.6 FIELD QUALITY CONTROL

A. Field inspection and testing will be performed under provisions of Section 01458.

END OF SECTION

SECTION 053100

STEEL DECKING

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Roof deck.

1.2 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent agency qualified according to ASTM E 329 for testing indicated.
- B. Welding: Qualify procedures and personnel according to AWS D1.3, "Structural Welding Code - Sheet Steel."
- C. AISI Specifications: Comply with calculated structural characteristics of steel deck according to AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members."
- D. Recycled Content of Steel Products: Provide products with an average recycled content of steel products so postconsumer recycled content plus one-half of preconsumer recycled content is not less than 25 percent.

1.3 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Steel Deck:
 - a) ASC Profiles, Inc.
 - b) Verco Manufacturing Co.
 - c) Or approved equal.

1.4 ROOF DECK

- A. Steel Roof Deck: Fabricate panels, without top-flange stiffening grooves, to comply with "SDI Specifications and Commentary for Steel Roof Deck," in SDI Publication No. 30.
 - 1) Galvanized Steel Sheet: ASTM A 653/A 653M, Structural Steel (SS), Grade 33.

END OF SECTION

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SECTION 05400

COLD FORMED METAL FRAMING

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Load bearing and non-load bearing formed steel stud exterior wall and interior wall framing.
- B. Formed steel joist framing and bridging

1.2 REFERENCES

- A. ASTM A653 - Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated Galvannealed) by Hot Dip Process.
- B. ASTM A780 - Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
- C. ASTM A924 - General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dipped Process.
- D. ASTM C954 - Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs from 0.033 Inch to 0.112 Inch in Thickness.
- E. ASTM C955 - Load Bearing (Transverse and Axial) Steel Studs, Runners (Tracks) and Bracing or Bridging for Screw Application of Gypsum Panel Products and Metal Plaster Bases.
- F. ASTM C1007 - Installation of Load Bearing (Transverse and Axial) Steel Studs and Related Accessories.
- G. AISI - Specification for Design of Cold Formed Steel Structural Members.
- H. AWS D1.1 - Structural Welding Code - Steel.
- I. AWS D1.3 - Structural Welding Code - Sheet Steel.
- J. SSPC - The Society for Protective Coatings.
- K. SSMA - Steel Stud Manufacturers Association.

1.3 QUALITY ASSURANCE

- A. Manufacturer: Company specializing in structural framing components with five years minimum experience.
- B. Installer: Experienced installer who has completed cold-formed metal framing similar in material, design, and extent to that indicated for this project.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. California Expanded Metal Products Co., www.cemcosteel.com.
- B. Consolidated Fabricators Corp., ww.confabbpd.com.
- C. Dietrich Industries, Inc., www.dietrichindustries.com.
- D. Knorr Steel Framing Systems, www.safco.com/knorr.
- E. Western Metal, www.wmlinc.com.
- F. Substitutions: Under provisions of Section 01630.

2.2 FRAMING SYSTEM

- A. With each type of metal framing required, provide manufacturer's standard steel runners, blocking, lintels, clip angles, shoes, reinforcements, fasteners, and accessories required to provide a complete framing system for applications indicated.

2.3 FRAMING MATERIAL

- A. ASTM A653, structural steel, of thickness, depth, finish, and grade indicated.

2.4 FRAMING COMPONENTS

- A. Studs: Standard C-shaped steel studs, punched, complying with ASTM C955 and as scheduled
- B. Steel Track: Standard U-shaped steel track of same material, finish, and thickness as studs, unpunched, complying with ASTM C955.
- C. Deflection Track: Top runner designed to allow for deflection of structure of same material, finish, and thickness as studs and of the following configuration:
 - 1) Top runner with slotted flanges 2-1/2 inch deep with slots 1 inch on center.
 - 2) Products: Subject to compliance with requirements provide one of the following:
 - (a) S L P - T R K , S l i p t r a c k S y s t e m s , I n c . www.dietrichindustries.com.
 - (b) The System, the Angle System, Metal-Lite, Inc., www.metal-lite.com.
 - (c) Substitutions: Under provisions of Section 01630.
- D. Joists: Standard C-shaped steel sections, with unpunched, stiffened flanges, complying with ASTM C955 and as scheduled
- E. Built-up Members: Standard C-shaped steel section, with stiffened flanges, nested into a U-shaped steel track, with unstiffened flanges, unpunched; of same material, finish and thickness as adjacent members complying with ASTM C955.
- F. Vertical Deflection Clips: Standard bypass clips, capable of accommodating upward and downward vertical displacement of primary structure.

2.5 FASTENERS

- A. Self-drilling, Self-tapping Screws: ASTM C954, sized to conform to applications indicated, galvanized finish.
- B. Welding: In conformance with AWS D1.1 and AWS D1.3.

2.6 ACCESSORIES

- A. Bracing, Furring, Bridging: Formed sheet steel, 0.0428 inch minimum thickness, galvanized finish.
- B. Plates, Gussets, Clips: Formed sheet steel, 0.0428 inch minimum thickness, galvanized finish.

2.7 FINISHES

- A. Galvanizing: G60 coating class according to ASTM A924.
- B. Primer: SSPC 20.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Verify that building framing components are ready to receive work.
- B. Beginning of installation means acceptance of existing conditions.

3.2 ERECTION OF STUDDING

- A. Install components in accordance with SSMA requirements, ASTM C1007, and manufacturer's instructions.
- B. Cut framing members by sawing or shearing; do not torch cut.
- C. Fasten framing members by welding or screw fastening as indicated and as follows:
 - 1) Comply with AWS D1.3 for welding work.
 - 2) Locate fasteners according to shop drawings with screw penetrating joined members by not less than three exposed screw threads.
- D. Align floor and ceiling tracks; locate to wall and partition layout. Secure in place with fasteners or welding at maximum 24 inches o.c.
- E. Place studs at 16 inches o.c.; not more than 2 inches from abutting walls and at each side of openings. Connect both flanges of studs to tracks using fastener method.
- F. Construct corners using minimum three studs. Double stud at wall opening, door, and window jambs.
- G. Erect studs one piece full length. Splicing of studs is not permitted.
- H. Erect studs, brace, and reinforce to develop full strength to meet design requirements.
- I. Fasten hole reinforcing plate over web penetrations which exceed standard punched openings.
- J. Extend stud framing through ceiling to underside of floor or roof structure above except where partitions are indicated to terminate at ceiling.

- K. Extend stud framing to ceiling only where indicated. Attach ceiling channel securely to acoustical ceiling track and/or ceiling framing in accordance with details indicated.
- L. For sound and fire resistance rated partitions extend framing to underside of roof or other continuous solid surface to obtain rating.
- M. Install intermediate studs above and below openings to match wall stud spacing.
- N. Provide deflection allowance in stud track, directly below horizontal building framing for non-load bearing framing.
- O. Attach steel plate to studs for attachment of fixtures anchored to walls.
- P. Install framing between studs for attachment of mechanical and electrical items, and to prevent stud rotation.
- Q. Install miscellaneous framing and connections, including supplementary framing, web stiffeners, clip angles, anchors, and fasteners to provide a complete and stable framing system.
- R. Touch-up field welds and damaged galvanized surfaces with primer in accordance with ASTM A780.

3.3 TOLERANCES

- A. Erect framing level, plumb and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet for member out-of-square tolerance.
- B. Spacing of individual members shall be no more than 1/8 inch from plan location.

3.4 RECYCLING CONSTRUCTION WASTE

- A. Recycle excess materials waste under the provisions of Section 01524.

END OF SECTION

SECTION 05500

METAL FABRICATIONS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Miscellaneous metal and fabricated ferrous metal items, galvanized and prime painted, within and attached to building.
- B. Associated manufactured items.
- C. Accessories.
- D. Refer to schedule at end of this section.

1.2 PRODUCTS SUPPLIED BUT NOT INSTALLED UNDER THIS SECTION

- A. Supply metal fabrications to be cast in structural concrete to Section 03300 – Concrete and Concrete Finishes.

1.3 RELATED SECTIONS

- A. Section 03200 – Reinforcing Steel.
- B. Section 03300 – Concrete and Concrete Finishes.
- C. Section 05100 - Structural Steel.
- D. Section 05400 - Cold Formed Metal Framing: Load bearing exterior framing and backing.
- E. Section 05521 – Pipe and Tube Railings.
- F. Section 09110 - Non-Load Bearing Metal Framing: Non-load bearing interior metal framing and backing.
- G. Section 09900 - Paints and Coatings: Field painting of metal fabrications.
- H. Other metal items are specifically called for and described in other sections.

1.4 REFERENCES

- A. AA - Aluminum Association Finishes Designation System.
- B. ANSI B18.21.1 - Lock Washers.
- C. ANSI B18.22.1 - Plain Washers.

- D. ASTM A36 - Specification for Carbon Structural Steel.
- E. ASTM A53 - Specification for Hot-Dipped, Zinc-Coated Welded and Seamless Steel Pipe.
- F. ASTM A123 - Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
- G. ASTM A153 - Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
- H. ASTM A167 - Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
- I. ASTM A283 - Specification for Low and Intermediate Tensile Strength Carbon Steel Plates, Shapes and Bars.
- J. ASTM A307 - Specification for Low-Carbon Steel Externally and Internally Threaded Fasteners.
- K. ASTM A500 - Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
- L. ASTM A653 - Steel Sheet, Zinc-Coated, (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process.
- M. ASTM A666 - Specification Annealed or Cold-Worked for Austenitic Stainless Steel Sheet, Strip, Plate and Flat Bar.
- N. ASTM A1008 - Specification for Steel Sheet, Cold-Rolled, Carbon, High-Strength Low-Alloy and High-Strength Low Alloy with Improved Formability.
- O. ASTM B209 - Specification for Aluminum and Aluminum Alloy Sheet and Plate.
- P. ASTM B221 - Aluminum Alloy Extruded Bars, Rods, Wire, Shapes and Tubes.
- Q. ASTM F593 - Specification for Stainless Steel Bolts, Hex Cap Screws and Studs.
- R. ASTM F594 - Specification for Stainless Steel Nuts.
- S. AWS D1.1 - Structural Welding Code - Steel.
- T. AWS D2.4 - Standard Symbols for Welding, Brazing and Nondestructive Examination.
- U. FS FF-S-325 - Shield, Expansion, Nail, Expansion and Nail, Drive Screw (Devices, Anchoring, Masonry).
- V. FS RR-W-410 - Wire Rope and Strands.
- W. SSPC - Society for Protective Coatings.

1.5 DESIGN REQUIREMENTS

- A. Sustainable Design Requirements: Steel and aluminum used in work of this section is intended to contribute to meeting requirements for recycled content outlined in LEED™-NC 2009 for Credit MR4.

1.6 SUBMITTALS

- A. Shop Drawings: Indicate materials, finishes, locations, sizes, profiles, attached hardware and fittings, reinforcing, anchorage, size and type of fasteners and details of fabricated metal work.
 - 1. Include erection drawings, elevations and details showing cuts, copes, connections holes, threaded fasteners and welds.
 - 2. Indicate welded connections using symbols conforming to AWS D2.4. Indicate shop and field welds with net weld lengths.
 - 3. Indicate size and location of welded connectors, concrete inserts or masonry inserts where connectors or inserts are required to receive work.
- B. Product Data: Submit manufacturer's data for manufactured items and accessories.
- C. Samples:
 - 1. Galvanized Finish: Submit samples, minimum 3 x 3 inches in size, illustrating each type of zinc coating specified.
 - 2. Stainless Steel Finish: Submit samples, minimum 3 x 3 inches in size, illustrating specified finish applied to stainless steel sheet.
- D. Welders' Certificates: Certify welders employed on work have passed AWS qualification tests within the previous 12 months.
- 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. Submit hard copies of completed Online Documentation required for LEED™ MR Credit 4.

1.7 QUALIFICATIONS

- A. Welders: Personnel qualified in accordance with AWS D1.1 within previous 12 months.

1.8 FIELD MEASUREMENTS

- A. Verify that field measurements are as indicated on shop drawings.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Steel Sections: ASTM A36.
- B. Plates, Angles, Bars and Rods:
 - 1. Carbon Steel: ASTM A36.
 - 2. Stainless Steel: ASTM A666, Type 304
- C. Steel Tubing: ASTM A500, Grade B.
- D. Steel Pipe: ASTM A53, Grade B, Schedule 40.
- E. Sheet Steel:
 - 1. Carbon Steel: ASTM A1008, cold rolled sheet steel; 24 gauge minimum thickness.
 - 2. Galvanized Sheet Steel: ASTM A653, Grade A, G90; 24 gauge minimum thickness.
 - 3. Stainless Steel Sheet: ASTM A167, Type 304; 18 gauge minimum thickness.
- G. Extruded Aluminum Tubing, Angles and Channels: ASTM B221, 6061 alloy, T6 temper.
- H. Aluminum Sheet: ASTM B209, 5005 alloy, H34 temper.
- I. Steel Cable: FS RR-W-410; galvanized steel rope with 6 strands each containing 19 wires wrapped around independent wire rope core; 1/2 inch diameter; 20,700 lb breaking strength.
- J. Chain: Grade 30 general purpose proof coil steel chain; welded straight links; #10 size with 0.60 x 1.45 inch nominal inside link size; galvanized finish.

2.2 MANUFACTURED ITEMS

- A. Elevator Sump Cover Grates: Welded steel grating; plain surface 1-1/4 x 3/16 inch steel bearing bars spaced 1-3/16 inches oc; cross bars at 4 inches oc; cut to length with equal stubs; galvanized finish; McNichols Co. #GW-125, Grating Pacific Standard Welded Grating or equal product substituted under provisions of Division 1.

2.3 ACCESSORIES

- A. Fasteners: Stainless steel for aluminum-to-aluminum and aluminum-to-steel connections; plated carbon steel for steel-to-steel connections.

1. Screws:

- a. Sheet Metal Screws: Self-tapping and drive screws as appropriate to application; length sufficient to penetrate through second surface minimum 1/4 inch.
- b. Machine Screws: ANSI B18.6.3.

2. Bolts and Nuts: Regular hex head bolts with hex nuts except where indicated otherwise on Drawings; no upset threads permitted

- a. Plated Carbon Steel: ASTM C954; length. Grade A.
- b. Stainless Steel: ASTM F593 and ASTM F594.

3. Washers:

- a. Plain Washers: ANSI B18.22.1.
- b. Lock Washers: Helical, spring type, carbon steel, ANSI B18.21.1.

4. Expansion Bolts:

- a. Wedge Type: FS FF-325(3), Group II, Type 4; wedge type expansion anchor; size as noted on Drawings; ITW Ramset/Red Head "Trubolt+" Seismic Wedge, Hilti Corp. "Kwik-Bolt TZ" or equal product substituted under provisions of Division 1.
- b. Sleeve Type: Size as noted on Drawings; Hilti Corp. Sleeve Anchor, ITW Ramset/Redhead Dynabolt Sleeve or equal product substituted under provisions of Division 1.
- c. Drop-In Type: Internally-treaded flush-mounted drop-in anchor; zinc-plated steel; size as noted on Drawings; Hilti-Corp. HDI Drop-In Anchor or equal product substituted under provisions of Division 1.

5. Eyebolts: Drop-forged steel eyebolts; fully threaded shanks with no shoulder; 3/4 inch inside diameter round eye.

- B. Cable End Fittings: Zinc-plated or galvanized steel; suitable for cable rail assembly indicated on Drawings.
- C. Chain Fittings: Zinc-plated steel threaded connectors; wide jaw; sized to accommodate specified chain.
- D. Reinforcing Steel: As specified in Section 03200; size as indicated on Drawings.

- E. Welding Materials: AWS D1.1; type required for materials being welded.
- F. Welded Stud Connectors: Shear type connectors in compliance with AWS D1.1; Nelson Studs; sizes as indicated on Drawings.
- G. Shop and Touch-Up Primer for Carbon Steel: SSPC 15, Type I; red oxide.
- H. Touch-up Primer for Galvanized Surfaces: SSPC 20, Type I; inorganic; zinc rich.
- I. Galvanizing Repair: Single pack premixed ready-to-apply liquid organic zinc compound recommended by manufacturer for repair of hot-dipped galvanized surfaces; 221 gms/ltr VOC content; 56 percent solids content by volume; 92 percent metallic zinc content by weight in dry film; flat finish; light gray color; ZRC Worldwide ZRC® 221 Cold Galvanizing Compound or equal product substituted under provisions of Division 1.
- J. Protective Back Coating: SSPC Paint 12; cold-applied asphalt mastic; inert type; non-corrosive; compounded for 15 mil dry thickness.
- K. Non-Shrink Grout: Premixed high-strength, non-shrink, non-ferrous grout requiring only addition of water at site; Master Builder's "Masterflow" 928 Grout or equal product substituted under provisions of Division 1.

2.4 FABRICATION

- A. Fabricate items true to shape, size and tolerances indicated on Drawings and on final reviewed shop drawings with shearing, punching, bending, forming and other operations necessary to complete work.
- B. Fit and shop assemble items in largest practical sections for delivery to site.
- C. Fabricate units complete or in largest practical sections before galvanizing.
- D. Fabricate anchorage and related components of same material and finish as metal fabrication, except where specifically noted otherwise.
 - 1. Provide anchors, bolts, and miscellaneous fasteners necessary to fasten work in place.
 - 2. Provide miscellaneous fasteners, brackets and framing as indicated or as necessary to complete installation.
- E. Fabricate items with joints tightly fitted and secured. Make exposed joints butted tight, flush and hairline.
- F. Fabricate items with straight lines, square corners or smooth bends and free from twists, kinks, warps, dents and other imperfections.
 - 1. Straighten work bent by shearing or bunching.
 - 2. Provide smooth finish and well-defined lines and arises on exposed surfaces of

completed work.

- G. Form assemblies and supports to exclude water.
 - 1. Fabricate items in manner that will provide for expansion and contraction, prevent shearing of fasteners, ensure rigidity and provide close fitting of sections.
 - 2. Provide gauge and assembly to ensure sufficient strength to prevent distortion during shipping, handling, installing and under severe service conditions.
 - 3. Prepare items to receive hardware; ensure components are properly detailed and have proper clearances.
 - 4. Drill holes for bolts and screws. Conceal fasteners where possible.
 - 5. Dress exposed edges smooth; ease to small uniform radius.
- H. Perform shop welding in accordance with applicable requirements of AWS D1.1.
 - 1. Weld interior permanent connections in ferrous metal items unless indicated otherwise.
 - 2. Weld behind finishes surfaces wherever possible.
 - 3. Grind exposed welds smooth and flush with adjacent finished surfaces.
 - 4. Remove welding spatter, flux, slag and oxides from finished surfaces.
- I. Complete provisions for bolted, screwed and riveted connections in shop unless otherwise indicated.
 - 1. Evenly space exposed heads.
 - 2. Bolts:
 - a. Countersink bolt heads; finish smooth and flush.
 - b. Provide washers under heads and nuts bearing on wood.
 - c. Use beveled washers where bearing is on sloped surfaces.
 - d. Draw nuts tight; prevent loosening of permanent connections by nicking threads.
 - 3. Screws: Use flat head type screws unless indicated otherwise on Drawings. Countersink; fill screw slots and finish smooth and flush.
 - 4. Rivets: Center and countersink heads; machine-drive tight and finish flush and smooth.

2.5 FINISHES

- A. Clean surfaces of rust, scale, dirt, grease, and foreign matter prior to finishing.
 - 1. Where hand cleaning methods are not adequate, clean in accordance with SSPC-SP1, SSPC-SP2, SSPC-SP-6 or SSPC-SP7 as required.
 - 2. Completely remove burrs, rough spots and pitting from normally exposed ferrous metal items.
- B. Painting:
 - 1. Do not prime surfaces in direct contact bond with concrete and where field welding is required.
 - 2. Apply prime paint materials in accordance with paint manufacturer's instructions and recommendations.
 - 3. Permit thorough drying before shipment.
 - 4. Spot paint abrasions and field connections after assembly.
 - 5. Galvanizing Repair: Apply to minimum 2 mil dry film thickness.
 - 6. Prime Paint: Apply to minimum 1.5 mil dry film thickness.
 - 7. Protective Back Coating for Protection of Dissimilar Materials: Apply to minimum 15 mil dry film thickness.
- C. Galvanizing:
 - 1. Hot-dip galvanize products after fabrication in accordance with ASTM A123 or ASTM A153 as applicable.
 - 2. Mark products with name of galvanizer, applicable ASTM designation and weight of zinc coating.
 - 3. Galvanize fabricated items complete or in largest practicable sections.
 - 4. Galvanize to the following minimum weights:
 - a. Items totally concealed from view: Minimum 2.0 oz/ square foot.
 - b. Items exposed to view: Minimum 1.1 oz/square foot.
 - 5. Wash-prime galvanized items to be painted within six hours of galvanizing.
 - 6. Touch-up galvanized and pre-galvanized items with specified primer.
- D. Anodizing:
 - 1. Clean and texture aluminum surface to medium matte finish by treating surface

with sodium hydroxide.

2. Apply clear anodic coating by immersing surface in sulfuric acid solution and passing direct electric current through aluminum and surface to produce minimum 0.7 mil thick oxide film.
- E. Finish Schedule:
1. Interior Ferrous Metal Items:
 - a. Concealed: Clean, chemically etch and shop-apply 1 coat primer.
 - b. Exposed: Clean, treat with hot phosphate, chemically etch and shop-apply 1 coat primer.
 2. Exterior Ferrous Metal Items:
 - a. Concealed: Clean and hot-dip galvanize to specified standards.
 - b. Exposed: Clean and hot-dip galvanize to specified standards.
 3. Interior Stainless Steel Items:
 - a. Concealed: #2B; cold rolled, annealed and descaled with final light roll pass through polished rolls.
 - b. Exposed: #4; polished satin luster finish with visible grain.
 3. Interior and Exterior Aluminum Items:
 - a. Concealed: Mill finish.
 - b. Exposed: AA-M12C22A41; non-specular mechanical finish as fabricated; chemically etched to fine matte finish; Class I clear anodized coating minimum 0.7 mils thick.
 4. Hardware Including Fasteners: Finish to match item fastened.
- F. Back paint concealed metal surfaces in contact with cementitious materials or dissimilar metals with protective backing paint to minimum dry film thickness of 15 mil.

2.6 SOURCE LABORATORY CONTROL

- A. Shop testing and inspections will be performed by Testing Laboratory.
- B. Provide free access to work at all times and cooperate with inspectors and laboratory personnel.
- C. Testing Laboratory will:
 1. Continuously inspect shop welding of load bearing fabricated items.

2. Ultrasonically test complete penetration welds in load bearing fabricated items.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that field conditions are acceptable and are ready to receive work.
- B. Verify that setting conditions and dimensions are correct.
- C. Verify that solid blocking and backing has been provided at framed and furred conditions.
- D. Do not begin installation until unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Obtain Architect's authorization prior to site cutting and making adjustments not scheduled.
- B. Clean and strip site primed steel items to bare metal where site welding is scheduled.
- C. Make provision for erection loads with temporary bracing. Keep work in alignment.
- D. Supply items required to be cast into concrete with setting templates to appropriate sections.

3.3 INSTALLATION

- A. Install metal fabrications as indicated on Drawings and final reviewed shop drawings.
- B. Install items plumb and level, accurately fitted, free from distortion or defects.
- C. Perform field welding only where indicated on final reviewed shop drawings in accordance with AWS D1.1.
- D. Install anchors and fasteners of sizes, types and spacing indicated and as required to fasten work rigidly in place.
 1. Embed anchors in concrete as work progresses.
 2. Do not cinch fastenings through finish alone without spacer washers.
 3. Install concrete inserts or pre-drilled expansion bolts for fastening items into concrete.
 4. Fasten work tightly to prevent rattle or vibration except where expansion and contraction tolerances are required.
- E. Set frames, plates, sills, bolts and similar items on non-shrink grout mixed in

accordance with manufacturer's instructions.

3.4 FIELD QUALITY CONTROL

- A. Field inspection and testing will be performed by Testing Laboratory.
- B. Provide free access to work at all times and cooperate with laboratory personnel.
- C. Testing Laboratory will:
 - 1. Continuously inspect welding of load bearing fabrications in field.
 - 2. Ultrasonically test full penetration welds of load bearing fabrications.

3.5 ADJUSTING

- A. After installation, touch-up field welds and scratched and damaged finishes.
 - 1. Interior Ferrous and Galvanized Items: Touch up with primer consistent with shop primer.
 - 2. Exterior Galvanized Items: Touch up with cold galvanizing compound. Prepare surface and apply compound in accordance with compound manufacturer's instructions to match appearance of adjacent finish.

3.6 CLEANING

- A. Remove weld spatter, excess sealant, dirt and other foreign materials from metal fabrications.
- B. Remove machining oil, silicone and other foreign materials from surfaces of galvanized steel and stainless steel manufactured items.
- C. Perform cleaning with materials and methods that will not damage finish.

3.7 PROTECTION OF INSTALLED WORK

- A. Protect work of this section from defacement or damage to profile, shape or finish until final acceptance.

3.8 SCHEDULE

- A. Provide and install items listed in schedule and shown on Drawings with anchorage and attachments necessary for installation.
- B. Schedule is list of principal items only. Refer to Drawing details for items not specifically scheduled.
- C. Steel Columns Not Included in Section 05120: Prime paint finish unless enclosed; galvanize finish where exposed to exterior.
- D. Ledge and Shelf Angles, and Channel angles and Plates Not Attached to Structural

Framing: Prime paint finish.

- E. Support Posts and Angle Brackets for Countertops: Prime paint finish.
- F. Pipe Sleeves: Galvanized finish.
- G. Lateral Supports for Storefronts: Galvanized finish.

END OF SECTION

SECTION 05720 - HANDRAILS AND RAILINGS

1.1 GENERAL

- A. Summary: This Section includes furnishing and installing of handrails and railings including metal fasteners such as bolts, clips, hinges, and rails, complete, as shown and as specified.
- B. Shop Drawings: Provide plans, elevations and detail connections.

1.2 PRODUCTS

- A. Handrail: 1 1/2" diameter Stainless Steel type 304 Handrail.
- B. Railing: 1 1/2" diameter Stainless Steel type 304 Railing.
- C. Fasteners: Bolts, nuts, screws, clips, washers, and any other fastenings necessary for proper erection of items specified herein to match handrail / railings.
- D. Finishes:
 - 1. Uni-directional brushed finish.
 - 2. Primer: "Rust-Block" as manufactured by Dunn-Edwards Paint Co., to be compatible with finish coat.

1.3 EXECUTION

- A. General: Set all work plumb, rigid, true to line and grade, and accurately fitted with tight joints.
- B. Attachments: Drill or punch all holes; shear cleanly all cuts. Provide all sleeves, anchors, mortars and sealants for connections to other work.
- C. Welding: AWS Code D1.0, uniform, ground smooth. Do not weld galvanized metals after fabrication.
- D. Non-welded Connections: Provide bolts, screws or rivets for field connections as detailed.
- E. Surface Treatment: Clean all deleterious coatings from surfaces, grind smooth all welds, burrs, and rough surfaces. Apply primers per manufacturer's specifications. Touch up field work as required.

END OF SECTION

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SECTION 05811

SEISMIC JOINT COVER ASSEMBLIES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Joint cover assemblies for seismic joints in exterior wall and floor surfaces and in interior wall, floor and ceiling surfaces.

1.2 RELATED SECTIONS

- A. Section 07900 - Joint Sealers: Expansion and control joint finishing utilizing sealant and bond breaker.
- B. Section 09250 - Gypsum Board: Gypsum board control joints; taping in drywall beads at interior wall cover joint assemblies.

1.3 REFERENCES

- A. ASTM A36 – Specification for Carbon Structural Steel.
- B. ASTM A167 - Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet and Strip.
- C. ASTM B209 - Specification for Aluminum and Aluminum Alloy Sheet and Plate.
- D. ASTM B221 - Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles and Tubes.
- E. ASTM D2000 - Classification System for Rubber Products in Automotive Applications.

1.4 DESIGN REQUIREMENTS

- A. Sustainable Design Requirements: Aluminum and steel used in work of this section is intended to contribute to meeting requirements for recycled content outlined in LEED™-NC3.0 Credit MR4.

1.5 PERFORMANCE REQUIREMENTS

- A. Joint Cover Assemblies:
 - 1. Movement Capabilities: 100 percent; range of movement in expansion equivalent to clear joint width; range of movement in contraction equal to clear joint width.
 - 2. Minimum Allowable Load for Floor Joint Covers: 500 pound without damage or permanent deformation.

3. Joint covers shall permit unrestrained movement of joint without disengagement of cover.

1.6 SUBMITTALS

- A. Shop Drawings: Indicate joint assembly layout, intersections, corners, butt joints, components, materials, finishes, fasteners, anchorage, and relation to other work for each assembly specified and required. Include locations in work and locations of splices.
- B. Product Data: Provide joint assembly profiles, dimensions and anchorage devices. Include movement capability of cover assemblies and suitability of materials used in exterior seals for ultra-violet exposure.
- C. Samples:
 1. Joint Assemblies: Submit samples, minimum 6 inches long, of each type of each joint assembly, illustrating profiles of components, materials and construction. Submit complete and fully assembled.
 2. Elastomeric Seals: Submit samples, minimum 6 inches long, of elastomeric seals illustrating selected seal color.
 3. Sealant: Submit samples of exposed sealant manufacturer's full range of colors for Architect's selection.
- D. Manufacturer's Installation Instructions: Indicate rough-in sizes and indicate tolerances for item placement.
- E. LEED Documentation:
 1. Aluminum: Submit letter or product data from manufacturer indicating recycled content. Designate percentage of post-consumer and post-industrial recycled content.
 2. Steel: Submit letter or product data from manufacturer indicating recycled content. Designate percentage of post-consumer and post-industrial recycled content.
 3. Submit hard copies of completed Online Documentation required for LEED™ MR Credit 4.

1.7 QUALITY ASSURANCE

- A. Source Limitations: Obtain joint cover assemblies systems from single source from single manufacturer.

1.8 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturer of seismic joint cover assemblies with minimum 10 years documented experience.
- B. Installer: Company specializing in installation of seismic joint cover assemblies with minimum 3 years documented experience and acceptable to manufacturer.

1.9 PREINSTALLATION CONFERENCE

- A. Convene pre-installation conference minimum 1 week prior commencing installation.
- B. Attendance: Contractor, joint cover assembly installer, Project Manager, Project Inspector and Architect.
- C. Review installation procedures and coordination with related work. Conduct inspection of substrates.

1.10 DELIVERY, STORAGE AND HANDLING

- A. Deliver products to site, store, handle and protect in accordance with manufacturer's instructions and recommendations.
- B. Deliver products to site ready for use and fabricated in as large sections and assemblies as practical.
- C. Deliver products in new clean unopened crates of sufficient size and strength to protect materials during transit. Provide temporary protective covering on anodized aluminum surfaces.
- D. Handle joint cover assemblies in manner to protect surfaces and to prevent distortion and other types of damage.
- E. Store products under cover in dry clean location off ground.
- F. Remove products that are damaged or otherwise not suitable for installation from site; replace with acceptable products.

1.10 FIELD MEASUREMENTS

- A. Check actual locations of walls and other construction to which work must fit by accurate field measurements prior to fabrications. Show recorded measurements on shop drawings.

1.11 EXTRA MATERIALS

- A. Provide 100 feet of each elastomeric primary seal in each color used, and special tools required for servicing components.
- B. Wrap and label materials to identify type and locations installed.

- C. Deliver to Owner; obtain receipt.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Construction Specialties, Inc.

1. Exterior and Interior Floor Joint Cover Assemblies: Seismic Pan System Floor Covers.
 - a. Floor-to-Floor: SSR Series.
 - b. Floor-to-Wall: SSRW Series.
2. Exterior Wall Joint Cover Assemblies: SF Series Flush Exterior Wall Seals.
3. Interior Wall and Ceiling Joint Cover Assemblies: Flush Thinline Wall Covers.
 - a. Wall-to-Wall: FWF Series.
 - b. Corner Wall: FWFC Series.

B. Manufacturer Offering Acceptable equivalent Products: Balco, Inc.

C. Substitutions: Under provisions of Division 1.

2.2 MATERIALS

- A. Aluminum Extrusions: ASTM B221, 6063 alloy, T5 temper.
- B. Aluminum Plate: ASTM B209, 6061 alloy, T6 temper.
- C. Structural Steel Shapes: ASTM A36.
- D. Stainless Steel: ASTM A167, Type 304.
- E. Vapor Barriers: Polyethylene sheet.
- F. Extruded Preformed Elastomeric Seals:
 1. Primary Seals: ASTM D2000; "Santoprene" non-hydroscopic thermoplastic rubber; colors to be determined.
 - a. Exterior Seals: UV resistant; 73 Shore A durometer hardness.
 - b. Interior Seals: 221-87 Shore A and 221-55 Shore A dual durometer hardness.

2. Secondary Seals: ASTM D2000; polyvinyl chloride; 65 Shore A durometer hardness; black color.

2.3 ACCESSORIES

- A. Sealant: Elastomeric types compatible with materials in contact with sealant and recommended by joint cover manufacturer.
- B. Fasteners: Stainless steel; non-magnetic; type and size to suit construction indicated and to provide secure attachment of cover joint assemblies.

2.4 FABRICATION

- A. Fabricate seismic joint cover assemblies to designs and profiles indicated and required to accommodate joint size, variations in adjacent materials and structural movement.
- B. Provide centering bars, sealing washers, gaskets, splice covers and closures necessary for complete installation. Provide necessary and related parts, devices, water barrier, anchors, form clips and other items required for water resistant installations.
- C. Furnish components in longest practice lengths to minimize end joint and site splicing.
- D. Fabricate special transitions and corner fittings as required.
 1. Provide hairline joints where joint cover changes directions or abuts other materials. Miter and weld corner joints.
 2. Provide corners, tees, transitions, curb risers assembled with connection mitered and secured to ensure proper fit and alignment.
- E. Exterior and Interior Floor Joint Cover Assemblies: Fabricate for floor-to-floor and floor-to-wall installation with extruded aluminum base frames and recessed aluminum pan to receive paving having center plate retained by series of spring-mounted steel channel turn bars spaced 18 inches oc.
 1. Floor-to-Floor Installation:
 - a. Pan: Form with continuous extruded aluminum nosing along each edge of continuous 1/4 inch thick aluminum plate. Weld plate to nosings; mechanically fasten plate to turn bars.
 - b. Base Frame: Configure continuous aluminum turn bar frame to receive pan nosings and to facilitate fastening to adjacent floor slab edges.
 2. Floor-to-Wall Installation:
 - a. Pan: Form with continuous extruded aluminum hinge nosing along wall edge, continuous extruded aluminum pan nosing along floor and

continuous 1/4 inch thick aluminum plate. Weld plate to nosings.

- b. Base Frame: Configure continuous aluminum hinge frame for fastening to adjacent wall and to receive pan hinge nosing. Configure continuous aluminum base frame assembly for fastening to adjacent floor slab edge and to receive pan nosing.
- F. Exterior Wall Joint Cover Assemblies: Fabricate with continuous extruded thermoplastic rubber primary seals, continuous extruded polyvinyl chloride secondary seals and continuous extruded aluminum frames. Fabricate assemblies for joints 7 inches wide and wider with turnbar assemblies at 18 inches o/c and continuous extruded aluminum center mullions.
1. Primary Seals: Fabricate to flush configuration with 2 symmetrically placed grooves, continuous longitudinal baffles and push-in arrows along each edge compatible with retainer reveals in aluminum frames.
 2. Secondary Seals: Fabricate to ribbed profile with push-in arrows along each edge compatible with retainer reveals in aluminum frames.
 3. Aluminum Frames: Fabricate for mounting behind primary seals and in front of secondary seals with retainer reveals to accept primary seals, reveals to accept secondary seals and angled seat predrilled for fasteners. Fabricate frames for joints 7 inches and wider with sockets to receive turnbar assemblies.
- G. Interior Wall and Ceiling Joint Cover Assemblies: Fabricate for wall-to-wall, corner wall, ceiling-to-ceiling and ceiling to wall installations with continuous extruded thermoplastic rubber primary seals and continuous extruded aluminum frames. Fabricate assemblies for joints 7 inches wide and wider with turnbar assemblies at 18 inches o/c and continuous extruded aluminum center mullions.
1. Primary Seals: Fabricate to flush configuration with 2 symmetrically placed grooves, continuous longitudinal baffles and push-in arrows along each edge compatible with retainer reveals in aluminum frames.
 2. Aluminum Frames:
 - a. Wall-to-Wall and Ceiling-to-Ceiling Installations: Fabricate both frames for face mounting with retainer reveals to accept primary seals and integral drywall beads predrilled for fasteners and grooved to receive taping compound. Fabricate frames for joints 7 inches and wider with sockets to receive turnbar assemblies.
 - b. Corner Wall and Ceiling-to-Wall Installations: Fabricate 1 frame for face mounting as specified above; fabricate other frame mounting behind primary seals with retainer reveals to accept primary seal and angled seat predrilled for fasteners. Fabricate frames for joints 7 inches and wider with sockets to receive turnbar assemblies.
- H. Shop-assemble components and package with anchors and fittings.

2.5 FINISHES

- A. Elastomeric Primary Seals Exposed to View: Colors to be determined.
- B. Aluminum:
 - 1. Exposed and Concealed: Mill finish.
 - 2. In Contact with Cementitious Materials: Prime painted.

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:
 - 1. Joint preparation and affected dimensions are acceptable.
 - 2. Field measurements and blockout dimensions are as indicated on shop drawings.
- C. Do not begin installation until unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Provide templates and rough-in measurements to related trades for location of support and anchorage items.

3.3 INSTALLATION

- A. Install joint covers and accessories in accordance with manufacturer's instructions and recommendations and with final reviewed shop drawings.
- B. Provide anchorage devices and fasteners necessary to secure seismic joint cover assemblies to in-place construction.
- C. Cut, drill and fit components as required for installation of seismic joint cover assemblies.
- D. Install joint cover assemblies in true alignment and proper relationship to seismic joints and adjoining finished surfaces.
- E. Maintain continuity of seismic joint cover assemblies with end joints held to minimum and metal members aligned mechanically.

- F. Cut and fit ends to produce joints that will accommodate thermal expansion and contraction of metal to avoid buckling.
- G. Exterior and Interior Floor Joint Cover Assemblies: Set floor covers at elevations to be flush with adjacent paving. Secure in place with required accessories.
 - 1. Shim as required to level ensuring base frames have continuous support to prevent rocking and vertical deflection.
 - 2. Locate anchors at intervals recommended by manufacturer but not less than 3 inches from each end and not more than 24 inches oc.
 - 3. Set centering bars diagonally at maximum 18 inch centers; ensure bars fully engage base members.
 - 4. Install double vapor barriers at exterior floor joints.
 - a. Ensure laps between upper and lower vapor barriers are offset.
 - b. Ensure vapor barriers continue to secondary seals of exterior wall joint cover accessories and to weeps at bases of exterior wall joint cover assemblies.
 - 5. Coordinate application of sealant between base frame and pan nosings.
- I. Exterior Wall Joint Cover Assemblies: Set wall joint cover assemblies to be set back 1/4 inch from adjacent finishes. Secure in place with required accessories.
 - 1. Set aluminum frames in sealant; secure with anchors located 18 inches oc maximum.
 - 2. For joints 7 inches and wider, set turnbars at maximum 18 inch centers; ensure bars fully engage frames.
 - 3. Install secondary seals in retainers in frames; form weeps at bases of exterior joint cover assemblies. Seal splice joints to provide watertight installation.
 - 4. Install primary seals in retainers in frames. Seal transitions and butt joints.
- J. Interior Wall and Ceiling Joint Cover Assemblies: Set interior wall and ceiling joint cover assemblies flush with face of adjacent finishes. Secure in place with required accessories.
 - 1. Set aluminum frame with integral drywall bead on face of gypsum board finish; secure with anchors through drywall bead at 18 inches maximum.
 - 2. At corner installations, set aluminum frame with angle fastener seat aligned with face mounted frame; secure with anchors located 18 inches oc maximum.
 - 3. For joints 7 inches and wider, set turnbars at maximum 18 inch centers; ensure

bars fully engage frames.

4. Install primary seals in retainers in frames.
5. Coordinate installation of joint compound over drywall beads.

3.5 ADJUSTING

- A. Adjust joint cover assemblies to freely accommodate joint movement.

3.6 CLEANING

- A. Do not remove strippable protective material until finish work in adjacent areas is complete.
- B. When protective material is removed, clean exposed metal surfaces to comply with manufacturer's instructions.

3.7 PROTECTION OF INSTALLED WORK

- A. Remove and store primary seals as required to protect installed work from damage by work of other trades.
- B. Provide temporary protection over joints.
- C. Re-install primary seals immediately prior to Substantial Completion.

3.8 SCHEDULE

- A. Provide and install seismic joint cover assemblies listed in schedule and shown on Drawings with accessories necessary to maintain performance of each assembly.
- B. Schedule is list of principal systems only. Refer to Drawings for conditions requiring assemblies not specifically scheduled.
- C. Seismic Joint Cover Assemblies:
 1. EJ#1: Interior floor joint cover assembly; 6 inch wide joint; Construction Specialties, Inc. SSR-600.
 2. EJ#2: Interior wall joint cover assembly; 6 inch wide joint; Construction Specialties, Inc. FWF-600.
 3. EJ#3: Exterior wall joint cover assembly; 6 inch wide joint; Construction Specialties, Inc. SF-600.
 4. EJ#4: Interior wall/floor joint cover assembly; 6 inch wide joint; Construction Specialties, Inc. SSRW-600.

END OF SECTION

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SECTION 06100

ROUGH CARPENTRY

PART 1 - GENERAL

1.1 SUMMARY

- A. Provisions of Division 01 apply to this section.
- B. Section Includes:
 - 1) Rough carpentry Work.
 - 2) Installation of plywood and sawn lumber.
- C. Related Sections:
 - 1) Section 01420: Testing and Inspection.
 - 2) Section 09250: Gypsum Board.

1.2 SYSTEM DESCRIPTION

- A. Regulatory Requirements:
 - 1) Work of this Section shall comply with CBC Chapter 23.

1.3 QUALITY ASSURANCE

- A. Comply with the following as a minimum requirement:
 - 1) Douglas fir, larch or hemlock structural and framing lumber shall be graded in accordance with the Standard Grading Rules of the West Coast Lumber Inspection Bureau (WCLIB) or the Western Lumber Grading Rules of the Western Wood Products Association (WWPA).
 - 2) Plywood shall conform to requirements of Product Standard PS 1-95, and shall be grade marked by a recognized grading agency (APA and PTL).
- B. Lumber shall bear official grade mark of the association under whose rules it was graded or official grade mark of another recognized grading agency.
- C. Structural and framing members 2 inches in thickness and larger shall be air-dried to moisture content not to exceed 19 percent before installation.
- D. Each piece of preservative treated lumber shall be identified by the Quality Mark of an approved inspection agency in accordance with CBC Chapter 23A; refer to Section 01420: Testing and Inspection.

E. Lumber showing visible signs of mold growth:

- 1) Any lumber showing visible signs of mold growth shall be removed from the project site or cleaned as outlined below.
- 2) The contractor is responsible for all costs associated with cleaning, post-cleaning testing, and reporting for lumber with mold.
 - a. Lumber that shows visible signs of mold growth prior to, or after installation, shall be cleaned pursuant to USEPA's guidance publication "Mold Remediation in Schools and Commercial Buildings dated March 2001 (EPA 402-K-01.001).
 - b. A minimum of 10% of the total locations cleaned must be sampled (tape lift method) post cleaning to ensure cleaning effort was successful. Cleaning will be considered acceptable when tape lift sample results evaluated by direct microscopic examination determine that the general abundance of mold is non-detect or rare (normal trapping to 1+).
 - c. A report prepared by a Certified Industrial Hygienist (CIH) that details the sampling and cleaning results shall be prepared and submitted to the OAR for review and approval of the LAUSD Office of Environmental Health and Safety.
 - d. Cleaned lumber shall not be installed or enclosed by finish materials until approval of test results. Cleaned lumber must meet moisture content requirements as required elsewhere in this specification prior to installation or application of finishes.

1.4 STORAGE, HANDLING AND PROTECTION

- A. The materials supplied as part of the Work of this section shall be protected from exposure to inclement weather before being covered by other Work.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Lumber: Structural and framing lumber shall be of following species and grades:

	<u>INSTALLATION</u>	<u>SPECIES</u>	<u>GRADE</u>
1).	Wall sheathing, roof sheathing and ceiling furring	Douglas fir and larch	Construction Board, WCLIB; WWPA
2)	Posts, (5" x 5" and larger, width not more than 2" greater than thickness).	Douglas fir and larch	No. 1 Structural Posts and Timbers, WCLIB. No. 1 Post and Timbers, WWPA.
3).	Beams, girders and truss members (5" and thicker, rectangular, width more than 2" greater than thickness) where exposed as finish members.	Douglas fir and larch WWPA.	Select Structural Beams and Stringers, WCLIB;
4).	Items in subparagraph 3	Douglas fir	No. 1 Structural

3.1 FASTENINGS

A. Nails and Spikes:

- 1) Furnish only common wire nails or spikes whenever indicated, specified or required.
- 2) Whenever necessary to prevent splitting, holes shall be pre-drilled for nails and spikes.
- 3) Nails in plywood shall not be overdriven.
- 4) Machine Applied Nailing: Use of machine nailing is subject to a satisfactory Project site demonstration for each Project and approval by the Architect or structural engineer retained by the Architect as an Architect Consultant and DSA. Installation is subject to continued satisfactory performance. Machine nailing is not permitted for 5/16 inch plywood. Do not permit nail heads to penetrate outer ply. Maintain minimum allowable edge distances when installing nails

B. Lag Screws:

- 1) When installing lag screws in a wood member, pre-drill hole as required by the CBC.
- 2) Lag screws, which bear on wood, shall be fitted with standard steel plate washers under head. Lag screws shall be screwed and not driven into place

C. Bolts:

- 1) Lumber and timber to be fastened together with bolts shall be clamped together with holes for bolts bored true to line.
- 2) Bolts shall be fitted with steel plates or standard cut washers under heads and nuts. Bolts shall be tightened when installed and again before completion of the Work of this section.

D. Wood Screws: When installing wood screws, pre-drill holes as required by the CBC.

E. Metal Framing Devices: Framing anchors, joist hangers, ties, and other mechanical fastenings shall be galvanized or furnished with a rust inhibitive coating. Nails and fastenings shall be of the type recommended by manufacturer.

3.2 INSTALLATION

A. Stud Walls, Partitions and Furring:

- 1) Wood stud walls, partitions and vertical furring shall be constructed of members of size and spacing indicated. Provide single treated plate at bottom and double plate at top unless otherwise indicated. Interior, nonbearing non-shear partitions may be framed with a single top plate, installed to provide overlapping at corners and at intersections with other wall and partitions or by metal ties as detailed.
- 2) Walls and partitions shall be provided with horizontal staggered blocking at least 2 inch nominal thickness and same width as studs, fitted snugly, and nailed into studs. Blocking

shall be installed at mid-height of partition or not more than 7 feet on center vertically. Install wood backing on top of top plate wherever necessary for nailing of lath or gypsum board.

- 3) Walls, partitions and furred spaces shall be provided with 2 inch nominal thickness wood firestops, same width as space to be firestopped, at ceiling line, mid-height of partition and at floor line. Firestops at floor line are not required when floor is concrete. If width of opening is such that more than one piece of lumber is necessary, provide 2 thicknesses of one inch nominal material installed with staggered joints
- 4) Firestops shall be installed in stud walls and partitions, including furred spaces, so the maximum dimension of any concealed space is not over 10 feet.
- 5) Corners, and where wood stud walls and wood vertical furring meet, shall be constructed of triple studs. Openings in stud walls and partitions shall be provided with headers as indicated and a minimum of 2 studs at jambs, one stud of which may be cut to support header in bearing.
- 6) Sills under bearing, exterior or shear walls shall be bolted to concrete with 5/8 inch diameter x 12 inch long bolts with nuts and washers, spaced not more than 4 feet on center unless noted otherwise. There shall be a bolt within 9 inches of each end of each piece of sill plate. Sills shall be installed and leveled with shims, washers, with nuts tightened to level bearing. Space between sill and concrete shall be dry packed with cement grout.

B. Floor Joists, Roof and Ceiling Framing:

- 1) Wood joists shall be of the size and spacing indicated, installed with crown edge up, and shall have at least 4 inch bearing at supports. Provide 2 inch solid blocking, cut in between joists, same depth as joists, at ends and bearings, unless otherwise indicated.
- 2) Trimmer and header joists shall be doubled, when span of header exceeds 4 feet. Ends of header joists more than 6 feet long shall be supported by framing anchors or joist hangers unless bearing on a beam, partition, or wall. Tail joists over 12 feet long shall be supported at header by framing anchors or on ledger strips at least 2 x 4.
- 3) Provide solid blocking between rafters and ceiling joists over partitions and at end supports where indicated.

C. Beams, Girders and Joists:

- 1) Ends of wood beams, girders and joists which are 2 feet or less above finished outside grade and which abut, but do not enter concrete or masonry walls, as well as wood blocking used in connection with ends of those members shall be treated with wood preservative.

D. Roof and Wall Sheathing:

- 1) Plywood roof sheathing shall be Structural I, Grade C-D, Exposure 1, thickness as indicated.
- 2) Where exposed roof sheathing is indicated, area shall be sheathed solid with dressed and center matched, V-jointed boards of sizes indicated. Boards shall be installed perpendicular to supports
- 3) Soffits of overhanging eaves, where indicated, shall be boxed-in using Group I, Exterior Type, Grade A-C, plywood, thickness as indicated

	when concealed. WCLIB No. 1 Beams	and larch	Beams and Stringers, and WWP. Stringers,
5).	Joists, rafters, lintels, posts, mullions and members (2" to 4"	Douglas fir and larch wide)	Select Structural; Structural Light thick, 2 to 4 Framing, WCLIB;
6).	Other lumber (2 to 4 thick, 2" to 4" wide) not specified	Douglas fir and larch	Construction Light Framing WCLIB; WWP In subparagraph 5 above.
7).	Framing lumber (2" to 4" thick,	Douglas fir	No. 1 Structural 5" and wider).and LarchJoists and Planks, WCLIB; WWP.
8).	Sills or plates installed on concrete or masonry surfaces 6" or less above earth or finish grade.	Douglas fir and Larch treated	Same as or subparagraphs 6 and 7.
9).	Sills, foundation plates & sleepers installed on concrete, masonry foundations, or installed on concrete slab in direct contact with earth.	Douglas fir and Larch treated	Same as subparagraphs 6 and 7.
10).	Miscellaneous nailing strips and blocks embedded in concrete or masonry.	Douglas fir and Larch treated	Same as subparagraphs 6 and 7.

B. Plywood: Plywood furnished for structural purposes, when exposed outdoors, shall be exterior type plywood. Other plywood furnished for structural purposes shall be exterior type, or Exposure 1.

C. OSB Board or Panels:

1). Oriented strand board or panels shall not be furnished as part of the Work of this section.

D. Preservative Treated Wood:

- 1) Wood and plywood specified; as treated wood shall be pressure treated wood in accordance with CBC requirements.
- 2) Seasoning: Treated lumber shall be air seasoned after treatment, for a minimum of 2 weeks before installation. Moisture content shall be 15 percent maximum
- 3) Creosote or arsenic is not permitted for treating wood.
- 4) When treated wood member have been notched, dapped, drilled, or cut, such newly cut surfaces shall be painted with a heavy coat of the same preservative material originally provided for treatment of wood member.

PART 3 - EXECUTION

- 4) Provide and install metal H-clips of required size, midway between rafters at unsupported edge joints of plywood roof sheathing where rafters are spaced at 24 inches on center. Clips shall be Plyclips, by Timber Fasteners Inc., or Panel Clips by Simpson Co., or equal.
- E. Wood Backing: Provide wood backing as indicated and as required to receive plumbing, electrical fixtures and equipment, cabinets, door stop plates and other fixed equipment.

3.3 CLEAN UP

- A. Remove rubbish, debris and waste materials and legally dispose of off the Project site.

3.4 PROTECTION

- A. Protect the Work of this section until Substantial Completion.

END OF SECTION

SECTION 06200

FINISH CARPENTRY

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Finish carpentry items within and attached to building, other than shop fabricated casework.
- B. Hardware and accessories.
- C. Fire retardant treatment.
- D. Refer to schedule at end of this section.

1.2 RELATED SECTIONS

- A. Section 05400 - Cold Formed Metal Framing: Exterior metal stud framing and backing.
- B. Section 05500 - Metal Fabrications: Brackets and supports for accessible locker benches and security benches.
- C. Section 06100 - Rough Carpentry: Lumber and plywood backing, blocking and nailers; fire retardant treated plywood other than specified in this section.
- D. Section 06411 - Laminate Clad Wood Cabinets: Shop fabricated custom cabinets.
- E. Section 06411 - Laminate Clad Countertops: Shop fabricated laminate clad wood countertops.
- F. Section 06652 - Solid Surfacing: Countertops installed over plywood sub-countertops.
- G. Section 09110 - Non-Load Bearing Metal Framing: Interior non-load bearing stud framing and backing.
- H. Section 09900 - Paints and Coatings: Backpriming, painting and finishing of finish carpentry items.

1.3 REFERENCES

- A. ANSI A208.1 - Mat Formed Wood Particleboard.
- B. ANSI A208.2 - Medium Density Fiberboard.
- C. APA - American Plywood Association "Grades and Specifications."

- D. ASTM A307 - Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.
- E. ASTM A563 - Carbon and Alloy Steel Nuts.
- F. AWWA - American Wood Products Association.
- G. FS FF-S-325 - Shield, Expansion, Nail, Expansion, and Nail, Drive Screw (Devices, Anchoring, Masonry).
- H. NHLA - National Hardwood Lumber Association.
- I. PS 1 - Construction and Industrial Plywood.
- J. PS 20 - American Softwood Lumber Standard.
- K. PS 51 - Hardwood and Decorative Plywood.
- L. WI - Woodwork Institute "Manual of Millwork."

1.4 DESIGN REQUIREMENTS

A. Sustainable Design Requirements:

1. Lumber used in work of this section is to come from forests that have been certified "Well Managed" forestry sources in accordance with programs of Forest Stewardship Council and is intended to contribute to meeting requirements for certified wood outlined in LEED™-NC 2009 Credit MR7.
2. Composite wood panels used in work of this section are intended to:
 - a. Contribute to meeting requirements for recycled content outlined in LEED™-NC 2009 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™-NC 2009 Credit IEQ4.4.
3. 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™-NC 2009 Credit IEQ4.1.
4. Regional Materials: Give preference to manufacturers and fabricators whose facilities are within 500 mile radius of project site and to materials that are harvested and extracted within 500 mile radius of project site to contribute to meeting requirements for regional materials outlined in LEED™-NC 2009 Credit MR5.

1.5 SUBMITTALS

- A. Shop Drawings: Indicate materials, component profiles, fastening methods, jointing details, finishes and accessories to minimum scale of 1-1/2 inch to 1 foot. First sheet of shop drawings shall bear WI Certified Compliance label.
- B. Samples: Submit samples, minimum 12 inches long, of each trim and molding profile required illustrating profile configuration, species, cut and color.
- C. Certificates: Submit WI Certified Compliance Certificates for trim, frames and millwork.
 - 1. For Material and Workmanship: Submit prior to delivery to jobsite.
 - 2. For Installation: Submit upon completion of work of this section.
- D. LEED Documentation:
 - 1. Certified Wood: Submit Forest Stewardship Council chain-of-custody certificate number with each delivery.
 - 2. Composite Wood Panels:
 - a. Recycled Content: Submit letter or product data from manufacturer indicating recycled contents. Designate percentage of post-consumer and post-industrial recycled content.
 - b. Urea-Formaldehyde Resin Content: Submit letter or product data from manufacturer stating that no materials used in this product contain urea-formaldehyde resins.
 - 3. 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.
 - 4. Regional Materials: Submit letter or product data from manufacturer or fabricator stating products in this submittal were extracted and manufactured locally; identify location of origin listing city, state and country. If only portion of product qualifies for this credit, submit product data or letter clearly designating percentage of product that is manufactured and extracted locally.
- 3. Submit hard copies of completed Online Documentation required for LEED™ MR Credit 4, MR Credit 5, EQ Credit 4.1 and EQ Credit 4.4.

1.6 QUALITY ASSURANCE

- A. Perform work in accordance with WI Custom Grade, except where otherwise specified. Provide WI Certification for material, fabrication and installation.
- B. Plywood sheet material shall bear grade stamps.

1.7 QUALIFICATIONS

- A. Trim and Millwork Fabricator: Company specializing in fabrication of trim, frames and millwork able to demonstrate successful experience with work of comparable extent, complexity and quality to that shown and specified.
- B. Installer: Company specializing in installation of finish carpentry with minimum 3 years documented experience.

1.8 DELIVERY, STORAGE AND HANDLING

- A. Deliver products to site, store, handle and protect in accordance with manufacturer's instructions and recommendations.
- B. Do not deliver finish carpentry items until project is ready for trim and millwork installation and proper facilities are available for handling, sorting and protecting trim, millwork and related materials.
 - 1. Building is enclosed.
 - 2. Plaster work and concrete work is complete and dry.
 - 3. Grinding and similar operations are complete.
 - 4. Storage area is broom clean.
- C. Store trim, millwork and related materials in clean, well-ventilated area protected from direct sunlight, excessive heat, rain or moisture and with:
 - 1. Relative humidity between 45 and 65 percent at 60 to 90 degrees F.
 - 2. Equilibrium Moisture Content conditions are between 8 and 12 percent.
- D. Store trim and millwork flat on level surface minimum 4 inches off floor with bottom moisture barrier and cover sheet; stack in manner to permit air circulation under and around trim and millwork.

1.9 ENVIRONMENTAL REQUIREMENTS

- A. Do not deliver or install trim, millwork and related materials until temperature and relative humidity required by fabricator have been stabilized in installation areas.
- B. Maintain required temperature and humidity in installation areas from date of delivery through remainder of construction.

1.10 FIELD MEASUREMENTS

- A. Verify that field measurements are as indicated on shop drawings.

- B. Verify details and dimensions of equipment and fixtures integral with finish carpentry and other items for proper fit and accurate alignment.

1.11 SEQUENCING AND SCHEDULING

- A. Provide information as required for timely and proper placement of backing and support items.
- B. Coordinate details with other work supporting, adjoining or fastening to finish carpentry.
- C. Coordinate installation of finish carpentry items with backpriming of woodwork specified under Section 09900. Ensure finish carpentry items are properly restacked by painter after backpriming.
- D. Coordinate installation of plywood sub-counters with fabrication and installation of solid surfacing countertops specified under Section 06652.

PART 2 PRODUCTS

2.1 LUMBER MATERIALS

- A. Softwood Lumber: PS 20; graded in accordance with WI; minimum 6 percent moisture content; moisture content not to exceed 12 percent for members up to 2 inch nominal thickness and 19 percent for members 2 to 4 inch nominal thickness; grade and species as scheduled.
- B. Hardwood Lumber: NHLA; graded in accordance with WI; minimum moisture content of 6 percent, maximum moisture content of 12 percent; grade and species as scheduled.

2.2 SHEET MATERIALS

- A. Softwood Plywood: PS 1; APA Group 1, Douglas Fir, exterior glue; grade and thickness as scheduled.
- B. Particleboard: ANSI A208.1, Grade 1-M-3.
- C. Medium Density Fiberboard: ANSI A208.2; homogeneous; minimum 45 lbs/cu ft.

2.3 ACCESSORIES

- A. Fasteners:
 - 1. Nails: Size and type to suit application; non-corrosive finish for exterior, plain finish for interior.
 - 2. Bolts, Nuts, Washers, Blind Fasteners, Lags, and Screws: Size and type to suit application; non-corrosive finish for exteriors; plain finish for interior.

- a. Standard Threaded Fasteners and Nuts: ASTM A307.
 - b. Malleable Washers: ASTM A563.
3. Expansion Bolts:
- a. Wedge Type: FS FF-325(3), Group II, Type 4; wedge type expansion anchor; zinc plated carbon steel; size as noted on Drawings; ITW Ramset/Red Head "Trubolt+" Seismic Wedge, Hilti Corp. "Kwik-Bolt TZ," or equal product substituted under provisions of Division 1.
 - b. Sleeve Type: Plated steel; size as noted on Drawings; Hilti Corp. Sleeve Anchor, ITW Ramset/Redhead Dynabolt Sleeve or equal product substituted under provisions of Division 1.
- B. Adhesive: Waterproof synthetic rubber/resin based multi-purpose construction adhesive recommended by manufacturer for adhering wood to specific substrate; VOC content not to exceed limits established by South Coast Air Quality Management District Rule #1168.
- C. Wood Filler: Water base; tinted to match surface finish color.

2.4 FACTORY PLYWOOD TREATMENTS

- A. Fire-Retardant Wood Treatment:
- 1. Manufacturers:
 - a. Arch Wood Protection, Inc.: Dricon® FRT.
 - b. Manufacturer Offering Acceptable Equivalent Product: Hoover Treated Wood Products, Inc.
 - c. Substitutions: Under provisions of Division 1.
 - 2. Fire Retardant Wood Treatment: AWWA Standard U1, Category UCFA; fire retardant chemical formulated for pressure treating and capable of providing spread of 25 or less on treated wood when tested in accordance with ASTM E84; formulation free of halogens, sulfates, chlorides and ammonium phosphate; capable of providing protection against termites and fungal decay.
- B. Application: Apply fire retardant wood treatment in accordance with applicable code requirements, AWWA Standard C27, Appendix H of AWWA Use Category System and published recommendations of wood treatment manufacturer.
- C. Kiln dry plywood to 15 percent maximum moisture content after treatment.

2.5 FABRICATION

- A. Shop-fabricate and assemble work in complete units in so far as dimensions permit shipment and installation.
- B. Fabricate interior wood trim, frames and millwork in accordance with WI Section 9, Custom Grade for opaque finish.
- C. Kerf backs of solid wood members more than 5 inches wide or more than 1 inch nominal thickness.
- D. Saw cut dot and dash cuts 6 to 8 inches oc through length of plywood used for solid surfacing countertop sub-counters.
- E. Conceal nailing where possible; set nail heads in exposed surfaces.
- F. Factory join base and running trim in lengths up to 20 feet.
 - 1. Join by use of rail bolts, joint fasteners, half laps or dowels.
 - 2. Joined members are to touch throughout profile. Sand members to visual straightness.
 - 3. Plug and sand smooth access holes required for joint fasteners.

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 fabricator's instructions and recommendations.
- B. Verify that surfaces and openings are ready to receive work and field measurements are as shown on shop drawings.
- C. Verify adequacy of backing and support framing.
- D. Verify that mechanical, electrical and building items affecting work of this section have been installed and properly located.
- E. Do not begin installation until unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Before installation, prime paint surfaces of items or assemblies to be in contact with cementitious materials.

- B. Coordinate backpriming of plywood, wood trim and millwork. Backpriming is specified under Section 09900.
- C. Minimum 48 hours prior to installation, place plywood underlayment panels separately on edge around area to receive underlayment to acclimate to temperature and humidity in area of installation.

3.3 INSTALLATION

- A. Install finish carpentry items in accordance with final reviewed shop drawings and with applicable WI requirements. Install interior wood trim, frames and millwork in accordance with WI Section 9, Custom Grade.
- B. Set work square, level, plumb with edges accurately scribed; secure in place with fasteners, clips, braces, brackets, anchors, shims and blocks.
- C. Miter inside and outside corners of running trim.
- D. Conceal nails and screws where possible. Countersink and plug screws in exposed and semi-exposed surfaces; set nails in exposed and semi-exposed surfaces.
- E. Install trim and millwork with nails, except as otherwise indicated.

3.4 PREPARATION FOR SITE FINISHING

- A. Apply wood filler in exposed fastener indentations. Sand work smooth.
- B. Site Finishing: Refer to Section 09900 - Paints and Coatings.

3.5 ADJUSTING

- A. Adjust moving and operating parts to function smoothly and correctly.
- B. Remove damaged, soiled or otherwise disfigured portions of the work and replace with new undamaged materials prior to final acceptance.

3.6 CLEANING

- A. Clean items installed under this section of pencil and ink marks.

3.7 PROTECTION OF INSTALLED WORK

- A. Protect finished installation from damage and defacement until final acceptance.

3.8 SCHEDULE

- A. Provide and install items listed in schedule and shown on Drawings with anchorage and attachments necessary for installation.

B. Schedule is list of principal items only. Refer to Drawing details for items not specifically scheduled.

C. Interior:

1. Bench Seats: Hardwood to be determined; density equivalent to that of Maple; WI Custom Grade for Transparent Finish.
2. Miscellaneous Standing and Running Trim: Poplar, Birch or Douglas Fir; WI Custom Grade for Opaque Finish.
3. Furring for Frameless Wall Mirrors: Poplar, Birch or Douglas Fir; WI Custom Grade for Opaque Finish.
4. Sub-Base at Cabinets: Softwood plywood with B-C face veneers; 1/2 inch thick.
5. Sub-Counters at Stone and Solid Surfacing Countertops: Softwood plywood with C-D face veneers; 3/4 inch thick.
6. Utility Backboards:
 - a. Telephone Backboards: Softwood plywood with A-C face veneers; 3/4 inch thick.
 - b. Electric Backboards: Softwood plywood with A-C face veneers; fire retardant treated; 3/4 inch thick.

END OF SECTION

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SECTION 06411

LAMINATE CLAD WOOD CABINETS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Specially fabricated plastic laminate faced wood cabinet units.
- B. Preparation for utilities.
- C. Cabinet and shelf hardware.

1.2 RELATED SECTIONS

- A. Section 05400 - Cold Rolled Metal Stud Framing: Exterior wall support framing and backing.
- B. Section 06200 - Finish Carpentry: Sub-base at cabinets; plywood sub-counters at stone and solid surfacing countertops.
- C. Section 06416 - Laminate-Clad Countertops: Countertops to be installed on base cabinets provided under this section.
- D. Section 06652 - Solid Surfacing Countertops: Countertops to be installed on base cabinets provided under this section.
- E. Section 09110 - Non-Load Bearing Metal Framing: Interior wall support framing and backing.
- F. Section 09650 - Resilient Flooring: Base at cabinets.
- G. Division 15 - Mechanical: Piped utilities.
- H. Division 16 - Electrical: Electrical utilities.

1.3 REFERENCES

- A. ALA - American Laminators Association.
- B. ANSI A135.4 - Basic Hardboard.
- C. ANSI A156.9 - Cabinet Hardware.
- D. ANSI A208.1 - Mat Formed Wood Particleboard.
- E. ANSI A208.2 - Medium Density Fiberboard for Interior Use.
- F. CBC - California Building Code, 2010 edition.

- G. NEMA LD3 - High Pressure Decorative Laminates.
- H. NHLA - National Hardwood Lumber Association.
- I. PS 1 - Construction and Industrial Plywood.
- J. PS 20 - American Softwood Lumber Standard.
- K. PS 51 - Hardwood and Decorative Plywood.
- L. WI - Woodwork Institute "Manual of Millwork."

1.4 DEFINITIONS

A. Exposed Portions:

1. Surfaces visible when doors and drawers are closed including knee spaces.
2. Underside of bottoms of cabinets over 4'-0" above finished floor including bottoms behind light valences.
3. Cabinet tops under 6'-0" above finished floor or if over 6'-0" and visible from an upper building level or floor.
4. Visible front edges of web frames, ends, divisions, tops, shelves and hanging stiles.
5. Sloping tops of cabinets that are visible.
6. Visible portions of bottoms, tops and ends in front of sliding doors.

B. Semi-Exposed Portions:

1. Shelves.
2. Divisions.
3. Interior face of ends, backs, and bottoms including those on banks of drawers.
4. Interior surfaces of cabinet top members when top member is 3'-0" or more above finished floor.
5. Drawer sides, subfronts, backs and bottoms.
6. Underside of bottoms of cabinets between 2'-0" and 4'-0" above finished floor.
7. Interior faces of hinged doors.
8. Visible surfaces in open cabinets or behind glass.

C. Concealed Portions:

1. Toe space unless otherwise specified.
2. Sleepers.
3. Web frames, stretchers and solid sub-tops.
4. Security panels.
5. Underside of bottoms of cabinets less than 2'-0" above finished floor.
6. Flat tops of cabinets 6'-0" or more above the finished floor, except if visible from upper building level.
7. 3 non-visible edges of adjustable shelves within cabinets.
8. Underside of countertops, knee spaces and drawer aprons.
9. Faces of cabinet ends of adjoining units that butt together.

1.5 DESIGN REQUIREMENTS

A. Sustainable Design Requirements:

1. Lumber used in work of this section is to come from forests that have been certified "Well Managed" forestry sources in accordance with programs of Forest Stewardship Council and is intended to contribute to meeting requirements for certified wood outlined in LEED™-NC 2009 Credit MR7.
2. Composite wood panels used in work of this section are intended to:
 - a. Contribute to meeting requirements for recycled content outlined in LEED™-NC 2009 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™-NC 2009 Credit IEQ4.4.
3. 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™-NC 2009 Credit IEQ4.1.
4. Regional Materials: Give preference to manufacturers and fabricators whose facilities are within 500 mile radius of project site and to materials that are harvested and extracted within 500 mile radius of project site to contribute to meeting requirements for regional materials outlined in LEED™-NC 2009 Credit MR5.

1.6 PERFORMANCE REQUIREMENTS

- A. Adjustable shelves shall support 50 lbs/sq ft uniformly dispersed applied load with deflection limited to $L/144$.

1.7 SUBMITTALS

- A. Shop Drawings: Include minimum requirements per WI Section 1 for casework. First sheet of shop drawings shall bear WI Certified Compliance label.
- B. Product Data: Manufacturer data for core materials, accessories and hardware.
- C. Samples:
 - 1. Laminates: Submit samples, minimum 2 x 3 inches in size, illustrating finishes, colors, patterns, textures of high pressure plastic laminates and of low pressure decorative laminates specified.
 - 2. Edge Banding: Submit samples, minimum 4 inches long, of each thickness and color of vinyl edge banding to be used.
 - 3. Door and Drawer Pulls: Submit samples of door and drawer pulls.
- D. Test Reports: Submit test reports of cabinets and connections verifying cabinets and connections support loads. Reports for tests conducted for fabricator or for WI for exact method of cabinet construction are acceptable.
- E. Certificates: Submit WI Certified Compliance Certificates for plastic laminate faced wood cabinets.
 - 1. For Material and Workmanship: Submit prior to delivery of casework to site.
 - 2. For Installation: Submit upon completion of work of this section.
- F. LEED Documentation:
 - 1. Certified Wood: Submit Forest Stewardship Council chain-of-custody certificate number with each delivery.
 - 2. Composite Wood Panels:
 - a. Recycled Content: Submit letter or product data from manufacturer indicating recycled contents. Designate percentage of post-consumer and post-industrial recycled content.
 - b. Urea-Formaldehyde Resin Content: Submit letter or product data from manufacturer stating that no materials used in this product contain urea-formaldehyde resins.

3. 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.
4. Regional Materials: Submit letter or product data from manufacturer or fabricator stating products in this submittal were extracted and manufactured locally; identify location of origin listing city, state and country. If only portion of product qualifies for this credit, submit product data or letter clearly designating percent age of product that is manufactured and extracted locally.
3. Submit hard copies of completed Online Documentation required for LEED™ MR Credit 4, MR Credit 5, EQ Credit 4.1 and EQ Credit 4.4.

1.8 QUALITY ASSURANCE

- A. Perform work in accordance with Custom Grade of Woodwork Institute "Manual of Millwork," except where otherwise specified.
- B. Provide WI certification is for material, fabrication and installation. Affix WI Certified Compliance Labels to each elevation of casework.

1.9 QUALIFICATIONS

- A. Fabricator: Company specializing in fabrication of plastic laminate faced wood cabinets able to demonstrate successful experience with work of comparable extent, complexity and quality to that shown and specified.
- B. Installer: Company specializing in installation of institutional casework with minimum 3 years documented experience.

1.10 REGULATORY REQUIREMENTS

- A. Cabinet Hardware: Comply with requirements of CBC Section 1117B.6 and 1125B.4.

1.11 DELIVERY, STORAGE AND HANDLING

- A. Deliver products to site, store, handle and protect in accordance with fabricator's instructions and recommendations.
- B. Do not deliver cabinets until project is ready for cabinet installation and proper facilities are available for handling, sorting and protecting cabinets and related materials. Ensure:
 1. Building is enclosed.
 2. Plaster work, concrete work, painting and other wet work is complete and dry.
 3. Grinding and similar operations are complete.
 4. Storage area is broom clean.

- C. Store cabinets in clean, well-ventilated area protected from direct sunlight, excessive heat, rain or moisture and with:
 - 1. Relative humidity between 45 and 65 percent at 60 to 90 degrees F.
 - 2. Equilibrium Moisture Content conditions between 8 and 12 percent.
- D. Set or store cabinets on level floor; provide temporary covers to protect exposed finished portions from damage. Do not use cabinets to store construction materials.
- E. Store cabinets in installation areas or in areas with same ambient conditions as area of installation for minimum 72 hours prior to installation.

1.12 ENVIRONMENTAL REQUIREMENTS

- A. Do not deliver or install cabinets until temperature and relative humidity required by fabricator have been stabilized in installation areas.
- B. Maintain required temperature and humidity in installation areas from date of delivery through remainder of construction.

1.13 FIELD MEASUREMENTS

- A. Verify that field measurements are as indicated on shop drawings.
- B. Verify details and dimensions of equipment and fixtures integral with casework and other items for proper fit and accurate alignment.

1.14 SEQUENCING AND SCHEDULING

- A. Provide information as required for timely and proper placement of backing and support items.
- B. Coordinate details with other work supporting, adjoining or fastening to casework.
- C. Coordinate fabrication and installation of laminate-clad wood cabinets and countertop supports with fabrication and installation of laminate-clad countertops specified under Section 06416 – Laminate-Clad Countertops and of solid surfacing countertops specified under Section 06653 – Solid Surfacing Fabrications.

1.15 EXTRA MATERIALS

- A. Deliver 100 of each type of shelf rest specified to Owner.
- B. Wrap and label materials to identify type and locations installed.
- C. Deliver to Owner; obtain receipt.

PART 2 PRODUCTS

2.1 LUMBER MATERIALS

- A. Softwood Lumber: PS 20; graded in accordance with WI; minimum moisture content of 6 percent; maximum moisture content of 12 percent; Douglas Fir, Ponderosa or Sugar Pine; Custom Grade for Opaque Finish.
- B. Hardwood Lumber: NHLA; graded in accordance with WI; minimum moisture content of 6 percent; maximum moisture content of 12 percent.
 - 1. Exposed and Semi-Exposed Locations: Species and cut to be determined; Custom Grade for Transparent Finish.
 - 2. Concealed Locations: Birch; Custom Grade for Opaque Finish.

2.2 SHEET WOOD MATERIALS

- A. Hardwood Plywood: PS 51; graded in accordance with WI; veneer core material; type of glue recommended for application; Birch; rotary cut; Custom Grade for Opaque Finish.
- B. Particleboard: ANSI A208.1, Grade M2; manufactured from 100 percent recycled and recovered wood fiber; no urea formaldehyde resins added during manufacturing.
- C. Medium Density Fiberboard: ANSI A208.2; minimum 45 lbs/cu ft; manufactured from 100 percent recycled and recovered wood fiber; no urea formaldehyde resins added during manufacturing.
- D. Hardboard: ANSI A135.4; pressed wood fiber with resin binder; tempered grade; smooth two sides.
- E. Medium Density Overlay (MDO) Plywood: PS 1; APA Group 2, B-B Douglas fir plywood, exterior glue, resin fiber overlay both faces.
- F. Modified Veneer Core Plywood: Minimum 3 ply Douglas fir plywood core with medium density fiberboard face and back crossbands; States Industries, Inc. ArmorCore® or equal product substituted under provisions of Division 1.

2.3 LAMINATE MATERIALS

- A. High Pressure Laminates: NEMA LD-3.
 - 1. Thickness: 0.028 inches.
 - 2. Colors, Textures and Finishes (PL-1): Multiple color pattern, smooth surface; matte finish; Formica 837-58, "Graphite, matt."
- B. Laminate Backing Sheet: NEMA LD-3, BK-20 Backer Type; undecorated plastic laminate.

C. Cabinet Lining Materials:

1. Interior Faces of Hinged Doors: NEMA LD-3, GP-28 Vertical Surfacing Type; color to match low pressure decorative laminate.
2. Semi-Exposed Interior Faces of Open Cabinets: NEMA LD-3, GP-28 Vertical Surfacing Type; color to match low pressure decorative laminate.
3. Faces of Adjustable Shelves Over 36 Inches Long: NEMA LD-3, GP-28 Vertical Surfacing Type; color to match low pressure decorative laminate.
4. Other Surfaces: Low pressure decorative laminate conforming to ALA and WI standards; color to be determined.

2.4 ACCESSORIES

A. Adhesives: VOC content not exceeding limit established by South Coast Air Quality Management District Rule #1168.

1. Vinyl Edge Banding: Hot melt type recommended by edge banding manufacturer.
2. Other Surfaces: WI Type II to suit application.

B. Vinyl Edge Banding:

1. Manufacturer:
 - a. Dollken-Woodtape.
 - b. Manufacturer Offering Acceptable Equivalent Product: Canplast.
 - c. Substitutions: Under provisions of Division 1.
2. Edge Banding: Rigid polyvinyl chloride; extruded; smooth surface; solid color; width to match component thickness; color to match adjacent low pressure decorative laminate.
 - a. Shelf Edges Behind Doors: 18 mils thick; Woodtape "Kwik Edge."
 - b. Shelf Edges in Open Cabinets: 3 mm thick; Woodtape, Inc. "Accent Edge."

C. Fasteners: Size and type to suit application.

1. Bolts, Nuts, Washers, Lags, Pins and Screws: Of size and type to suit application; plain finish in concealed and exposed locations.
2. Powder Driven Fasteners: Tempered steel pins with special corrosion-resistant plating or coating; guide washers to control penetration accurately to maximum 1-1/4 inch; low velocity piston-driven powder-actuated tool; Hilti Fastening System;

Impex Tool Corporation, or equal product substituted under provisions of Division 1.

3. Concealed Joint Fasteners: Threaded steel.

D. Primer: Alkyd primer sealer type.

2.5 HARDWARE

A. Shelf Rests for Adjustable Shelves: Zinc alloy; plug-in pins for 5 mm diameter drilled holes; nickel plated finish.

1. Shelves to 5'-0" Above Finish Floor: Angle with side plug-in pin and recessed seat; Hafele America Co. 282-24-710.

2. Shelves Over 5'-0" Above Finish Floor: Angle with side plug-in and top shelf fixing lug; Hafele America Co. 282-24-720 or Hettich International "Sekura 1."

B. Hinges: Concealed European type that permit doors to be removed from cabinet bodies without use of tools; minimum 120 degree door opening; adjustable; self-closing; 2-piece mounting plate for screw attachment; bright nickel finish; Blum "Clip" Concealed Hinge #75M5550 at overlay door and #75M5650 at twin application or Grass America "Twist Lock" #4803.

C. Drawer Slides:

1. Drawers 33-1/2 Inches Wide and Less: 100 lbs/pair capacity; full extension with progressive movement; rail mounted; all-ball bearing; hold-in indent; clear zinc plated finish; Accuride Model #7432 Full Extension Drawer Slide or Knap & Vogt #8500.

2. Drawers Over 33-1/2 Inches Wide: 150 lbs/pair capacity; full extension with 1 inch over travel; rail mounted; ball bearing; hold-in indent; clear zinc plated finish; Accuride Model #3640 Heavy Duty Over Travel Slide.

D. Cabinet Pulls: Wire type metal pull; stainless steel; 5/16 inch diameter; 4 inches center to center; 1-5/16 inch projection; satin finish; Epco #MC402-4-SS.

E. Cabinet Locks: ANSI A156.11, Grade 2; 1-1/8 inch diameter zinc housing; six-pin solid brass cylinder; cylinder retaining screws to facilitate rekeying; keyed alike, keyed differently and masterkeyed.

1. Doors: Steel bolt with nominal 1 inch throw.

2. Drawers: Steel bolt with minimum 1/2 inch throw.

F. Catches:

1. Non-Locking Pairs of Doors: Magnetic type; adjustable; aluminum case; self aligning; 3-1/2 to 4-1/2 pound pull strength; Knape & Vogt #916.

2. Lockable Pairs of Doors: Elbow type; cast bronze with plated dull chromium finish; Ives #2 Elbow Catch.

G. Bumpers: Rubber recessed type; styrene butadiene rubber; 70 Shore A durometer hardness; tapered sides; 7/8 inch diameter tapering to 3/4 inch; 5/8 inch high; 3/16 inch diameter hole for fastener with 5/16 inch diameter recess for head; "black" color.

H. Substitutions: Under provisions of Section Division 1.

2.6 FABRICATION

A. Fabricate plastic laminate clad wood cabinets and display cases in accordance with WI Section 15, Custom Grade, Type I, Style A with Type A flush overlay doors and drawers, except as amended by these specifications.

B. Fabricate lower cases and tall cases with bases and sleepers separate from cabinet body.

C. Minimum Nominal Thickness and Material for Cabinet Components:

1. Facing at Desks: Minimum 3/4 inch thick medium density fiberboard.
2. Cabinet Backs: Minimum 1/4 inch thick particleboard core; 1/2 inch thick at exposed locations.
3. Cabinet Tops, Bottoms, Ends and Divisions: Minimum 3/4 inch thick particleboard core.
4. Flush Door and Drawer Fronts: Minimum 3/4 inch thick medium density fiberboard core.
5. Cabinet Shelves:
 - a. Shelves Up to 24 Inches Long: Minimum 3/4 inch thick particleboard, medium density fiberboard, MDO plywood or modified veneer core plywood core for low pressure decorative laminate finish.
 - b. Shelves 24 Inches to 36 Inches Long: 1 inch thick particleboard, medium density fiberboard, MDO plywood or modified veneer core plywood core for low pressure decorative laminate finish.
 - c. Shelves 36 Inches to 48 Inches Long: 1 inch thick particleboard MDO plywood or modified veneer-core plywood core for high pressure laminate finish.
 - d. Shelves 48 Inches and Longer: As detailed on Drawings.
6. Countertop Support Legs and Brackets: Minimum 3/4 inch thick modified veneer-core plywood core.

- D. Apply high pressure laminate finish to exposed horizontal and vertical surfaces of cabinets and to exposed and semi-exposed surfaces of countertop support legs and countertop support brackets.
 - 1. Apply laminate finish in full uninterrupted sheets consistent with manufactured sizes.
 - 2. Apply with pattern of laminate oriented in same direction throughout.
 - 3. Make corners and joints hairline. Slightly bevel arrises.
- E. Apply cabinet lining material to semi-exposed surfaces of cabinets.
 - 1. Apply high pressure laminate material to semi-exposed faces of cabinet doors.
 - 2. Apply high pressure laminate material to semi-exposed faces of open cabinets.
 - 3. Apply high pressure laminate material to both faces of cabinet shelves over 36 inches long.
 - 4. Apply low pressure laminate material to other semi-exposed cabinet surfaces.
- F. Apply low pressure laminate to flat tops of cabinets 72 inches or more above finished floor.
- G. Apply high pressure laminate self edge to visible edges of cabinet doors, drawers, web frames, ends, tops, bottoms and divisions and to visible edges of countertop support legs and brackets. Use full-length pieces only.
- H. Apply vinyl edge banding to front edge of cabinet shelves. Apply 3 mm banding to front edge of cabinet shelves in cabinets without doors; apply 18 mil banding to front edges of cabinet shelves in cabinets wit doors. Use full length pieces only.
- I. Drill cabinet dividers and ends for adjustable shelf rests. Align drilled holes so that shelves may be aligned between low and high open shelving units. Drill front edges of shelves to be installed above 5'-0" to receive fixing lugs of shelf rests.
- J. When necessary to cut and fit on site, provide materials with ample allowance for cutting. Provide trim for scribing and site cutting.
- K. Provide cutouts for plumbing fixtures, inserts, appliances, outlet boxes, and other fixtures and fittings.
 - 1. Verify locations of cutouts from on-site dimensions.
 - 2. Seal contact surfaces of cut edges.
- L. Seal unfinished edges of shelves.

2.7 FACTORY FINISHING

- A. Back prime wood surfaces in contact with cementitious materials.
- B. Miscellaneous Standing and Running Trim: Apply shop finish to hardwood surfaces in accordance with WI Section 5, System 4 - Conversion Varnish, Custom Grade.
 - 1. First Coat: Oil based stain.
 - 2. Second Coat: Sanding sealer.
 - 3. Third Coat: Top coat of conversion varnish.
 - 4. Fourth Coat: Top coat of conversion varnish.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify adequacy of backing and support framing.
- B. Verify that plumbing, mechanical, electrical and building items affecting work of this section have been installed and properly located.
- C. Do not begin installation until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Set and secure cabinet units, countertop support legs and countertop support brackets in place rigid, plumb and level in accordance with WI Section 15, Custom Grade.
- B. Use purpose designed fixture attachments at concealed locations for wall mounted cabinet and countertop support components.
- C. Use threaded steel concealed joint fasteners to align and secure adjoining cabinet units.
- D. Secure removable panels with oval head screws with matching countersunk finishing washers.
- E. Carefully scribe casework which is against other building materials, leaving gaps of 1/16 inch maximum. Do not use additional overlay trim for this purpose.
- F. Secure cabinet and counter support legs to floor using appropriate angles and anchorages.
- G. Countersink anchorage devices at exposed locations used to wall mount components, and conceal with solid plugs of hardwood with finish to match surround. Finish flush with surrounding surfaces.

H. Install locks and hardware.

1. Install minimum 2 magnetic catches for doors over 48 inches high.
2. Install bumpers at walls perpendicular and immediately adjacent to cabinets. Align bumper with door pull; mechanically fasten to wall.
3. Install locking and operating hardware on base and tall cabinets within 48 inches of floor. Ensure locks are installed on appropriate cabinets.

3.3 ADJUSTING

- A. Adjust doors, hardware, fixtures and other moving and operating parts to function smoothly and correctly.

3.4 CLEANING

- A. Clean finished cabinets, countertops, shelves, hardware, fittings and fixtures in accordance with fabricator's instructions.

3.5 PROTECTION OF INSTALLED WORK

- A. Protect completed work from damage until final acceptance.

END OF SECTION

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SECTION 06652

SOLID SURFACING COUNTERTOPS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Special fabricated solid surfacing countertops.
- B. Preparation for utilities.
- C. Accessories.

1.2 RELATED SECTIONS

- A. Section 05500 - Metal Fabrications: Angle brackets supporting solid surfacing countertops.
- B. Section 06200 - Finish Carpentry: Plywood subcounters.
- C. Section 06411 - Plastic Laminate Clad Countertops: Countertops other than specified in this section.
- D. Division 15 - Mechanical: Sinks, piped utilities and plumbing fittings.

1.3 REFERENCES

- A. ASTM D638 - Test Method for Tensile Properties of Plastics.
- B. ASTM D785 - Test Method for Rockwell Hardness of Plastics and Electrical Insulating Materials.
- C. ASTM D790 - Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.
- D. ASTM E84 - Test Method for Surface Burning Characteristics of Building Materials.
- E. NEMA LD-3 - High Pressure Decorative Laminates.
- F. WI - Woodwork Institute "Manual of Millwork."

1.5 DESIGN REQUIREMENTS

- A. Sustainable Design Requirements: Adhesives and sealants 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™-NC 2009 Credit IEQ4.1.

1.6 SUBMITTALS

- A. Shop Drawings: Include minimum requirements per WI Section 1 for countertops. First sheet of shop drawings shall bear WI Certified Compliance label. Include:
 - 1. Full size details, edge details and attachment.
 - 2. Locations and sizes for furring and blocking including concealed blocking specified in other sections.
 - 3. Locations and sizes of cutouts and holes for plumbing fixtures and fittings, toilet accessories and other items installed in solid surface countertops.
 - 4. Seam locations.
- B. Product Data: Submit manufacturer's data for solid surface material and for accessories. Indicate product description, fabrication information and compliance with specified performance requirements.
- C. Samples:
 - 1. Color: Submit samples, minimum 6 x 6 inches in size, of solid surface material illustrating specified colors, textures and finishes. Indicate full range of color and pattern variation.
 - 2. Seam: Submit cut samples and seam together for representation of seaming techniques.
- D. Certificates: Submit WI Certified Compliance Certificates for solid surfacing countertops.
 - 1. For Material and Workmanship: Submit prior to delivery of casework to site.
 - 2. For Installation: Submit upon completion of work of this section.
- F. LEED Documentation:
 - 1. Adhesives and Sealants: Submit letter or product data from manufacturer stating that adhesives and sealants used in work of this section do not exceed VOC content limits established in South Coast Air Quality Management District Rule #1168.

2. Submit hard copies of completed Online Documentation required for LEED™ IEQ Credit 4.1.

1.7 OPERATION AND MAINTENANCE DATA

- A. Maintenance Data: Include surface protection procedures, maintenance procedures and recommended maintenance materials for solid surface materials.

1.8 QUALITY ASSURANCE

- A. Perform work in accordance with Premium Grade of Woodwork Institute "Manual of Millwork," except where otherwise specified.
- B. Provide WI certifications for material, fabrication and installation. Affix WI Certified Compliance Labels to each elevation.

1.9 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacture of solid surfacing material of type specified with minimum 10 years documented experience.
- B. Fabricator: Company specializing in fabrication of solid surfacing countertops able to demonstrate successful experience with work of comparable extent, complexity and quality to that shown and specified.
- C. Installer: Company specializing in installation of solid surfacing countertops with minimum 3 years documented experience.

1.10 DELIVERY, STORAGE AND HANDLING

- A. Deliver products to site, store, handle and protect in accordance with manufacturer's and fabricator's instructions and recommendations.
- B. Do not deliver countertops until project is ready for countertop installation and proper facilities are available for handling, sorting and protecting countertops and related materials.
 1. Building is enclosed.
 2. Plaster work, concrete work, painting and other wet work is complete and dry.
 3. Grinding and similar operations are complete.
 4. Storage area is broom clean.
- C. Store countertops in clean, well-ventilated area protected from direct sunlight, excessive heat, rain or moisture.

- D. Store countertops on level surface; provide temporary covers to protect exposed finished portions from damage. Do not store construction materials on countertops.
- E. Store countertops in installation areas or in areas with same ambient conditions as area of installation for minimum 72 hours prior to installation.
- F. Handle materials to prevent damage to finished surfaces.

1.11 FIELD MEASUREMENTS

- A. Verify that field measurements are as indicated on shop drawings.
- B. Field measure angle supports after installation to verify sizes and shapes of supports prior to fabrication of countertops.
- C. Verify details and dimensions of equipment and fixtures integral with countertops and other items for proper fit and accurate alignment.

1.12 COORDINATION

- A. Provide information as required for timely and proper placement of backing and support items.
- B. Coordinate details with other work supporting, adjoining or fastening to countertops.
- C. Coordinate fabrication of countertops with installation of plumbing piping, fixtures and fittings and with counter mounted toilet accessories.

1.13 WARRANTY

- A. Provide manufacturer's 10-year warranty against defects in materials. Provide material and labor to repair or replace defective material.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Manufacturers:
 - 1. a. Caesar Stone (in reception desk)
 - b. DuPont: Corian (in workroom)
 - 2. Manufacturers Offering Acceptable Equivalent Products:
 - a. Avonite, Inc.
 - b. Formica Corporation.

- c. Nevamar Corporation.
 - d. Ralph Wilson Plastics.
3. Substitutions: Under provisions of Division 1.
- B. Solid Surface Material (CR-1): ANSI Z124.3 and ANSI Z124.6, Type 6; homogenous filled acrylic; non-coated; non-laminated; non-composite; minimum 1/2 inch thick sheets.

1. Properties:

Property	Test Method	Results
Tensile Strength	ASTM D638	6000 psi
Flexural Strength	ASTM D790	8000 psi
Hardness	ASTM D785	94
Color Stability	NEMA LD-3	No change
Abrasion Resistance	NEMA LD-3	No loss of pattern
Boiling Water Surface Resistance	NEMA LD-3	No visible change
Impact Resistance	NEMA LD-3	No failure
Stain Resistance	ANSI Z124	Passes
Flame Spread	ASTM E84	<25
Smoke Developed	ASTM E84	<30

- 2. Surface Sheen: Matte.
- 3. Workroom Color: To match Corian, honed Collection color "Concrete."
- 4. Reception Desk Color: To match Caesar Stone, honed - color "Eggshell 3141."

2.2 ACCESSORIES

- A. Joint Adhesives: Type recommended by solid surfacing manufacturer to create color-matched seam; VOC content not exceeding limit established by South Coast Air Quality Management District Rule #1168.

- B. Sealant: Manufacturer's standard silicon sealant; mildew resistant; clear or color to match solid surfacing; VOC content not exceeding limit established by South Coast Air Quality Management District Rule #1168.

2.3 FABRICATION

- A. Fabricate countertops in accordance with WI Section 17, Premium Grade, except as amended by these specifications and in accordance with and manufacturer's instructions and recommendations.
- B. Fabricate countertops with aprons, backsplashes and side splashes to profiles, shapes and sizes indicated on Drawings.
- C. Fabricate deck with integral square mount apron from 1/2 inch thick sheet. Radius top edge of deck.
- D. Form splashes separate from 1/2 inch thick solid material. Form 4 inches high with edges square.
- E. Fabricate for topmount lavatories and sinks.
- F. Fabricate components in shop to greatest extent practical.
- G. Fabricate components in largest sections possible. Where single piece construction is not feasible, fabricate multiple pieces with flush joints sealed with joint adhesive.
 - 1. Locate joints in accordance with final reviewed shop drawings.
 - 2. Reinforce horizontal joints with 2 inch wide reinforcing strip of solid surfacing material centered under each joint except where joint is backed with plywood sub-counter.
 - 3. Finished joints shall be inconspicuous in appearance and without voids.
- H. Provide holes and cutouts for plumbing fixtures and fittings and for toilet accessories.
- I. Rout and finish component edges to smooth uniform finish. Rout cutouts; smooth edges.
- J. Finish surfaces to uniform sheen.
- K. Fabrication Tolerances:
 - 1. Variation in Component Size: $\pm 1/8$ inch.
 - 2. Location of Openings: $\pm 1/8$ inch from indicated location.

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 counter supports and subcounters have been installed and properly secured.
- C. Verify that counter supports will adequately support and provide anchorage for countertops.
- D. Do not begin installation until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Set and secure countertops in place rigid, plumb and level in accordance with WI Section 17, Premium Grade, except as amended by these specifications and in accordance with and manufacturer's instructions and recommendations.
- B. Form field joints with joint adhesive with joints no greater than 1/16 inch; keep components and hands clean when making joints.
- C. Adhere countertops in place with sealant. Fill voids between countertops and adjacent surfaces with sealant to match color of solid surface material.
- D. Apply backsplashes and endsplashes; adhere to countertop using color matched sealant.
- E. Coordinate installation of toilet accessories.
- F. Installation Tolerances:
 - 1. Level, Plumb and Square: 1/8 inch in 120 inches.
 - 2. Installed Countertop Height: $\pm 1/4$ inch from indicated height.
 - 3. Clearance Between Solid Surface Material and Adjacent Walls: Minimum 1/16 inch to maximum 1/8 inch.

3.3 ADJUSTING

- A. Touch up marred surfaces; replace work that cannot be repaired to Owner's and Architect's satisfaction.

3.4 CLEANING

- A. Clean finished countertops, fittings and fixtures in accordance with fabricator's instructions.
- B. Remove adhesives, sealants and other stains.

3.5 PROTECTION OF INSTALLED WORK

- A. Protect completed work from damage until final acceptance.
- B. Provide protective coverings to prevent physical damage or staining for duration of construction. Mark covering in large lettering "No Standing."

END OF SECTION

SECTION 07130 - MEMBRANE WATERPROOFING SYSTEM

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This Section includes waterproofing system at sides of planter walls and retaining walls.

1.2 QUALITY ASSURANCE

- A. Applicable Standards: Apply the latest editions of the standards described below:
 - 1. ASTM - American Society for Testing and Materials
- B. Installer's Qualifications: Show successful experience in installation of waterproofing and sealant work, including not less than five [5] years experience in projects of similar scope.
- C. Inspection and Correction:
 - 1. Arrange for manufacturer's representative to inspect waterproofing work during installation to insure that work is being performed per manufacturer's current printed specifications.
 - 2. Provide unobstructed access to waterproofing work.
 - 3. Correct defects and irregularities as recommended by the manufacturer's representative.
- D. Environmental Condition: Comply with the manufacturer's minimum temperature recommendations for the installation of sealant and waterproofing materials.

1.3 SUBMITTALS

- A. Product Data: Manufacturers' current catalog cuts and printed specifications for each specified product.
- B. Samples:
 - 1. Membrane Waterproofing: Two [2] - 6 in. x 6 in. on wood.
- C. Certification: Manufacturer's representative's certification that work has been installed in strict accordance with the manufacturer's specifications.

1.4 PRODUCT STORAGE AND HANDLING

- A. Storage: Store and protect materials under temperature and climatic conditions recommended by their respective manufacturers.
- B. Damaged Materials: Remove all damaged materials and replace at no additional expense to Owner.

1.5 FINAL ACCEPTANCE

- A. Review Date: Submit written request for review for Final Acceptance at least five [5] days in advance.
- B. Completion: Work will be accepted upon satisfactory completion of all waterproofing work only.

- C. Responsibility: Upon Final Acceptance, Owner will assume responsibility for maintenance of the work.

PART 2 - PRODUCTS

- 2.1 GENERAL: Do not use materials stored for a period of time exceeding the manufacturer's maximum recommended shelf-life of the material.

2.2 MEMBRANE WATERPROOFING

- A. Type: Cold-applied two component elastomeric polyurethane.
- B. Manufacturer: Tbd

2.3 SEALANT

- A. General: Single or double component, primerless and non-sagging.
- B. Air Exposed:
1. Type: Two-part, urethane sonolastic sealant.
 2. Color: TBD
 3. Manufacturer: TBD
- C. Submerged:
1. Type: Two-part polysulfide.
 2. Color: TBD
 3. Manufacturer: TBD

2.4 BACK-UP MATERIAL

- A. Description: Non-staining, non-oily, back-up filler material, completely compatible with the sealant and waterproofing materials.
- B. Type: Polyethylene foam rod, expanded polyurethane or neoprene.

PART 3 - EXECUTION

3.1 GENERAL

- A. Verification of Other Trades: Verify completion and acceptance in other Sections of work prior to commencement of waterproofing system. Ensure sleeves and conduits [and other projections] which pass through surfaces to receive waterproofing system are properly installed.
- B. Preparation of Surface Conditions:
1. Ensure surfaces are free of cracks, depressions, waves or projections which may be detrimental to proper installation of waterproofing system. Repair surfaces as required by manufacturer's representative.

2. Seal cracks and expansion joints with recommended backup material and sealant. Ensure proper depth-to-width ratio as recommended by sealant manufacturer.
3. Ensure expansion joints are sharply formed, free of broken edges or loose aggregates.
4. Clean surfaces of dust, dirt and foreign matter detrimental to proper installation of waterproofing system.
5. Prime surfaces to receive waterproofing in accordance with manufacturer's current printed specifications.

3.2 INSTALLATION

- A. Membrane Waterproofing System: Install in accordance with the manufacturer's current printed specifications.
- B. Back-Up Materials:
 1. Verify compatibility of filler material with the sealant manufacturer prior to application.
 2. Use filler about 1/3 to 1/2 wider than width of joint so sufficient pressure is exerted by filler to provide substantial resistance to displacement.
- C. Sealant:
 1. Install sealant in strict accordance with manufacturer's printed specifications taking care to produce a bead of proper width and depth.
 2. Immediately remove all surplus sealant after completion of application.

3.3 CLEAN-UP

- A. Keep all areas of work clean, neat and orderly at all times.
- B. Upon completion of work, remove off the site all surplus materials, tools, equipment, rubbish and debris resulting from the work.

END OF SECTION

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SECTION 07130
SHEET WATERPROOFING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Post-applied modified bituminous sheet waterproofing system for vertical application.
- B. Prefabricated drainage composite.

1.2 RELATED SECTIONS

- A. Section 02300 - Earthwork: Backfilling against post-applied sheet waterproofing.
- B. Section 02620 - Subdrainage: Subsurface drainage pipe.
- C. Section 03300 - Concrete Cast-In-Place: Waterproofing substrate.
- D. Section 05811 Preformed Seismic Joint Seals.
- E. Section 07620 - Sheet Metal Flashing and Trim.
- F. Section 07650 - Flexible Flashing: Silicone sheet flashing adhered to foil faced rubberized asphalt flashing.
- G. Section 07900 - Joint Sealers.

1.3 REFERENCES

- A. ASTM C366 - Method for Measurement of Thickness of Sandwich Cores.
- B. ASTM C836 - Specification for High Solids, Cold Liquid-Applied Elastomeric Waterproofing for Use with Separate Wearing Course.
- C. ASTM D412 - Tests for Rubber Properties in Tension.
- D. ASTM D570 - Test Method for Water Absorption of Plastics.
- E. ASTM D882 - Test Methods for Tensile Properties of Thin Plastic Sheeting.
- F. ASTM D903 - Test Method for Peel or Stripping Strength of Adhesive Bonds.
- G. ASTM D1621 - Test Method for Compressive Properties for Rigid Cellular Plastics.
- H. ASTM D1644 - Test Methods for Nonvolatile Content of Varnishes.

- I. ASTM D1876 - Test Method for Peel Release of Adhesives (T-Peel).
- J. ASTM D1970 - Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection.
- K. ASTM D3767 - Practice for Rubber - Measurements of Dimensions.
- L. ASTM D3776 - Test Method for Mass per Unit Area (Weight) of Woven Fabric.
- M. ASTM D3786 - Test Method for Bursting Strength of Knitted Goods and Nonwoven Fabrics: Diaphragm Bursting Strength Tester Method.
- N. ASTM D4491 - Test Methods for Water Permeability of Geotextiles by Permittivity.
- O. ASTM D4533 - Test Method for Trapezoid Tearing Strength of Geotextiles.
- P. ASTM D4632 - Test Method for Breaking Load and Elongation of Geotextiles (Grab Method).
- Q. ASTM D4716 - Test Method for Constant Head Hydraulic Transmissivity (In Plane Flow of Geotextiles and Geotextile Related Products).
- R. ASTM D4751 - Test Method for Determining the Apparent Opening Size of a Geotextile.
- S. ASTM D4833 - Test Method for Index Puncture Resistance of Geotextiles, Geomembranes and Related Products.
- T. ASTM D5385 - Test Method for Hydrostatic Pressure Resistance of Waterproofing Membranes.
- U. ASTM D5957 - Guide for Flood Testing Horizontal Waterproofing Installations.
- V. ASTM E96 - Tests for Water Vapor Transmission of Materials in Sheet Form.
- W. ASTM E154 - Testing Materials for Use as Vapor Barriers Under Concrete Slabs and as Ground Covers in Crawl Spaces.

1.4 SYSTEM DESCRIPTION

- A. Sheet Waterproofing System: Post-applied waterproofing system consisting of surface conditioner, modified bituminous membrane, mastic and liquid membrane applied over below grade cast-in place concrete walls and covered with prefabricated drainage composite. Cast-in-place concrete provided under separate section.

1.5 PERFORMANCE REQUIREMENTS

- A. Products provided under this section are to be compatible with products specified un-

der Section 07140 – Fluid Applied Waterproofing to permit tie-in with fluid applied waterproofing system.

1.6 SUBMITTALS

A. Shop Drawings:

1. Show locations and extent of waterproofing. Include details for substrate joints and cracks, sheet flashings, penetrations, inside and outside corners, tie-ins with adjoining waterproofing and other termination conditions. Include conditions not specifically delineated on Drawings but required for waterproof installation.
2. Submit shop drawings to manufacturer for review and approval prior to submitting to Architect.

B. Product Data: Provide manufacturers product data, installation instructions, use limitations and recommendations for surface conditioner, liquid membrane, tapes, sheet membrane and prefabricated drainage composite. Include certification data indicating VOC content of components of waterproofing system.

C. Samples:

1. Sheet Membrane: Submit samples, minimum 6 x 6 inches in size, of waterproofing sheet.
2. Drainage Composite: Submit samples, minimum 6 x 6 inches in size, of prefabricated drainage composite.

1.7 QUALITY ASSURANCE

A. Source Limitations: Provide primary waterproofing products supplied by single manufacturer. Provide secondary and accessory products that are acceptable to manufacturer of primary products.

1.8 QUALIFICATIONS

- A. Manufacturer: Company specializing in production of self-adhesive sheet waterproofing with minimum 20 years documented experience.
- B. Applicator: Company specializing in installation of sheet membrane waterproofing with minimum 3 years documented experience and approved by manufacturer.

1.9 PREINSTALLATION CONFERENCE

- A. Convene preinstallation conference minimum 1 week prior to beginning work of this

section.

- B. Attendance: Contractor, waterproofing applicator, waterproofing supplier, waterproofing manufacturer's representative, Construction Manager, Project Inspector and Architect.
- C. Agenda: Review installation procedure and coordination required with related and adjacent work. Review special details and flashing. Conduct walkover inspection of substrates.

1.10 DELIVERY, STORAGE AND HANDLING

- A. Deliver products to site, store and protect in accordance with manufacturer's instructions and recommendations.
- B. Sequence deliveries to avoid delays but minimize on-site storage.
- C. Deliver products in manufacturer's original sealed containers and packages with labels identifying material name, brand, and date of manufacture.
- D. Store and handle products in accordance with manufacturer's instructions, recommendations, and material safety data sheets.
- E. Protect products from damage from sunlight, weather, excessive temperatures, and construction operations. Remove damaged material from site and dispose of in accordance with applicable regulations.
- F. Do not double-stack pallets of membrane on job site. Provide cover on top and sides allowing for adequate ventilation.
- G. Protect mastic and adhesive from moisture and potential sources of ignition.
- H. Store drainage composite flat and off ground. Provide cover on top and sides.
- I. Protect surface conditioner from freezing.

1.11 ENVIRONMENTAL REQUIREMENTS

- A. Perform work only when existing and forecasted weather conditions are within limits established by manufacturer of materials and products used.
- B. Proceed with installation only when substrate construction and preparation work is complete and in condition to receive sheet membrane waterproofing.

1.12 COORDINATION

- A. Coordinate work of this section with related work provided under other sections as re-

quired to avoid delays and prevent omission of related work required for correct installation.

- B. Coordinate application of waterproofing with work in and around waterproofing that precedes, follows or penetrates waterproofing.
- C. Coordinate installation of drainage composite with installation of subdrainage piping specified under Section 02620 - Subdrainage.

1.13 WARRANTY

- A. **Manufacturer's Warranty:** Provide manufacturer's written 10-year material warranty upon completion of work.
 - 1. Agree to replace waterproofing that does not remain watertight during specified warranty period.
 - 2. Warranty does not include failure of waterproofing due to structural failure of substrate.
- B. **Installer's Warranty:** Provide installer's written 3-year warranty upon completion of work. Include removing and reinstalling collateral materials associated with replacement of waterproofing that fails within specified warranty period.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Grace Construction Products: Bituthene® Waterproofing Systems.
- B. Manufacturer Offering Acceptable Equivalent Product: Carlisle Corporation.
- C. Substitutions: Under provisions of Division 1.

2.2 MATERIALS

- A. **Sheet Membrane:** Self-adhesive cold-applied composite sheet consisting of 56 mils of rubberized asphalt and 4 mils cross-laminated high-density polyethylene film; specially formulated for use with water-based surface conditioner; capable of forming lapped seams without use of special adhesive or heat; supplied with release sheet to be removed during installation; dark gray-black color; Bituthene® System 4000 Waterproofing Membrane.

Property	Test Method	Result
Thickness	ASTM D3767	60 mils

	Method A	
Flexibility (180 degree bend over 1 inch mandrel at -45 degrees F)	ASTM D1970	Unaffected
Tensile Strength Membrane - Die C	ASTM D412 Modified	325 psi minimum
Tensile Strength Film	ASTM D882 Modified	5000 psi minimum
Elongation at Ultimate Failure of Rubberized Asphalt	ASTM D412 Modified	300 percent minimum
Crack Cycling (100 cycles at -25 degrees F)	ASTM C836	Unaffected
Lap Adhesion at Minimum Application Temperature	ASTM D1876 Modified	5 lbs/inch
Peel Strength	ASTM D903 Modified	9 lbs/inch
Puncture Resistance	ASTM E154	50 lbs minimum
Resistance to Hydrostatic Head	ASTM D5385	231 ft of water
Permeance	ASTM E96 Section 12 Water Method	0.05 perms maximum
Water Absorption	ASTM D570 maximum	0.1 percent

- B. Prefabricated Drainage Composite: 3-ply composite consisting of dimpled high impact polystyrene drainage core with needle-punched nonwoven polypropylene filter fabric adhered to face of core and high strength backing film adhered to back of core; Hydroduct® 220 Drainage Composite.

Property	Test Method	Result
Core Thickness	ASTM C366 Method B	0.433 inches nominal
Core Compressive Strength	ASTM D1621	15,000 psf
Core Flow Rate	ASTM D4716	16 gpm/ft width at 3600 psf

Fabric Weight	ASTM D3776	4.0 oz/sq yd
Fabric Tensile Strength	ASTM D4632	110 lbs
Fabric Apparent Opening Size	ASTM D4751	100 US sieve
Fabric Flow Rate	ASTM D4491	150 gpm/sq ft
Fabric Mullen Burst	ASTM D3786	215 psi
Fabric Puncture Strength	ASTM D4833	65 lbs

- C. Surface Conditioner: Water-based latex surface treatment; 125 g/L volatile organic compounds; Bituthene® System 4000 Surface Conditioner.
- D. Mastic: Trowel-grade rubberized asphalt; 200 g/L volatile organic compounds; Bituthene® Mastic.
- E. Liquid Membrane: Two-component cold-applied trowel-grade elastomeric; 10 g/L volatile organic compounds; black color; Bituthene® Liquid Membrane with following properties:

Property	Test Method	Result
Solids Content	ASTM D1644	100 percent
Elongation	ASTM D412	250 percent minimum
Peel Strength	ASTM D1970	5 lbs/inch minimum
Flexibility (180 degree bend over 1 inch mandrel at -25 degrees F)	ASTM D1970	Unaffected

- F. Foil-Faced Rubberized-Asphalt Flashing: Self-adhesive rubberized asphalt detail membrane with aluminum-faced film; waterproof and impermeable to moisture; extended UV exposure up to 1 year; Perm-A-Barrier® Aluminum Flashing.
- G. Tapes:
- For Adhering Drainage Composites to Waterproofing: Double-sided self-adhesive tape formulated for use with specified waterproofing and drainage composite; 1 inch wide; Hydroduct® Tape.
 - For Sealing Drainage Composite Fabric Facing: Underground tape recommended by drainage composite manufacturer for use; 3 inches wide.

- H. Termination Bar: Aluminum bars; 1 inch wide x 1/8 inch thick; predrilled at 8 inches o.c.
- I. EPDM Boot: Premolded EPDM pipe boot flashing with flange.
- J. Clamping Ring: Stainless steel hose clamps with worm drives.

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 manufacturer's instructions and recommendations.
- B. Verify that substrate surfaces are durable, dry, and free from matter detrimental to adhesion of waterproofing membrane.
- C. Verify that concrete surfaces have properly cured and dried minimum 7 days.
- D. Verify that items such as pipes, conduits, vents, and ducts that penetrate surfaces to receive waterproofing are in place and securely installed.
- E. Do not begin application until unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Protect adjacent surfaces not designated to receive waterproofing.
- B. Prepare substrate surfaces in accordance with manufacturer's instructions and recommendations.
 - 1. Remove contaminants such as grease, oil, and wax from exposed surfaces.
 - 2. Fill form tie holes with concrete and finish flush with surrounding surface.
 - 3. Repair bugholes over 1/2 inch in length and 1/4 inch deep and finish flush with surrounding surface.
 - 4. Remove scaling to sound unaffected concrete and repair exposed area.
 - 5. Grind irregular construction joints to suitable flush surface.
 - 6. Remove dirt and debris.

3.3 APPLICATION - WATERPROOFING

- A. Apply waterproofing system in accordance with manufacturer's instructions and rec-

ommendations.

- B. Spray surface conditioner to concrete surfaces at recommended coverage rates. Allow surface conditioner to dry completely and thoroughly.
- C. Detail corners, joints and penetrations.
 - 1. Inside Corners:
 - a. Install 3/4 inch fillet of liquid membrane at intersection of wall and footing.
 - b. Apply 12 inch wide strip of membrane centered over fillet.
 - c. Apply full sheet of membrane over treated corner to ensure 2 ply coverage.
 - 2. Outside Corners:
 - a. Apply 12 inch wide strip of membrane centered over corner.
 - b. Apply full sheet of membrane over treated corner to ensure 2-ply coverage.
 - 3. Joints and Cracks:
 - a. Seal joints with waterstop, joint filler and sealant. Allow sealants to fully cure.
 - b. Prestrip cracks over 0.060 inches wide with 9 inch wide strip of membrane centered over crack.
 - c. Prestrip construction and control joints with 9 inch wide strip of membrane centered over crack.
 - 4. Penetrations of Below Grade Walls:
 - a. Apply membrane to within 1 inch of base of protrusion.
 - b. Apply liquid membrane 0.1 inch thick around protrusion; extend 2-1/2 inches onto membrane and onto protrusion.
 - c. Apply liquid membrane to sheet membrane around protrusion to provide bed and separation for EPDM boot; set EPDM boot in liquid membrane and trowel apply additional liquid membrane over termination of boot to sheet membrane.
 - d. Install stainless steel clamping band to seal boot to protrusion.
- D. Apply membrane to below grade walls.

1. Apply sheet membrane in strips of 8 feet or less; overlap seams minimum 2-1/2 inches.
2. Where application exceeds 8 feet, apply membrane in 2 or more sections with upper section overlapping lower section in weatherboard fashion.
3. Membrane Termination:
 - a. Terminate membrane just below finish grade line or top of concrete paving unless otherwise noted or detailed.
 - 1) Firmly press membrane edge against substrate to ensure positive adhesion.
 - 2) Secure in place with flat aluminum termination bar fastened at maximum 8 inches oc.
 - 3) Apply liquid membrane covering substrate surface immediately above membrane and extending over top edge of membrane sheet and onto termination bar.
 - b. Terminate membrane approximately 2 inches below top of concrete retaining wall where flexible silicone sheet flashing is detailed between top of concrete and curtain wall and precast concrete wall panels.
 - 1) Firmly press membrane edge against substrate to ensure positive adhesion.
 - 2) Apply foil-faced rubberized asphalt flashing over remaining exposed concrete and onto membrane overlapping membrane and adjacent pieces minimum 2 inches.
 - 3) Firmly press foil-faced flashing against concrete and membrane substrates to ensure positive adhesion.
 - 4) Secure in place with flat aluminum termination bar fastened at maximum 8 inches oc.
 - 5) Apply liquid membrane covering substrate surface immediately above foil-faced flashing and extending over top edge of flashing and onto termination bar.
 - 6) Coordinate installation of flexible silicone sheet flashing.
4. At footings, extend membrane to top of footing and down outside face of footing.
5. Roll membrane with hand roller.
6. Seal laps and terminations within 12 inches of corners with 1 inch wide troweling

of mastic or liquid membrane.

7. Apply troweled bead of mastic or liquid membrane to vertical and horizontal terminations at end of each workday.
8. Patch tears and inadequately lapped seams with membrane.

3.4 APPLICATION - DRAINAGE COMPOSITES

- A. Apply drainage composite over completed waterproof membrane in accordance with manufacturer's instructions and recommendations. Apply with backing film side at back of core toward waterproofing.
- B. Apply drainage composite to vertical waterproofed surfaces.
 1. Apply drainage composite horizontally extending from perimeter discharge pipe to approximately 6 inches below anticipated grade.
 2. Apply initial course drainage composite with bottom edge extending out from structure so that it passes behind and under discharge pipe. Wrap additional filter fabric over discharge pipe.
 3. Apply subsequent courses of drainage composite maintaining shingle pattern weatherlap at core and fabric facing.
 - a. Fold back fabric on lower course; do not detach from dimples.
 - b. Place cones of upper course over flange of lower course.
 - c. Overlap fabric of upper course over lower course; seal with underground tape.
 4. Adhere drainage composite to waterproofing membrane with strips of double-sided tape. Press drainage composite firmly into tape.
 5. For inside and outside corners, abut adjoining drainage composite at corner; cover open core with filter fabric.
 6. Cover exposed core at top terminations with strip of filter fabric.
 7. At penetrations, apply double-sided tape around penetration in picture frame configuration. Cut drainage composite to fit snugly around penetrations; press cut edge firmly into tape.
 8. Coordinate placement of backfill; ensure that backfill is placed as soon as possible in manner to prevent damage to drainage composite and waterproofing system.

3.5 CLEANING

- A. Remove masking materials after installation.
- B. Clean stains from surfaces that would be exposed in completed work.

3.6 PROTECTION

- A. Protect completed membrane waterproofing from subsequent construction activities as recommended by manufacturer.

END OF SECTION

SECTION 07190
WATER REPELLENTS

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 penetrating water-repellent treatments for the following vertical and horizontal surfaces:
 - 1. Cast-in-place concrete.
 - 2. Masonry Brick Veneer
- B. Related Sections:
 - 1. Section 04813 "Masonry Veneer" for integral water-repellent admixture for unit masonry assemblies.

1.3 PERFORMANCE REQUIREMENTS

- A. General Performance: Water repellents shall meet performance requirements indicated without failure due to defective manufacture, fabrication, or installation.
 - 1. Water Repellents: Comply with performance requirements specified, as determined by preconstruction testing on manufacturer's standard substrate assemblies representing those indicated for this Project.
- B. Water Absorption: Minimum 80 percent reduction of water absorption after 24 hours in comparison of treated and untreated specimens.
 - 1. Cast-in Place Concrete: ASTM C 642.
 - 2. Precast Concrete: ASTM C 642.
 - 3. Cast Stone: ASTM C 1195.
 - 4. Concrete Masonry Units: ASTM C 140.
 - 5. Clay Brick: ASTM C 67.
 - 6. Natural Stone: ASTM C 97.
 - 7. Portland Cement Plaster (Stucco): ASTM D 6532.

- C. Water-Vapor Transmission: Comply with one or both of the following:
 - 1. Maximum 10 percent reduction in rate of vapor transmission in comparison of treated and untreated specimens, according to ASTM E 96/E 96M.
 - 2. Minimum 80 percent water-vapor transmission in comparison of treated and untreated specimens, according to ASTM D 1653.
- D. Water Penetration and Leakage through Masonry: Minimum 90 percent reduction in leakage rate in comparison of treated and untreated specimens, according to ASTM E 514.
- E. Durability: Maximum 5 percent loss of water-repellent properties after 2500 hours of weathering according to ASTM G 154 in comparison to water-repellent-treated specimens before weathering.
- F. Chloride-Ion Intrusion in Concrete: NCHRP Report 244, Series II tests.
 - 1. Reduction of Water Absorption: 80 percent.
 - 2. Reduction in Chloride Content: 80 percent.

1.4 PRECONSTRUCTION TESTING

- A. Preconstruction Testing: Installed water repellents shall comply with performance requirements indicated, as evidenced by reports of tests performed on manufacturer's standard substrate assemblies by a qualified testing agency.
 - 1. Select sizes and configurations of assemblies to adequately demonstrate capability of water repellents to comply with performance requirements.
 - 2. In addition to verifying performance requirements, use test applications to verify manufacturer's written instructions for application procedure and optimum rates of product application to substrate assemblies.
 - 3. Notify Architect seven days in advance of the dates and times when assemblies will be tested.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
 - 1. Include manufacturer's printed statement of VOC content.
 - 2. Include manufacturer's standard colors.
 - 3. Include manufacturer's recommended number of coats for each type of substrate and spreading rate for each separate coat.
 - 4. Printout of current "MPI Approved Products List" for each product category specified in Part 2 that specifies water repellents approved by MPI, with the proposed product highlighted.

- B. Samples: For each type of water repellent and substrate indicated, 12 by 12 inches (300 by 300 mm) in size, with specified water-repellent treatment applied to half of each Sample.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Applicator.
- B. Product Certificates: For each type of water repellent, from manufacturer.
- C. Preconstruction Testing Reports: For water-repellent-treated substrates.
- D. Field quality-control reports.
- E. Warranty: Special warranty specified in this Section.

1.7 QUALITY ASSURANCE

- A. Applicator Qualifications: An employer of workers trained and approved by manufacturer.
- B. MPI Standards: Comply with MPI standards indicated and provide water repellents listed in its "MPI Approved Products List."
- C. Mockups: Apply water repellent to each type of substrate required.
 - 1. Locate each test application as directed by Architect.
 - 2. Size: 10 sq. ft. (9.3 sq. m).
 - 3. Final approval by Architect of water-repellent application will be from test applications.
- D. Pre-installation Conference: Conduct conference at Project site.

1.8 PROJECT CONDITIONS

- A. Limitations: Proceed with application only when the following existing and forecasted weather and substrate conditions permit water repellents to be applied according to manufacturers' written instructions and warranty requirements:
 - 1. Concrete surfaces and mortar have cured for not less than 28 days.
 - 2. Building has been closed in for not less than 30 days before treating wall assemblies.
 - 3. Ambient temperature is above 40 deg F (4.4 deg C) and below 100 deg F (37.8 deg C) and will remain so for 24 hours.
 - 4. Substrate is not frozen and substrate-surface temperature is above 40 deg F (4.4 deg C) and below 100 deg F (37.8 deg C).

5. Rain or snow is not predicted within 24 hours.
6. Not less than 24 hours have passed since surfaces were last wet.
7. Windy conditions do not exist that might cause water repellent to be blown onto vegetation or surfaces not intended to be treated.

1.9 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which Applicator agree(s) to repair or replace materials that fail to maintain water repellency specified in "Performance Requirements" Article within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PENETRATING WATER REPELLENTS

- A. Silane, Penetrating Water Repellent: Clear, containing 20 percent or more solids of alkyltrialkoxysilanes; with alcohol, mineral spirits, water, or other proprietary solvent carrier; and with 400 g/L or less of VOCs.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Advanced Chemical Technologies, Inc.; Sil-Act Multiguard.
 - b. BASF Construction Chemicals, LLC; Hydrozo 100 Plus.
 - c. Chemical Products Industries, Inc.; SW-244-100 VOC.
 - d. Dayton Superior Corporation; Weather Worker J-29-WB.
 - e. Degussa Corp; Protectosil Aqua-Trete 40, Protectosil Chem-Trete PB 100.
 - f. Fox Industries, Inc.; FX-425.
 - g. Kelly-Moore Paint Company Inc.; Kel-Seal 77.
 - h. LymTal International, Inc.; Iso-Flex 618-100 CRS.
 - i. Nox-Crete Products Group; Stifel VC.
 - j. Pecora Corporation; KlereSeal 9100-S.
 - k. Price Research, Ltd.; Price Aqua Silane-20.
 - l. PROSOCO, Inc.; SLX100.
 - m. Specco Industries, Inc.; Waterstopper S-40 Silane.
 - n. Tamms Industries, Inc., Euclid Chemical Company; Baracade Silane 100.
 - o. Textured Coatings of America, Inc.; Rainstopper 1750 Clear.
 - p. Tnemec Inc.; Dur A Pell 100.
 - q. Vexcon Chemicals Inc.; Certi-Vex Envio Water Proof 500 Powerseal 40.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Applicator present, for compliance with requirements and conditions affecting performance of the Work.
 - 1. Verify that surfaces are clean and dry according to water-repellent manufacturer's requirements. Check moisture content in three representative locations by method recommended by manufacturer.
 - 2. Inspect for previously applied treatments that may inhibit penetration or performance of water repellents.
 - 3. Verify that there is no efflorescence or other removable residues that would be trapped beneath the application of water repellent.
 - 4. Verify that required repairs are complete, cured, and dry before applying water repellent.
- B. Test pH level according to water-repellent manufacturer's written instructions to ensure chemical bond to silica-containing or siliceous minerals.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Cleaning: Before application of water repellent, clean substrate of substances that could impair penetration or performance of product according to water-repellent manufacturer's written instructions and as follows:
 - 1. Cast-in-Place Concrete and Concrete Unit Masonry: Remove oil, curing compounds, laitance, and other substances that inhibit penetration or performance of water repellents according to ASTM E 1857.
 - 2. Portland Cement Plaster (Stucco): ASTM E 1857.
- B. Protect adjoining work, including mortar and sealant bond surfaces, from spillage or blow-over of water repellent. Cover adjoining and nearby surfaces of aluminum and glass if there is the possibility of water repellent being deposited on surfaces. Cover live vegetation.
- C. Coordination with Mortar Joints: Do not apply water repellent until pointing mortar for joints adjacent to surfaces receiving water-repellent treatment has been installed and cured.
- D. Coordination with Sealant Joints: Do not apply water repellent until sealants for joints adjacent to surfaces receiving water-repellent treatment have been installed and cured.

1. Water-repellent work may precede sealant application only if sealant adhesion and compatibility have been tested and verified using substrate, water repellent, and sealant materials identical to those required.

3.3 APPLICATION

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect the substrate before application of water repellent and to instruct Applicator on the product and application method to be used.
- B. Apply a heavy-saturation coating of water repellent, on surfaces indicated for treatment, using 15 psi- (103 kPa-) pressure spray with a fan-type spray nozzle or roller to the point of saturation. Apply coating in dual passes of uniform, overlapping strokes. Remove excess material; do not allow material to puddle beyond saturation. Comply with manufacturer's written instructions for application procedure unless otherwise indicated.
 1. Precast Concrete: At Contractor's option, first application of water repellent on units may be completed before installing them. Mask mortar and sealant bond surfaces to prevent water repellent from migrating onto joint surfaces.
- C. Apply a second saturation coating, repeating first application. Comply with manufacturer's written instructions for limitations on drying time between coats and after rainstorm wetting of surfaces between coats. Consult manufacturer's technical representative if written instructions are not applicable to Project conditions.

3.4 FIELD QUALITY CONTROL

- A. Testing of Water-Repellent Material: Owner reserves the right to invoke the following procedure at any time and as often as Owner deems necessary during the period when water repellent is being applied:
 1. Owner will engage the services of a qualified testing agency to sample water-repellent material being used. Samples of material delivered to Project site will be taken, identified, sealed, and certified in presence of Contractor.
 2. Testing agency will perform tests for compliance of water-repellent material with product requirements.
 3. Owner may direct Contractor to stop applying water repellents if test results show material being used does not comply with product requirements. Contractor shall remove noncomplying material from Project site, pay for testing, and correct deficiency of surfaces treated with rejected materials, as approved by Architect.
- B. Coverage Test: In the presence of Architect, hose down a dry, repellent-treated surface to verify complete and uniform product application. A change in surface color will indicate incomplete application.

1. Notify Architect seven days in advance of the dates and times when surfaces will be tested.
2. Reapply water repellent until coverage test indicates complete coverage.

3.5 CLEANING

- A. Immediately clean water repellent from adjoining surfaces and surfaces soiled or damaged by water-repellent application as work progresses. Correct damage to work of other trades caused by water-repellent application, as approved by Architect.
- B. Comply with manufacturer's written cleaning instructions.

END OF SECTION 071900

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SECTION 07213

THERMAL BATT INSULATION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Thermal batt insulation for walls and ceilings between conditioned spaces and unconditioned environments.
- B. Thermal batt insulation for filling perimeter window and door shim spaces and crevices in wall construction between conditioned spaces and unconditioned environments.

1.2 PRODUCTS SUPPLIED BUT NOT INSTALLED UNDER THIS SECTION

- A. Supply thermal batt insulation to Section 05400 – Cold Formed Metal Framing for installation in boxed jamb, header and sill construction.

1.3 RELATED SECTIONS

- A. Section 05300 - Metal Deck: Structural steel roof decking to receive thermal insulation.
- B. Section 05400 - Cold Formed Metal Framing: Exterior wall framing.
- C. Section 07840 - Firestopping: Fire safing insulation.
- D. Section 09820 - Acoustical Insulation and Sealant: Acoustical insulation.
- E. Division 15 - Mechanical: Piping insulation; ductwork insulation.

1.4 REFERENCES

- A. ASTM C665 - Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing.
- B. ASTM E84 - Surface Burning Characteristics of Building Material.
- C. CBC - California Building Code, 2010 edition.

1.5 SYSTEM DESCRIPTION

- A. Thermal Batt Insulation: Fiberglass thermal batt insulation applied below ceiling decks and between framing members to provide thermal barrier at enclosure between conditioned spaces and non-conditioned spaces and between conditioned spaces and exterior environment.

1.6 DESIGN REQUIREMENTS

- A. Sustainable Design Requirements: Thermal batt insulation used in work of this section are intended to contribute to meeting requirements for recycled content outlined in LEED™-NC 2009 Credit MR4.

1.7 SUBMITTALS

- A. Product Data: Provide data on product characteristics, performance criteria and limitations.
- B. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- C. LEED Documentation:
 - 1. Submit letter or product data from manufacturer indicating recycled contents. Designate percentage of post-consumer and post-industrial recycled content.
 - 2. Submit hard copies of completed Online Documentation required for LEED™ MR Credit 4.

1.8 QUALITY ASSURANCE

- A. Insulation to meet Greenguard™ Environmental Institute "Certification Standards for Indoor Air Quality."

1.9 REGULATORY REQUIREMENTS

- A. Comply with requirements of CBC Section 719.2.

1.10 DELIVERY, STORAGE AND HANDLING

- A. Deliver products to site, store, handle and protect in accordance with manufacturer's instructions and recommendations.
- B. Protect insulation materials from physical damage and from deterioration by moisture, soiling, and other sources. Store inside and in dry location.
- C. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.

1.11 COORDINATION

- A. Coordinate installation of thermal batt insulation specified under this section with installation of acoustical batt insulation specified under other section.

PART 2 PRODUCTS

2.1 MATERIALS

A. Manufacturers:

1. Johns Manville International, Inc.: JM Formaldehyde-Free™ Thermal Fiber Glass Insulation.
2. Manufacturer Offering Acceptable Equivalent Product: Kanuf Insulation.
3. Substitutions: Under provisions of Division 1.

B. Batts:

1. For Vertical Applications Between Studs in Walls: ASTM C665, Type III, Class A; preformed glass fiber batts with foil faced reinforced Kraft paper facing.
 - a. Components:
 - 1) Insulation: Preformed glass fiber batts manufactured of long resilient glass fibers bonded with acrylic thermosetting binder; for maldehyde free; minimum 25 percent recycled glass content; flame spread of 25 or less per ASTM E84; smoke developed of 50 or less per ASTM E84.
 - 2) Facing: Foil-scrim-kraft type laminated to glass fiber batt; flame spread of 25 or less per ASTM E84; smoke developed of 50 or less per ASTM E84; 0.02 perm rating or less.
 - b. R-Value: R-19.
 - c. Thickness: 6-1/2 inches.
2. For Horizontal Applications Below Ceiling Decks: ASTM C665, Type I, unfaced preformed glass fiber batts manufactured of long resilient glass fibers bonded with acrylic thermosetting binder; formaldehyde free; minimum 25 percent recycled glass content; flame spread of 25 or less per ASTM E84; smoke developed of 50 or less per ASTM E84.
 - a. R-Value: R-19.
 - b. Thickness: 6-1/2 inches.

2.2 ACCESSORIES

- #### **A. Tape: Polyethylene or polyester; self-adhering type; mesh reinforced; minimum 2 inches wide.**

B. Insulation Fasteners:

1. Fasteners: Steel impale spindle and clip-on flat metal base; length to suit insulation thickness; capable of securely and rigidly fastening insulation in place.
2. Adhesive for Insulation Fasteners: Type recommended by insulation fastener manufacturer for type of insulation and substrate.

PART 3 EXECUTION

3.1 PREPARATION

- 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 mechanical and electrical services within walls and through ceiling have been installed and tested.
- C. Do not begin installation until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install batt insulation in accordance with manufacturer's instructions.
- B. Install batt insulation without gaps or voids.
- C. Trim insulation neatly to fit spaces. Use batts free of damage. Insulate miscellaneous gaps and voids. Do not compress insulation.
- D. Fit insulation tight in spaces and tight to exterior side of mechanical and electrical services within plane of insulation.
- E. Use batt widths and lengths that fill cavities formed by framing members. If more than 1 length is required to fill cavity, provide lengths that will produce snug fit between ends.
- F. Walls: Place batts in cavities formed by framing members with facing toward warm side of building spaces.
 1. Lap ends and side flanges of membrane between framing members.
 2. Tape stapling flanges to flanges of metal studs.
 3. Tape seal tears and cuts in membrane.
- G. Ceiling Decks: Install batts to bottom of structural decks; retain in place with insulation fasteners spaced in accordance with fastener manufacturer's recommendations.

SECTION 07250
WEATHER BARRIERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

- 1. Building paper.
- 2. Building wrap.
- 3. Flexible flashing.

- B. Related Requirements:

- 1. Section 09253 "Gypsum Sheathing" for sheathing joint and penetration treatment.

1.3 ACTION SUBMITTALS

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

- 1. For building wrap, include data on air and water-vapor permeance based on testing according to referenced standards.

1.4 INFORMATIONAL SUBMITTALS

- A. Evaluation Reports: For water-resistive barrier and flexible flashing, from ICC-ES.

PART 2 - PRODUCTS

2.1 WATER-RESISTIVE BARRIER

- A. Building Paper: ASTM D 226, Type 1 (No. 15 asphalt-saturated organic felt), unperforated.

- B. Building Paper: Water-vapor-permeable, asphalt-saturated kraft building paper.
1. Water vapor transmission not less than 35 g/sq. m x 24 hr per ASTM D 779.
 2. Water resistance not less than 1 hour per ASTM F 1249.
- C. Building Wrap: ASTM E 1677, Type I air barrier; with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, when tested according to ASTM E 84; UV stabilized; and acceptable to authorities having jurisdiction.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Dow Chemical Company (The); Styrofoam Weathermate plus Brand Housewrap.
 - b. DuPont (E. I. du Pont de Nemours and Company); Tyvek Stucco Wrap.
 - c. Ludlow Coated Products; Barricade Building Wrap.
 - d. Pactiv, Inc.; GreenGuard RainDrop.
 - e. Raven Industries Inc.; Fortress Pro Weather Protective Barrier.
 - f. Reemay, Inc.; Typar HouseWrap.
 2. Water-Vapor Permeance: Not less than 50 g through 1 sq. m of surface in 24 hours per ASTM E 96/E 96M, Desiccant Method (Procedure A).
 3. Air Permeance: Not more than 0.004 cfm/sq. ft. at 0.3-inch wg (0.02 L/s x sq. m at 75 Pa) when tested according to ASTM E 2178.
 4. Allowable UV Exposure Time: Not less than three months.
- D. Building-Wrap Tape: Pressure-sensitive plastic tape recommended by building-wrap manufacturer for sealing joints and penetrations in building wrap.

2.2 MISCELLANEOUS MATERIALS

- A. Flexible Flashing: Composite, self-adhesive, flashing product consisting of a pliable, butyl rubber or rubberized-asphalt compound, bonded to a high-density polyethylene film, aluminum foil, or spunbonded polyolefin to produce an overall thickness of not less than 0.030 inch (0.8 mm).
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. DuPont (E. I. du Pont de Nemours and Company); DuPont Flashing Tape.
 - b. Grace Construction Products, a unit of W. R. Grace & Co. - Conn.; Vycor Butyl Self Adhered Flashing.
 - c. Protecto Wrap Company; BT-25 XL.
 - d. Raven Industries Inc.; Fortress Flashshield.
 - e. Advanced Building Products Inc.; Wind-o-wrap.
 - f. Carlisle Coatings & Waterproofing; CCW-705-TWF Thru-Wall Flashing.
 - g. Fiberweb, Clark Hammerbeam Corp.; Aquaflash 500.
 - h. Fortifiber Building Systems Group; Fortiflash 40.

- i. Grace Construction Products, a unit of W. R. Grace & Co. - Conn.;
Vycor V40 Self-Adhered Flashing.
 - j. MFM Building Products Corp.; Window Wrap.
 - k. Polyguard Products, Inc.; Polyguard JT-30 Tape.
 - l. Sandell Manufacturing Co., Inc.; Presto-Seal.
- B. Primer for Flexible Flashing: Product recommended by manufacturer of flexible flashing for substrate.
- C. Nails and Staples: ASTM F 1667.

PART 3 - EXECUTION

3.1 WATER-RESISTIVE BARRIER INSTALLATION

- A. Cover exposed exterior surface of sheathing with water-resistive barrier securely fastened to framing immediately after sheathing is installed.
- B. Cover sheathing with water-resistive barrier as follows:
- 1. Cut back barrier 1/2 inch (13 mm) on each side of the break in supporting members at expansion- or control-joint locations.
 - 2. Apply barrier to cover vertical flashing with a minimum 4-inch (100-mm) overlap unless otherwise indicated.
- C. Building Paper: Apply horizontally with a 2-inch (50-mm) overlap and a 6-inch (150-mm) end lap; fasten to sheathing with galvanized staples or roofing nails.
- D. Building Wrap: Comply with manufacturer's written instructions.
- 1. Seal seams, edges, fasteners, and penetrations with tape.
 - 2. Extend into jambs of openings and seal corners with tape.

3.2 FLEXIBLE FLASHING INSTALLATION

- A. Apply flexible flashing where indicated to comply with manufacturer's written instructions.
- 1. Prime substrates as recommended by flashing manufacturer.
 - 2. Lap seams and junctures with other materials at least 4 inches (100 mm) except that at flashing flanges of other construction, laps need not exceed flange width.
 - 3. Lap flashing over water-resistive barrier at bottom and sides of openings.
 - 4. Lap water-resistive barrier over flashing at heads of openings.
 - 5. After flashing has been applied, roll surfaces with a hard rubber or metal roller to ensure that flashing is completely adhered to substrates.

END OF SECTION 072500

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SECTION 07540

THERMOPLASTIC MEMBRANE ROOFING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Fully adhered thermoplastic single ply membrane roofing.
- B. Roof board.
- C. Associated membrane-clad sheet metal and membrane flashings.
- D. Sheet metal flashing incorporated into roofing membrane.
- E. Walkway pads.
- F. Nailers.
- G. Associated fasteners, adhesives and sealants.
- H. Clearing and testing roof drains.

1.2 RELATED SECTIONS

- A. Section 05300 - Metal Decking: Metal roof decking.
- B. Section 06100 – Rough Carpentry: Wood roof curbs and roofed-in sleepers.
- C. Section 07620 - Sheet Metal Flashings and Trim: Sheet metal flashings other than specified in this section.
- D. Section 07650 – Flexible Flashing: Self-sealing/self-adhering rubberized asphalt and butyl membrane flashing.

1.3 REFERENCES

- A. ASTM International:
 - 1. ASTM A653 – Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process.
 - 2. ASTM C473 - Methods for Physical testing of Gypsum Board Products and Gypsum lath.
 - 3. ASTM C518 - Test Method for Steady-State Heat Flux Measurements and Thermal Transmission properties by Means of the Heat Flow Meter Apparatus.

4. ASTM C1177 - Specification for Glass Mat Gypsum Substrate for Use as Sheathing.
 5. ASTM D570 - Test Method for Water Absorption of Plastics.
 6. ASTM D638 - Test Method for Tensile Properties of Plastics.
 7. ASTM D1004 - Test Method for Initial Tear Resistance of Plastic Film and Sheet-
ing.
 8. ASTM D1204 - Test Method for Linear Dimensional Changes of Non-Rigid
Thermoplastic Sheet or Film at Elevated Temperature.
 9. ASTM D2126 - Test Method for Response of Rigid Cellular Plastics to Thermal
and Humid Aging.
 10. ASTM D2136 - Methods of Testing Coated Fabrics – Low Temperature Bend
Test.
 11. ASTM D2565 - Practice for Xenon Arc-Type Exposure of Plastics Intended for
Outdoor Applications.
 12. ASTM D3273 – Test Method for Resistance of Growth to Mold on the Surface of
Interior Coatings in an Environmental Chamber.
 13. ASTM D4434 - Specification for Poly(Vinyl/Chloride) Sheet Roofing.
 14. ASTM D5602 - Test Method for Static Puncture Resistance of Roofing Mem-
brane Specimens.
 15. ASTM D5635 - Test Method for Dynamic Puncture Resistance of Roofing Mem-
brane Specimens.
 16. ASTM E84 - Surface Burning Characteristics of Building Materials.
 17. ASTM E96 - Test Methods for Water Vapor Transmission of Materials.
 18. ASTM E661 - Test Method for Performance of Wood and Wood Based Floor and
Roof Sheathing Under Concentrated Static and Impact Loads.
- B. CBC - California Building Code, 2010 edition.
- C. FM 4470 - Approval Standard for Class 1 Roof Coverings.
- D. UL 790 - Tests for Fire Resistance of Roof Covering Materials.
- E. WCLIB - West Coast Lumber Inspection Bureau "Standard Grading Rules."

1.4 SYSTEM DESCRIPTION

- A. Membrane System: Single ply feltback polyvinyl chloride thermoplastic membrane sheet roofing with heat welded seams fully adhered to gypsum roof board mechanically fastened to metal roof deck. Metal roof decking specified under separate sections.
- B. Flashing Systems: Membrane flashings, sheet metal flashings and membrane-clad metal flashings.

1.5 DESIGN REQUIREMENTS

- A. Sustainable Design Requirements: Roofing materials used in work of this section are intended to contribute to meeting requirements for reduction of roof heat island effect outlined in LEED™-NC 2009 Credit SS7.2.

1.6 PERFORMANCE REQUIREMENTS

- A. Fire Hazard Classification: UL 790, Class A.
- B. Roof Assembly Classification: FM 4470, Class 1 Construction; Class 1-75 wind uplift in accordance with FM Construction Bulletin I-28.

1.7 SUBMITTALS

- A. Shop Drawings: Submit shop drawings to manufacturer for review and approval prior to submitting to Architect.
 - 1. Roofing: Indicate membrane layout with seams; include roof outline, size, locations, dimensions, elevations, penetrations and details.
 - 2. Membrane-Clad Metal and Sheet Metal Flashings: Indicate material profiles, jointing patterns, jointing details, fastening methods, and installation details.
- B. Product Data: Submit manufacturer's literature completely describing each component. Also include:
 - 1. Specifications including physical properties.
 - 2. Samples of manufacturer's and installer's warranties.
- C. Samples:
 - 1. Roof Membrane: Submit samples, minimum 6 x 6 inches in size, of membrane illustrating construction and color.
 - 2. Gypsum Roof Board: Submit samples, minimum 6 x 6 inches in size, of gypsum roof board.
- D. Manufacturer's Application Instructions: Submit latest edition of roof system manufac-

turer's specifications and application instructions.

E. Manufacturers' Certifications:

1. Submit letters from primary roofing manufacturer certifying:
 - a. That materials supplied comply with requirements of identified ASTM and industry standards or practices and requirements of this specification including membrane and polymer thicknesses.
 - b. That membrane is within 2 mils of specified membrane thickness.
 - c. Number of years manufacturer has directly manufactured proposed primary roofing system under trade name and trademarks proposed.
 - d. Number of years membrane has been consistently produced with same formulation.
 - e. That applicator has experience in applying manufacturer's roofing and is approved to install primary roofing products.
 - f. That proposed application complies with manufacturer's requirements in order to qualify project for specified warranty.
2. Submit letters from insulation manufacturer certifying:
 - a. That materials supplied comply with requirements of identified ASTM and industry standards or practices and requirements of this specification.
 - b. Written approval by insulation manufacturer for use and performance of product in proposed system.

F. Applicator's Certifications: Submit letter certifying:

1. That applicator has reviewed these Specifications, Drawings, related addenda and related modifications to date and that these documents are workable and do not conflict with manufacturer's requirements for specified warranty.
2. That Specifications, Drawings, related addenda and related modifications to date are satisfactory to applicator and manufacturer in their entirety.
3. That system specified meets identified code and insurance requirements as required by this specification.

G. Certificate of Completion: Upon completion and prior to final acceptance, provide certificate signed by Contractor and Applicator, stating that sheet membrane roofing systems comply with Contract Documents, and that installation methods comply with manufacturer's printed instructions.

H. LEED Documentation:

1. Submit letter or product data from manufacturer indicating roof membrane ply has Solar Reflective Index equal to or greater than 78.
2. Submit hard copies of completed Online Documentation required for LEED™ SS Credit 7.2.

1.8 OPERATION AND MAINTENANCE DATA

- A. Maintenance Data: Submit manufacturer's printed recommendations completely describing recommended maintenance procedures for specified roof system including inspection frequencies, penetration addition policies, temporary repairs, and leak call procedures.

1.9 QUALITY ASSURANCE

- A. Comply with requirements and recommendations contained in latest edition of NRCA Handbook of Accepted Roofing Knowledge (HARK).
- B. Comply with the latest written application instructions of manufacturer of primary roofing products.
1. In event these specifications deviate from manufacturer's latest specifications and application instructions, these specifications shall prevail except where they conflict with manufacturer's requirements for specified warranty.
 2. In event these specifications conflict with manufacturer's requirements for specified warranty, manufacturer's specifications and application instructions shall prevail.
 3. There shall be no deviation made from these specification or final reviewed shop drawings without prior written authorization by Owner, Architect and manufacturer.
- C. Provide primary roofing products supplied by single manufacturer. Provide secondary or accessory products which are acceptable to manufacturer of primary roofing products.
- D. Membrane to have no formulation changes in last 15 years as certified by manufacturer.
- E. Membrane to have minimum 22 mils waterproofing polymers above reinforcement as documented by third party source.
- F. Attend job meetings and furnish competent, full-time supervision, experienced roof mechanics, materials, tools and equipment necessary to complete, in acceptable manner, roof installation, in accordance with these specifications.

- G. Ensure primary roofing materials manufacturer provides direct trained company personnel to attend job meetings, perform periodic inspections, and conduct final inspection upon completion of work of this section.
- H. Provide roofing foreman with copy of these specifications and maintain copy on job site for duration of work.

1.10 QUALIFICATIONS

- A. Manufacturer: Company successfully producing specified types of primary roofing products for not less than 20 years.
- B. Applicator: Company successfully installing same or similar roofing materials for not less than 5 years, certified in writing by roofing materials manufacturer to install primary products and employing personnel trained and authorized by manufacturer.

1.11 REGULATORY REQUIREMENTS

- A. Conform to requirements of CBC Chapter 15.
 - 1. Wind Resistance Classification: Provide roofing system complying with CBC Chapter 15, Section 1504.1.
 - 2. Fire Hazard Classification: Provide roofing system complying with CBC Chapter 15, Section 1505.1 and Table 1505.1.
 - 3. Identification of Roofing Materials: Deliver materials in packages identified in accordance with requirements of CBC Chapter 15, Section 1506.4.
- B. Comply with requirements of California Energy Code Section 118.

1.12 CONFERENCES

- A. Pre-installation Conference:
 - 1. Convene preinstallation conference minimum one week prior to commencing work of this section.
 - 2. Attendance: Contractor, roofing applicator, roofing supplier, roofing manufacturer's technical representative, Construction Manager, Project Inspector and Architect.
 - 3. Agenda: Review Construction Documents, schedule of work, existing conditions, details of work, installation procedures and coordination with related work. Conduct walkover inspection of substrate.
- B. Post Installation Conference:
 - 1. Arrange conference at completion of project to be attended by parties that were

present at preinstallation conference. Notify roofing manufacturer by means of manufacturer's printed Notification of Completion form to schedule post installation conference and final inspection.

2. Attendance: Contractor, roofing applicator, roofing supplier, roofing manufacturer's technical representative, Construction Manager, Project Inspector and Architect.
3. Agenda:
 - a. Conduct walkover inspection of completed roof. Identify items to be completed and problems which may impede issuance of warranty.
 - b. Verify that roof drains and rain water leaders are working properly.
 - c. Roofing applicator and roofing manufacturer's technical representative shall prepare punch list of items required to be completed and corrected. Roofing applicator and roofing manufacturer's representative to complete, sign and mail punch list form to manufacturer's headquarters.

1.13 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to site, store, handle and protect in accordance with manufacturer's instructions and recommendations.
- B. Deliver materials in manufacturer's unopened original containers or wrappings bearing seals and approvals, dry, undamaged.
- C. Deliver materials in sufficient quantity to allow continuity of work.
- D. Distribute materials placed on roof to preclude overloading deck and building structure.
- E. Protect materials against damage from construction traffic and operations.
- F. Store materials out of direct exposure to elements in weather protected environment, clear of ground and moisture.
 1. Store roofing membrane lying down on pallets and fully protected from the weather with clean canvas tarpaulins; unvented polyethylene tarpaulins are not acceptable
 2. Store flammable materials in cool dry area away from sparks and open flames; follow precautions outlined on containers or supplied by material manufacturer/supplier.
 3. Store adhesives at temperatures between 40 and 80 degrees F.
- G. Handle materials in manner to preclude damage or contamination with moisture or foreign matter.

1. Place materials on pallets and fully protect from moisture.
 2. Handle rolled goods to prevent damage to edges or ends.
 3. Handle membrane to avoid over bending, tearing, and other damage during transportation and installation.
- H. Select and operate material handling equipment so as not to damage existing construction and applied roofing. Do not operate or situate material handling equipment in locations that will hinder smooth flow of vehicular or pedestrian traffic.
- I. Reject compressed rolls and materials exhibition signs of damage, prolonged storage, and moisture absorption.
1. Remove rejected materials from site on daily basis or store off roof separate from other materials.
 2. Provide undamaged materials to replace rejected materials at not additional cost to Owner.

1.14 JOB CONDITIONS

- A. Membrane materials may be installed under certain adverse weather conditions but only after consultation with manufacturer, as installation time and system integrity may be affected.
- B. Install only as much of roofing as can be made weather-tight each day, including flashing and detail work. Clean and heat weld seams before leaving job site that day.
- C. Schedule and execute work without exposing interior building areas to effects of inclement weather. Protect existing building and its contents.
- D. Ensure surfaces to receive insulation, membrane or flashings are dry. Should surface moisture occur, provide necessary equipment to dry surface prior to application.
- E. Secure new and temporary construction, including equipment and accessories, in manner to preclude wind blow-off and subsequent roof or equipment damage.
- F. Install uninterrupted waterstops at end of each day's work; remove completely before proceeding with next day's work. Waterstops shall not emit dangerous or unsafe fumes and shall not remain in contact with finished roof as installation progresses. Contaminated membrane shall be replaced at no cost to Owner.
- G. Certain membranes are incompatible with asphalt, coal tar, heavy oils, roofing cements, creosote and some preservative materials. Ensure such materials do not remain in contact with membranes. Consult manufacturer regarding compatibility, precautions and recommendations.

- H. Arrange work sequence to avoid use of newly constructed roofing as walking surface or for equipment movement and storage.
 - 1. Where such access is absolutely required, provide necessary protection and barriers to segregate work area and to prevent damage to adjacent areas.
 - 2. Provide substantial protection layer consisting of plywood over felt or plywood over insulation board for new and existing roof areas that receive rooftop traffic during construction.
- I. Prior to and during application, remove dirt, debris and dust from surfaces either by vacuuming, sweeping, blowing with compressed air and/or similar methods.
- J. Immediately remove roofing waste material (i.e., scrap roof membrane, empty cans of adhesive) from site and properly transported to legal dumping area authorized to receive such material.
- K. Report rooftop contamination that is anticipated or that is occurring to manufacturer to determine corrective steps to be taken.
- L. Verify that roof drain lines are functioning correctly (not clogged or blocked) before starting work. Report blockages in writing (letter copy to manufacturer) to Construction Manager for corrective action prior to installation of roof system.
- M. Immediately stop work if unusual or concealed condition is discovered and immediately notify Owner of such condition in writing for correction at Owner's expense (letter copy to manufacturer).
- N. Complete site cleanup, including both interior and exterior building areas that have been affected by construction, to Owner's satisfaction.
- O. Repair landscaped areas damaged by construction activities at no cost to Owner.
- P. Conduct fastener pullout tests in accordance with latest revision of SPRI/ANSI Fastener Pullout Standard to help verify condition of deck/substrate and to confirm expected pullout values.
- Q. Do not install adhered membrane under following conditions without consulting manufacturer's technical department for precautionary steps:
 - 1. Roof assembly permits interior air to pressurize membrane underside.
 - 2. Exterior wall has 10 percent or more of surface area comprised of opening doors or windows.
 - 3. Wall/deck intersection permits air entry into wall flashing area.
- R. Take precautions when using adhesives at or near rooftop vents and air intakes to prevent adhesive odors from entering building.

1. Coordinate operation of vents and air intakes in manner to avoid intake of adhesive odor while ventilating building.

2. Keep lids on unused cans at all times.

S. Wear protective gear when using solvents and adhesives and as required by job conditions.

1.15 COORDINATION

A. Coordinate work with involved trades to ensure required sequencing of work and to provide weather protection of work.

B. Schedule construction operations to prevent construction traffic on newly installed roofing.

C. Coordinate and supervise installation of roof mounted plumbing, mechanical and electrical equipment; ensure equipment is properly set and can be properly flashed into roofing.

D. Coordinate and supervise installation of sheet metal work in contact with, but not incorporated into, roofing.

E. Coordinate and supervise installation of flexible membrane flashing in contact with roofing. Ensure roofing is separated from incompatible materials.

1.16 WARRANTIES

A. Manufacturer's Warranty: Upon successful completion of project and after post installation procedures have been completed, furnish Owner with manufacturer's 20 Year System Warranty.

1. System Warranty shall provide for roof membrane and accessories that comprise roof system, and contractor labor.

2. Warranty shall be Non-Prorated provide for No Dollar Limit (NDL) and shall not exclude ponding water. No time limited shall be assigned for such ponding water during warranty period.

3. Warranty covers only products purchased from manufacturer.

B. Applicator's Warranty: In addition, provide applicator's guarantee for completed work performed under this section to remain watertight and otherwise free from defects for period of 5 years from date of acceptance by Owner.

1. Repair or cause to be repaired work related to roofing, flashing, or metal found to be defective or otherwise not in accordance with Contract Documents.

2. Repair or cause to be repaired damaged roofing materials and leaks resulting from improper workmanship and faulty materials as reported during terms of guarantee.
 3. Repair or cause to be repaired building materials and finishes damaged by leaks due to improper workmanship and faulty materials as reported during terms of guarantee
 4. Bear costs by Owner, including attorney's fees, to enforce compliance with obligations of guarantee.
 5. Applicator's warranty obligation shall run directly to Owner; copy shall be sent to manufacturer.
- C. Owner Responsibility: Owner to notify both manufacturer and applicator of leaks as they occur during periods when both warranties are in effect.

PART 2 PRODUCTS

2.1 MEMBRANE MATERIALS

A. Manufacturers:

1. Sarnafil, Inc.: Sarnafil® G410 Feltback.
2. Manufacturer Offering Acceptable Equivalent Product: Johns Manville.
3. Substitutions: Under provisions of Division 1.

- B. Roofing Membrane: ASTM D4434, Type II, Grade I; thermoplastic membrane with fiberglass reinforcement and factory applied 9 ounce geotextile felt backing; integral factory-applied lacquer coating to repel dirt and sustain reflectivity; 60 mil thickness; "white" color with initial reflectivity of 0.83, initial emissivity of 0.92 and Solar Reflective Index greater than 104; Sarnafil® G410-15 Feltback having following typical properties:

Property	Test Method	Result
Tensile Strength	ASTM D638	1600 psi
Elongation at Break	ASTM D638	270% M.D. 250% C.M.D.
Seam Strength	ASTM D638	80% of Tensile Strength
Tensile Strength After Heat Aging per ASTM D3045	ASTM D638	95% of original

Elongation After Heat Aging per ASTM D3045	ASTM D638	90% of original
Tearing Resistance	ASTM D1004	14 lbs/ft
Low Temperature Bend	ASTM D2136	Passes
Accelerated Weathering	ASTM D2565	No cracking, negligible discoloration and no crazing after 10,000 hours
Linear Dimensional Change	ASTM D1204	0.02%
Weight Change After Immersion in Water	ASTM D570	2.5%
Static Puncture Resistance	ASTM D5602	Passes
Dynamic Puncture Resistance	ASTM D5635	Passes

2.2 FLASHING MATERIALS

A. Wall and Curb Flashing:

1. Membrane Type: ASTM D4434, Type II, Grade I; thermoplastic membrane with fiberglass reinforcement; lacquer coating; 60 mils thick; "white" color; Sarnafil G-410 Membrane.
2. Membrane-Clad Metal Type: PVC coated heat-weldable sheet metal; 25 gauge G90 galvanized sheet metal with 20 mil unsupported poly-vinyl chloride membrane laminated 1 side; capable of being formed into variety of shapes and profiles; Sarnafil Sarnaclad.
3. Sheet Metal Type: ASTM A653; galvanized sheet steel; G90 coating designation; minimum 24 gauge core steel.

B. Perimeter Edge Flashing: PVC coated heat-weldable sheet metal; 25 gauge G90 galvanized sheet metal with 20 mil unsupported poly-vinyl chloride membrane laminated 1 side; capable of being formed into variety of shapes and profiles; Sarnafil Sarnaclad.

C. Miscellaneous Flashing:

1. Expansion Joint Covers: Prefabricated from membrane; designed for securing to wall or horizontal surfaces to span and accommodate movement of new and existing expansion gaps from 1 inch to 4-1/2 inches across; Sarnafil Sarnafash.
2. Reglets: Extruded 6063-T5 aluminum; 0.10 to 0.12 inch wall thickness; 2-1/4 inch deep profile; 10 foot lengths; prefabricated inside and outside corners for

wall intersections; Sarnafil Sarnareglet.

3. Stack Flashings: Prefabricated vent pipe flashing made from 48 mil G410 membrane; Sarnafil Sarnastack.
4. Obstructed Penetration Flashing: Prefabricated flashing made from 48 mil G410 membrane; configured to flash obstructed conduit and pipe where obstruction prevent use of standard stack flashings; sized to fit penetration; Sarnafil Open Post Flashing.
5. T-Joint Patches: Circular patch of 48 mil polyester reinforced thermoplastic membrane; color to match roofing membrane; Sarnafil Sarnacircles G.
6. Flashing Corners: Preformed outside and inside flashing corners of 60 mil membrane; color to match roofing membrane; Sarnafil Sarnacorners Universal.

D. Flashing Accessories:

1. Sealant: 1-part moisture-curing polyurethane sealant; Sarnafil Multi-Purpose Sealant.
2. Adhesive: Solvent-based reactivating-type adhesive used to attach membrane to flashing substrate; StaBond Adhesive.
3. Leveling/Separation Felt: Non-woven polyester or polypropylene mat type recommended by roof membrane manufacturer as cushion layer behind flashing membrane when flashing substrates are rough-surfaced or incompatible with flashing membrane.
4. Hose Clamps: Stainless steel draw bands; worm drive type.
5. Coverstrips: 8 inch wide precut flashing strips of roofing membrane for covering plates and bars.

2.3 ROOF BOARD MATERIALS

- A. Gypsum Roof Board: ASTM C1177; moisture-resistant treated siliconized gypsum core with glass mat facings embedded front and back; 4'-0" x 8'-0" sheets; 1/2 inch thick; G-P Gypsum Corporation DensDeck® Roof Board or equal product substituted under provisions of Division 1.

Property	Test Method	Result
Flexural Strength Parallel	ASTM C1177	80 lbs minimum
Flute Spanability	ASTM E661	5 inches
Permeance	ASTM C355	35 perms
R-Value	ASTM C518	0.56

Coefficient of Thermal Expansion		8.5×10^{-6} in/in/°F
Linear Variation with Change in Moisture		6.25×10^{-6} in/in%RH
Water Absorption	ASTM C473	10.0% maximum
Compressive Strength		500 psi minimum
Surface Water Absorption	ASTM C473	<2.5 grams
Flame Spread	ASTM E84	0
Smoke Developed	ASTM E84	0
Mold Resistance	ASTM D3273	10

2.4 ATTACHMENT COMPONENTS

A. Roof Board Fasteners:

1. Plates: 3 inch round, 26 gauge stamping of SAE 1010 steel with AZ 55 Galvalume coating; Sarnaplate.
2. Fasteners: #12 corrosion-resistant threaded fasteners used with conjunction with appropriate plates; modified buttress thread; shank diameter of approximately 0.168 inch; thread diameter of approximately 0.214 inch; driving head diameter of approximately 0.435 inch with #3 Phillips recess for positive engagement; Sarnafastener #12.

B. Membrane Adhesive: Water-based adhesive recommended by roofing manufacturer to attach membrane to horizontal or near-horizontal substrates; Sarnacol 2121 Adhesive.

C. Membrane Fasteners:

1. Plates: High strength linear plate recommended by manufacturer to attach membrane to concrete roof decks, 18 gauge corrosion resistant steel; 1-1/2 x 3-3/4 inch; Sarnadisc XPN.
2. Fasteners: #14 corrosion-resistant threaded fastener used in conjunction with appropriate plate to attach insulation boards or with appropriate discs and bars to attach membrane; shank diameter of 0.190 inch; thread diameter of 0.245 inch; #3 Phillips drive head with 0.435 inch diameter; Sarnafil Sarnafastener-HD.

D. Stops: Extruded aluminum low profile bar used in conjunction with appropriate fasteners to attach to roof deck, to walls/curbs at terminations, penetrations and at incline changes of substrate; 1 inch wide x 1/8 inch thick flat aluminum bar with predrilled

holes every 6 inches on center; Sarnafil Sarnastop.

- E. Bars: FM-approved heavy-duty 14 gauge roll-formed galvanized or stainless steel bar used to attach membrane to roof decks; pre-punched with holes every 1 inch on center to allow various fastener spacing options; Sarnafil Sarnabar.
- F. Cords: 5/32 inch diameter flexible thermoplastic extrusion welded to top surface of membrane and against side of bar for holding membrane in position; red color; Sarnafil Sarnacord.

2.5 MISCELLANEOUS ACCESSORIES

- A. Aluminum Tape: 2 inch wide pressure-sensitive aluminum foil tape; used as separation layer between small areas of asphalt contamination and membrane and as bond-breaker under coverstrip at PVC clad sheet metal component joints.
- B. Sealing Tape Strip: Compressible foam with pressure-sensitive adhesive on one side. Used with metal flashings as a preventive measure against air and wind blown moisture entry.
- C. Multi-Purpose Tape: High performance sealant tape with used with metal flashings as preventive measure against air and wind blown moisture entry.
- D. Hot Air Welding Machines:
 - 1. Membrane Field: 220 volt self-propelled hot-air welding machine used to seal long lengths of the membrane seams; Sarnafil Sarnamatic 641mc.
 - 2. Membrane Perimeter: 120 volt self-propelled hot-air welding machine used to seal long-lengths of membrane seams along perimeter details; Perimat Welder.
- E. Solvent: High quality solvent cleaner for general cleaning of membrane surface and daily cleaning of seam areas prior to hot-air welding in tear off or dirty conditions or if membrane is not welded the same day it is unrolled; Sarnafil Sarnasolv.
- F. Wood Nailers: Meeting recommendations of FM Loss Prevention Data Sheet 1-49; WCLIB No. 2 Grade Douglas fir lumber; surfaced four sides; kiln dried to maximum 19 percent moisture content after preservative treatment; preservative salt treated to retain 0.25 lbs dry salt/ cu ft wood with Wolman Salts or equal product compatible with roofing membrane; minimum 6 inches wide; thickness to match thickness of insulation at point of installation.

2.6 MISCELLANEOUS FASTENERS AND ANCHORS

- A. Fasteners, anchors, nails, straps, bars and other attachment devices shall be post-galvanized steel, aluminum or stainless steel.
- B. Mixing metal types and methods of contact shall be assembled in manner to avoid galvanic corrosion.

- C. Fasteners for attachment of metal to masonry shall be expansion type fasteners with stainless steel pins.
- D. Concrete fasteners and anchors shall have minimum embedment of 1-1/4 inch and shall be approved for such use by fastener manufacturer.
- E. Miscellaneous wood fasteners and anchors used for flashings shall have minimum embedment of 1 inch and shall be approved for such use by fastener manufacturer.

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 manufacturers' instructions and recommendations.
- B. Verify that substrates are acceptable for product installation in accordance with manufacturer's instructions and recommendations.
- C. Verify that installed work of other trades meets following conditions:
 - 1. Roof drains and scuppers have been properly installed.
 - 2. Roof openings, curbs, nailers, equipment supports, pipe, sleeves, ducts, vents and other roof penetrations are properly secured and prepared to receive new roofing materials.
 - 3. Surfaces are smooth and free of dirt, debris and incompatible materials.
 - 4. Roof surfaces shall be free of water, ice and snow.
- D. Verify that roof deck and roof construction are structurally sound and provide proper support to roofing system.
 - 1. Verify that roof deck has been secured to structural framing according to local building code and in manner to resist anticipated wind loads in that location.
 - 2. Verify that deck surfaces are structurally sound and free from corrosion.
 - 3. Verify that steel roof decking is minimum 22 gauge grade E and conform and is installed to meet latest revision of FM's Loss Prevention Data Sheet 1-28 and local code's current requirements.
- E. Examine substrate for defects such as excessive surface roughness, contamination, structural inadequacy, and other conditions that will adversely affect quality of work.

1. Verify that substrate surfaces are smooth, free of depressions, waves, flaws, sharp edges, projections and loose and foreign material.
 2. Verify that substrate surfaces are free of water, ice and snow.
 3. Verify that substrate surfaces are clean and free of laitance, oil, grease, curing compounds and other materials that could impair adhesive bond.
- F. Do not begin installation until unsatisfactory conditions have been corrected.

3.2 PROTECTION

- A. Protect other trades and general public from injury and debris from roofing work.
1. Provide fencing, barricades and enclosures to prevent access to areas of roof construction, materials, tools and equipment.
 2. Relocate as work progresses.
- B. Protect surfaces including vehicles parked adjacent to buildings, air intakes and exhausts on buildings, roof mounted mechanical equipment, roof drains, access hatches, windows, skylights and other items or personnel downwind from adhesive application from over-spray of adhesive.
1. Shut down air intake systems with air intakes on roof and seal roof mounted static air vents; block other intakes to prevent fumes from being taken into ventilation system.
 2. Resume air circulation only after roof has been closed and fumes have dissipated.
 3. Ensure building is well aired prior to occupancy.
- C. Where work must continue over finished roof membrane, protect membrane.

3.3 PREPARATION

- A. Prepare substrates as required to provide dry, clean, smooth substrate for roofing application.
- B. Remove sharp ridges and other projections above surface.
- C. Sweep or vacuum substrate surfaces to remove foreign substances prior to commencing roofing.

3.4 WOOD NAILER INSTALLATION

- A. Install continuous wood nailers at perimeter of roof and around roof projections and

penetrations as indicated on Drawings.

- B. Provide nailers of thickness required to match substrate or insulation height to allow smooth transition.
- C. Anchor nailers to meet roofing manufacturer's requirements and that of FM Loss prevention Data Sheet 1-4; ensure anchors resist minimum force of 300 pounds per linear foot in every direction.
 - 1. Individual nailer lengths shall not be less than 3 feet.
 - 2. Space nailer fasteners 12 inches oc; space 16 inches oc if necessary to match structural framing.
 - 3. Stagger nailer fasteners 1/3 nailer width.
 - 4. Install nailer fasteners within 6 inches of each end; install 2 fasteners at each end of nailer lengths.

3.5 ROOF BOARD INSTALLATION

- A. Install gypsum roof board in accordance with manufacturers' instructions and recommendations.
- B. Do not install gypsum roof board until other trades have completed work that requires traversing decks on foot and with equipment.
- C. Do not install gypsum roof board over wet, damp, dirty, contaminated or uneven substrates
- D. Install only as much gypsum roof board as can be covered with roofing membrane and completed before end of days work and before onset of inclement weather.
- E. Cut gypsum roof board to neatly fit around penetrations and projections.
- F. Mechanically fasten gypsum roof board to roof deck with approved fasteners and plates at rates and patterns recommended by manufacturer and meeting FM requirements.
 - 1. Use quantity of fasteners and plates and locate fasteners and plates so that gypsum roof board rest evenly on substrate so that there are no significant and avoidable air spaces between boards and substrate.
 - 2. Install each board tightly against adjacent boards on each side.
 - 3. Install fasteners consistently in accordance with manufacturer's recommendations. Ensure fasteners have minimum penetration into metal deck recommended by fastener and membrane manufacturer.
 - 4. Use fastener tools with depth locator and torque-limiting attachment as recom-

mended or supplied by fastener manufacturer to ensure proper installation.

3.6 MEMBRANE INSTALLATION

- A. Install roofing in accordance with specifications in latest edition of roofing manufacturer's application guide and these specifications.
 - 1. Characteristics of finished roof, including adhesive quantities, are to be within tolerances established by roofing materials manufacturer.
 - 2. Work is to be completed in such manner that no water leakage occurs into building or roof system.
 - 3. Overall appearance of completed work is to be esthetically pleasing to satisfaction of Architect and Owner. Make necessary preparations, utilize recommended application techniques, apply specified materials and exercise care in ensuring final application is acceptable.
- B. Examine surface of insulation and substrate prior to installation of membrane.
 - 1. Ensure substrate is clean, dry, free from debris and smooth with no surface roughness or contamination.
 - 2. Remove and replace broken, delaminated, wet or damaged insulation and roof boards.
- C. Apply roof membrane immediately following application of gypsum roof board as continuous operation.
- D. Apply membrane so that overlaps are shingles with flow of water wherever possible.
- E. Separate membrane from flexible flashing and other incompatible materials with aluminum tape.
- F. Adhere membrane to gypsum roof board with water-based adhesive.
 - 1. Apply field adhesive over properly installed and prepared substrate surface at rates recommended by manufacture for specific substrates. Do not apply adhesive to back of membrane.
 - a. Pour adhesive out of pail and spread using notched 1/4 x 1/4 x 1/4 inch rubber squeegees.
 - b. Do not allow adhesive to skin-over or surface dry prior to installation of membrane.
 - c. Do not use water-based adhesive if temperatures below 40° F are expected during application or subsequent drying time.

2. Immediately unroll roof membrane into wet adhesive.
 - a. Overlap adjacent rolls by 3 inches. Repeat process throughout roof area.
 - b. Immediately after application into adhesive, press each roll firmly in place with water-filled foam-covered lawn roller by frequent rolling in 2 directions.

G. Weld coverstrips at seams that do not have factory selvage edge.

H. Count number of pails of adhesive used per area per day to verify conformance to specified adhesive rate.

I. Ensure no adhesive is applied in seam areas.

3.7 HOT-AIR WELDING OF SEAM OVERLAPS

A. Hot air weld seams. Except where indicated and detailed otherwise, overlap seams to be machine welded 3 inches and overlap seams to be hand welded 4 inches.

B. Tack welding of full or half-width rolls of membrane for purposes of temporary restraint is not permitted.

C. Weld using equipment provided by or approved by membrane manufacturer and employing mechanics who have successfully completed training course provided by membrane manufacturer's Technical Representative prior to welding.

D. Ensure membrane to be welded is clean and dry.

E. Hand Welding:

1. Allow hot-air welding equipment to warm up for at least 1 minute prior to welding.

2. Complete hand-welded seams in 2 stages.

- a. Weld back edge of seam with narrow but continuous weld to prevent loss of hot air during final welding.

- b. Insert nozzle into seam at 45 degree angle to edge of membrane. Once proper welding temperature has been reached and membrane begins to "flow," position hand roller perpendicular to nozzle and press lightly.

- 1) For straight seams, use 1-1/2 inch wide nozzle.

- 2) For corners and compound connections, use 3/4 inch wide nozzle.

F. Machine Welding:

1. Machine weld seams using automatic welding equipment in accordance with manufacturer's instructions and following local codes pertaining to electric

supply, grounding and over current protection.

- a. Provide dedicated circuit house power or dedicated portable generator.
 - b. Ensure not other equipment is operated of circuit or generator.
2. Use metal tracks over deck membrane and under machine welder to minimize or eliminate wrinkles.

G. Quality Control of Welded Seams:

1. Make daily on-site evaluations of welded seams to locations as directed by Architect or manufacturer's representative.
 - a. Check each welded seam for continuity using rounded screwdriver.
 - b. Visible evidence that welding is proceeding correctly is smoke during welding operation, shiny membrane surfaces, and uninterrupted flow of dark grey material from underside of top membrane.
2. Take 1 inch wide cross-section samples of welded seams at least 3 times per day.
 - a. Correctly installed welds display failure from shearing of membrane prior to separation of weld.
 - b. Patch each test cut at no extra cost to Owner.

3.8 MEMBRANE FLASHING INSTALLATION

- A. Install membrane flashings in accordance with manufacturer's requirements and recommendations and the specifications shall be followed. Verify that material submittals shall have been accepted by manufacturer prior to installation.
- B. Install membrane flashings concurrently with roof membrane as job progresses.
 1. Temporary flashings will be allowed only with prior written authorization of Architect and manufacturer.
 2. Authorization when issued will only be for specific locations on specific dates.
- C. Separate membrane flashing from flexible flashing and other incompatible materials with aluminum tape.
- D. If water enters under newly completed roofing, remove roofing assembly in affected area and replaced at no cost to Owner.
- E. Adhere membrane flashings to compatible, dry, smooth, and solvent-resistant surfaces. Use caution to ensure adhesive fumes are not drawn into the building.

- F. Apply adhesive for membrane flashings over properly installed and prepared substrate in accordance with manufacturer's instructions and recommendations.
 - 1. Apply adhesive in smooth, even coats with no gaps, globs or similar inconsistencies.
 - 2. Do not apply adhesive in seam areas that are to be welded.
- G. Apply flashing only to area which can be completely covered in same day's operations.
 - 1. Firmly press bonded sheet in place with hand roller.
 - 2. Apply membrane flashing in same manner throughout overlapping edges of membrane panels as required by welding techniques.
- H. Install stops, bars and cords according to detail on Drawings with approved fasteners into structural deck at base of parapets, walls and curbs. Provide stops at base of tapered edge strips and at transitions, peaks, and valleys according to detail on Drawings.
- I. Extend flashings minimum 8 inches above roofing level unless otherwise accepted in writing by Architect and manufacturer's technical department.
- J. Consistently adhere flashing membrane to substrate. Cut and hot-air weld interior corners, exterior corners and miters into place. Ensure membrane does not contact bitumen.
- K. Mechanically fasten flashing membrane along counter-flashed top edge with stop at 6 to 8 inches on center.
- L. Terminate membrane flashings according to manufacturer's recommended details.
- M. Provide additional securement for membrane flashings that exceed 30 inches in height in accordance with recommendations of manufacturer's technical department.

3.9 CLAD METAL FLASHING/EDGE METAL INSTALLATION

- A. Install clad metal flashings and edge metal in accordance with manufacturer's requirements and recommendations and the specifications shall be followed. Verify that material submittals shall have been accepted by manufacturer prior to installation.
- B. Install clad metal flashings concurrently with roof membrane as job progresses.
 - 1. Temporary flashings will be allowed only with prior written authorization of Architect and manufacturer.
 - 2. Authorization when issued will only be for specific locations on specific dates.

- C. If water enters under newly completed roofing, remove roofing assembly in affected area and replaced at no cost to Owner.
- D. Form and install clad metal flashings and edge metal per details on Drawings.
 - 1. Fasten clad metal flashings into solid wood nailers or metal backing with 2 rows fasteners 4 inches oc staggered. Ensure fasteners penetrate wood nailers minimum 1 inch and through metal backing minimum 1/4 inch.
 - 2. Install clad metal flashing to provide adequate resistance to bending to allow for normal thermal expansion and contraction.
- E. Space adjacent sheets of clad metal 1/4 inch apart. Cover joint with aluminum tape and hot-air weld minimum 4 inch wide strip of flashing membrane over joint.

3.10 METAL FLASHING INSTALLATION

- A. Metal flashing details, fabrication practices and installation methods shall conform to applicable requirements of Factory Mutual Loss Prevention Data Sheet 1-49 and SMACNA.
- B. Complete sheet metal flashing work in conjunction with roofing and membrane flashings so that watertight condition exists daily.
- C. Install metal flashing to provide adequate resistance to bending to allow for normal thermal expansion and contraction.
- D. Install metal flashing joints watertight.
- E. Securely fasten metal flashings into solid wood blocking or metal backing. Ensure fasteners penetrate wood nailers minimum 1 inch and through metal backing minimum 1/4 inch.
- F. Provide airtight and continuous metal hook strips behind metal fascias.
 - 1. Extend hook strips past wood nailers over wall surfaces by minimum 1-1/2 inch; securely seal from air entry.
 - 2. Fasten hook strips maximum 12 inches on center into wood nailer or metal backing.
- G. Install counter flashings to overlap base flashings minimum 4 inches.

3.11 TEMPORARY CUT-OFF

- A. Install flashings concurrently with roof membrane in order to maintain watertight condition as work progresses.
- B. Construct temporary waterstops to provide watertight seals.

1. Make stagger of insulation joints even by installing partial panels of insulation.
 2. Carry roof membrane into waterstop.
 3. Seal waterstop to deck and substrate so that water will not be allowed to travel under roofing. Seal edge of membrane in continuous heavy application of sealant.
- C. When work resumes, cut out contaminated membrane. Remove sealant, contaminated membrane, insulation fillers and other temporary components from work area and properly disposed of off site. None of these materials shall be used in new work.
- D. If inclement weather occurs while temporary waterstop is in place, provide labor necessary to monitor situation to maintain watertight condition.
- E. If water enters under newly-completed roofing, remove and replace materials in affected area at no cost to Owner.

3.12 CLEANING AND REPAIR

- A. Remove debris and adhesives markings from interior and exterior finished surfaces.
- B. In areas where finished surfaces are soiled by adhesive and other sources of soiling caused by work of this section, consult manufacturer of surfaces for cleaning advice and conform to their instructions.
- C. Repair or replace defaced and disfigured finishes caused by work of this section.
- D. Repair or correct installations and details noted as deficient during post installation inspection and as required to meet manufacturer's final endorsement for issuance of specified guarantee.
- E. Clean roof membrane and flashing surfaces of debris.
1. Remove hand prints, footprints, general traffic grime, industrial pollutants from membrane by scrubbing with non-abrasive soap solution in accordance with roofing manufacturer's recommendations.
 2. Rinse completely with clean water.
- F. Clear roof drains and rain water leaders of debris and obstructions. Test by flooding with water.
- G. Remove debris from paved and landscape areas.
- H. Leave job site free of debris, roofing materials, equipment and related items.

3.13 PROTECTION OF INSTALLED WORK

- A. Where traffic and construction must continue over finished roof installation, protect

roof surfaces.

1. Cover roof surfaces with minimum 3/8 inch thick asphalt-free fiberboard laid over minimum 6 mil compatible plastic sheeting with ends and edges lapped 6 inches.
2. If storage is necessary, cover roof surfaces with minimum 3/8 inch thick plywood over minimum 3/8 inch thick asphalt-free fiberboard over minimum 6 mil compatible plastic sheeting with ends and edges of sheeting lapped 6 inches; offset plywood and fiberboard joints.

3.14 DEMONSTRATION

- A. Provide maintenance documents and personal instruction for Owner's facilities staff and other interested parties at single pre-determined mutually convenient time.
- B. Include following topics in instruction:
 1. Access restriction and precautions.
 2. Avoiding mechanical damage.
 3. Potential contaminants and rectification.
 4. Cleaning.
 5. Emergency repairs.
 6. Procedures for permanent repairs and alterations.

END OF SECTION

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SECTION 07620

SHEET METAL FLASHING AND TRIM

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Copings, parapet, curb and sleeper cap flashings.
- B. Receivers, reglets and counter-flashings.
- C. Head, sill and sill pan flashings.
- D. Miscellaneous building sheet metal flashing.
- E. Associated sealant.

1.2 RELATED SECTIONS

- A. Section 07130 – Sheet Waterproofing: Foil-faced rubberized asphalt flashing.
- B. Section 07540 - Thermoplastic Membrane Roofing: Membrane clad sheet metal flashings incorporated into roofing; membrane flashings associated with membrane roofing.
- C. Section 07650 – Flexible Flashing: Self-adhering sheet membrane flashing; silicone sheet flashing.
- D. Section 07900 - Joint Sealers: Sealant types.
- E. Section 09900 - Paints and Coatings: Prime and finish painting of sheet metal flashing and trim.

1.3 REFERENCES

- A. ASTM A653 – Specification for Steel Sheet, Zinc-Coated, (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process.
- B. ASTM B32 – Specification for Solder Metal.
- C. ASTM B209 – Specification for Aluminum and Aluminum Alloy Sheet and Plate.
- D. ASTM B749 – Specification for Lead and Lead Alloy Strip, Sheet and Plate.
- E. ASTM D2092 - Practices for Preparation of Zinc-Coated Galvanized Steel Surfaces for Paint.
- F. ASTM D4586 – Specification for Asphalt Roof Cement - Asbestos Free.

- G. NRCA - National Roofing Contractor's Association "Roofing Manual."
- H. SMACNA - Sheet Metal and Air Conditioning Contractors National Association "Architectural Sheet Metal Manual."
- I. SSPC - Structural Steel Painting Council.

1.4 SYSTEM DESCRIPTION

- A. Work of this section is to provide flashing and sheet metal not specifically described in other sections of these specifications but required to prevent penetration of water through exterior shell of building.

1.5 DESIGN REQUIREMENTS

- A. Sustainable Design Requirements: Steel and aluminum used in work of this section is intended to contribute to meeting requirements for recycled content outlined in LEED™-NC 2009 Credit MR4.

1.6 SUBMITTALS

- A. Shop Drawings: Clearly indicate materials, configurations and profiles, jointing methods and locations, fastening methods and locations, flashing terminations and installation details. Show joint layout and elevations for joints exposed to view from grade outside of building with dimensions.
- B. Setting Drawings or Templates: Submit setting drawings or templates and setting instructions for exact locations of items to be embedded in work of other sections.
- C. Product Data: Submit manufacturer's literature completely describing manufactured products.
- D. 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. Submit hard copies of completed Online Documentation required for LEED™ MR Credit 4.

1.7 QUALITY ASSURANCE

- A. Perform work in accordance with NRCA and SMACNA standard details and requirements.

1.8 QUALIFICATIONS

- A. Fabricator and Installer: Company specializing in sheet metal flashing work with minimum 5 years documented experience.

1.9 STORAGE AND HANDLING

- A. Deliver products to site, store handle and protect in accordance with manufacturer's instructions and recommendations.
- B. Deliver, store and handle packaged materials in original containers with seals unbroken and labels intact until time of use.
- C. Discharge materials carefully and store on clean concrete or raised platform in secure dry area. Do not dump on ground.
- D. Stack preformed and prefinished material to prevent twisting, bending, or abrasion, and to provide ventilation. Slope metal sheets to ensure drainage.
- E. Prevent contact with materials during storage which may cause discoloration, staining or damage.
- F. Do not store materials with strippable film in areas exposed to sunlight.

1.10 FIELD MEASUREMENTS

- A. Verify field measurements are as indicated on shop drawings.

1.11 COORDINATION

- A. Ensure timely delivery of items to be embedded in work of other sections; furnish with setting drawings and templates.
- B. Coordinate installation of reglets with installation of underlayments.
- C. Coordinate installation of sheet metal work in contact with, but not incorporated into, membrane roofing with installation of roofing; install under supervision of roofing system applicators.

1.12 WARRANTY

- A. Installer's Warranty: Cover damage to work resulting from failure of work of this section to resist penetration of moisture for period of 2 years from date of Substantial Completion.

PART 2 PRODUCTS

2.1 SHEET MATERIALS

- A. Galvanized Steel: ASTM A653; thicknesses as indicated on Drawings and, if not indi-

cated, never less than 24 gauge; minimum 1.25 oz/sq ft galvanized coating.

- B. Aluminum: ASTM B209; thicknesses as indicated on Drawings and, if not indicated, never less than 0.062 inch; plain sheet; finish to match adjacent aluminum.
- C. Lead: ASTM B749, Grade B; weights as indicated on Drawings and, if not indicated, never less than 4 lbs/sq ft.

2.2 ACCESSORIES

- A. Fasteners: Galvanized steel, aluminum, or stainless steel with soft neoprene washers at exposed fasteners; finish as follows:
 - 1. Galvanized Steel: Galvanized steel or stainless steel.
 - 2. Lead: Galvanized steel or stainless steel.
 - 3. Aluminum: Aluminum or stainless steel.
- B. Drawbands: Stainless steel hose clamps; worm drive.
- C. Protective Backing Paint: SSPC Paint 12; cold-applied asphalt mastic type; non-corrosive; compounded for 15 mil dry film thickness.
- D. Solder: ASTM B32; 50/50 type.
- E. Sealant: Polyurethane Type Exterior Non-Traffic Sealant as specified in Section 07900.
- F. Plastic Cement: ASTM D4856; asphalt type with mineral fiber components; capable of setting within 24 hours at temperature of 75 degrees F and 50 percent relative humidity.
- G. Flashing Compound: Polyisobutylene type non-skinning non-drying sealant; bulk or tape form as applicable to installation requirements.

2.3 FABRICATION

- A. Fabricate sheet metal flashings and related components in accordance with profiles and material thickness recommended by SMACNA except where more stringent requirements are indicated on Drawings or specified herein.
- B. Form sheet metal flashings and related components of materials indicated on Drawings unless specified otherwise.
- C. As far as practicable, form and fabricate sheet metal in shop. Where on-site fabrication is required, provide work equal to shop quality.
- D. Fabricate required connection pieces.

- E. Form sections square, true and accurate in size, in maximum possible lengths and free of distortion or defects detrimental to appearance or appearance.
- F. Allow for expansion and contraction at joints.
- G. Provide loose locking slip joints:
 - 1. At maximum 8 feet from internal and external corners.
 - 2. At maximum 24 foot intervals on straight runs.
 - 3. At centers of runs, less than 20 feet but more than 20 feet.
 - 4. Fill loose locked seams with flashing compound prior to assembly.
- H. Reinforce for strength and appearance.
- I. Cut, fit and drill sheet metal to accommodate related, adjacent or adjoining work.
- J. Hem exposed edges of metal on underside 1/2 inch; miter and seam corners.
- K. Provide standing seam joints in copings, parapet caps and sleeper caps. Provide lock joints in other components where practical; where impractical, lap, rivet and solder joints.
 - 1. Turn lock joints on exposed surfaces in direction of flow.
 - 2. Provide seams that follow direction of water flow.
- L. Solder metal joints. After soldering, remove flux. Wipe and wash solder joints clean.
- M. Fabricate corners from one piece with minimum 18 inch long legs; solder for rigidity, seal with sealant.
- N. Fabricate pan flashing with end dams.
- O. Fabricate vertical faces with bottom edge formed outward 1/4 inch and hemmed to form drip.
- P. Fabricate cleats and starter strips of same material as sheet, interlockable with sheet.

2.4 FINISH

- A. Clean, degrease, neutralize and phosphate treat galvanized sheet metal surfaces to receive paint finish in accordance with ASTM D2092, Method A.
- B. Back paint concealed metal surfaces and surfaces in contact with dissimilar metals and cementitious materials with protective backing paint to a minimum dry thickness of 15 mils.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine substrate conditions to determine acceptability for installation. Verify that substrates are acceptable for product installation in accordance with fabricator's instructions and recommendations.
- B. Verify that openings are solidly set and ready for flashing installation.
- C. Verify that self-adhering sheet membrane has been installed prior to sheet metal flashing in areas to receive sheet metal flashing.
- D. Do not begin installation until unsatisfactory conditions have been corrected.

3.2 PROTECTION

- A. Exercise care when working on and about roof surfaces to avoid damaging and puncturing membrane and flashings.
- B. Place plywood panels on membrane roof surfaces adjacent to work of this section as temporary protection during course of cutting and fabrication.
- C. Do not store sheet metal materials directly on roof surface. Place on pallets, plywood panels or temporary sleepers.
- D. Protect interior of building from water intrusion during operations performed under this section.

3.3 PREPARATION

- A. Install starter and edge strips, and cleats before starting installation.

3.4 INSTALLATION

- A. Install flashing to conform to details indicated on Drawings and included in NRCA and SMACNA manuals.
 - 1. Install shop fabricated sheet metal work in accordance with final reviewed shop drawings.
 - 2. Install manufactured assemblies in accordance with final reviewed shop drawings and manufacturer's installation instructions.
- B. Perform required site fabrication in accordance with Part 2 "Fabrication" Article above.
- C. Install work watertight with components in true and accurate alignment with other components and related work, with joints accurately fitted, with corners reinforced and with surfaces free from dents.

- D. Install flashings to ensure diversion of moisture to exterior.
- E. Coordinate sheet metal installation with work of other trades to ensure proper sequencing.
- F. Secure flashings in place using concealed fasteners. Use exposed fasteners only in locations indicated or authorized by Architect.
 - 1. Fasten in accordance with SMACNA.
 - 2. Secure sheet metal runs to underlying material by fastening through slotted holes in flange at 3 inches or maximum, unless indicated otherwise.
 - 3. Provide waterproof washers where fasteners penetrate flashings.
 - 4. Where sheet metal occurs over other sheet metal, use nails with minimum 1 inch diameter metal disks.
- G. Apply plastic cement compound between metal flashings and felt membranes and flashings.
- H. Fit flashings tight in place. Make corners square, faces true and straight in planes, and lines accurate to profiles.
- I. Solder metal joints for full metal surface contact. After soldering, wash metal clean with neutralizing solution and rinse with water.
- J. Install sheet metal work so as to adequately provide for expansion and contraction in finished work.
- K. Apply joint compound at slip joints or wherever metal-to-metal contact occurs and movement may occur.
- L. Install sealant and sealant accessories in accordance with Section 07900.

3.5 ADJUSTING

- A. Replace damaged material with new undamaged material prior to final acceptance.

3.6 CLEANING

- A. Clean sheet metal work; leave free from grease, finger marks and stains.
- B. Remove scrap and debris from surrounding areas and grounds.

3.7 PROTECTION

- A. Protect installed work of this section from defacement or damage until final acceptance.

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SECTION 07650
FLEXIBLE FLASHING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Self-adhering sheet membrane flexible flashing.
- B. Requirements for self-adhering membrane flashing specified in other sections.

1.2 RELATED SECTIONS

- A. Section 05400 – Cold Formed Metal Framing: Exterior wall metal stud framing.
- B. Section 07540 - Thermoplastic Membrane Roofing: Single ply membrane roofing; membrane flashing heat welded to single ply roofing membrane.
- C. Section 07620 - Sheet Metal Flashing and Trim: Head flashing at steel door and window frames; counterflashing and reglets.
- D. Section 09253 - Gypsum Sheathing: Wall sheathing under air barrier and self-adhering sheet membrane flashing.

1.3 REFERENCES

- A. ASTM D412 - Test Methods for Vulcanized Rubber and Thermoplastic Rubbers and Thermoplastic Elastomers - Tension.
- B. ASTM D903 - Test Method for Peel and Stripping Strength of Adhesive Bonds.
- C. ASTM D1970 - Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection.
- D. ASTM D2000 – Classification System for Rubber Products in Automotive Applications.
- E. ASTM E96 - Test Methods for Water Vapor Transmission of Materials.

1.4 SUBMITTALS

- A. Shop Drawings: Indicate special joint and termination conditions.
- B. Product Data: Submit manufacturer's data on material characteristics, performance criteria and limitations for each component in system.
- C. Samples: Submit samples, minimum 6 x 6 inches in size, of each type self-adhering sheet membrane.

- D. Manufacturer's Installation Instructions: Submit preparation, installation requirements and techniques, product storage and handling criteria.
- E. Manufacturer's Certifications: Certify that volatile organic compound (VOC) content of each component of self-adhering sheet membrane flashing system complies with requirements of South Coast Air Quality Management District.

1.5 QUALITY ASSURANCE

- A. Source Limitation: Provide primary materials for each component of system which are products of single manufacturer.

1.6 QUALIFICATIONS

- A. Manufacturers: Company specializing in manufacture of flexible flashing with minimum 10 years documented experience.
- B. Installer: Company specializing in installation of flexible flashing with minimum 3 years documented experience.

1.7 REGULATORY REQUIREMENTS

- A. Conform to regulations of South Coast Quality Management District and California Air Resources Board regarding volatile organic compound content.

1.8 PREINSTALLATION CONFERENCE

- A. Convene preinstallation conference minimum 1 week prior to beginning work of this section.
- B. Attendance: Contractor, flexible flashing installer, sheet metal flashing installer, weather resistive barrier installers, Project Manager, Project Inspector and Architect.
- C. Agenda: Review installation procedures and coordination required with related construction. Conduct inspection of substrates.

1.9 DELIVERY, STORAGE AND HANDLING

- A. Deliver products to site, store, handle and protect in accordance with manufacturer's instructions and recommendations.
- B. Sequence deliveries to avoid delays while minimizing on-site storage.
- C. Deliver products to job site in their original unopened containers with labels intact and legible at time of use.
- D. Protect products from sunlight, weather, excessive temperatures, and construction operations.

1. Store self-adhering sheet membrane flashing where temperatures do not fall below 50 degrees F and do not exceed 90 degrees F.
2. Do not double stack self-adhering sheet membrane flashing pallets. Provide cover on top and sides allowing for adequate ventilation.

- E. Remove damaged material from site and dispose of in accordance with applicable regulations.

1.10 ENVIRONMENTAL REQUIREMENTS

- A. Perform work only when existing and forecasted weather conditions are within limits established by manufacturer of products used.
- B. Do not apply self-adhering sheet membrane flashing when air and surface temperature is below 25 degrees F.

1.11 COORDINATION

- A. Coordinate installation of flexible flashings with installation of sheet metal flashings and reglets specified under Section 07620 - Sheet Metal Flashing. Ensure weather lap between flexible flashings and sheet metal flashing and screeds is maintained throughout.
- B. Coordinate installation of self-adhering membrane flashings with installation of air barriers specified under Section 07272 - Fluid Applied Membrane Air Barrier. Ensure weather lap between membrane flashing and air barrier is maintained throughout.

PART 2 PRODUCTS

2.1 SELF-ADHERING SHEET MEMBRANE FLASHING

- A. Manufacturer:
 1. Grace Construction Products.
 2. Manufacturer Offering Acceptable Equivalent Products: Carlisle Corporation.
 3. Substitutions: Under provisions of Division 1.
- B. Rubberized Asphalt Self-Adhering Sheet Membrane Flashing: Cold-applied self adhering membrane composed of high-density cross-laminated polyethylene film coated 1 side with layer of rubberized asphalt.
 1. 25 Mil Strip Form: 25 mil total thickness; silicone coated release sheet; available in 4, 6, 9 and 12 inch widths; 75 foot long rolls; Grace Vycor® Plus Self-Adhered Flashing.

2. 40 Mil Strip and Roll Form: 40 mil total thickness; paper release liner; available in 6, 9, 12, 18 and 36 inch widths; 75 foot long rolls; Grace Vycor® V40 Self-Adhered Flashing.
- C. Butyl Self-Adhering Sheet Membrane Flashing: Cold-applied self-adhering membrane composed of high-density cross-laminated polyethylene film coated 1 side with layer of butyl rubber adhesive; "gray-black" color.
1. 25 Mil Strip Form: 25 mil total thickness; plastic release liner; available in 6 and 9 inch wide strips; 75 foot rolls; Grace Vycor® Butyl.
 2. 30 Mil Roll Form: 30 mil total thickness; embossed slip-resistant texture on laminated polyethylene film; interwound with disposable silicone coated release sheet; available in 34 inch wide x 70 foot long rolls; Grace Ultra.

Property	Test Method	Result
Tensile Strength	ASTM D412 Die C Modified	250psi
Elongation	ASTM D412 Die C Modified	250%
Low Temperature Flexibility	ASTM D1970	Unaffected at -20°F
Adhesion to Plywood	ASTM D903	3.0 lbs/in width
Permeance	ASTM E96	0.05 perms

- D. Accessories:
1. Primer: Water-based latex liquid for substrate preparation; maximum 10 g/L VOC content; Perm-A-Barrier® WB Primer.
 2. Termination Mastic: Rubberized asphalt-based mastic; maximum 200g/L VOC content; Bituthene® Mastic.

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 manufacturer's instructions and recommendations.
- B. Verify that substrates are structurally sound, free of voids and contaminants and ready for work of this section.

- C. Verify that substrate joints and fasteners are flush.
- D. Do not begin installation until unsatisfactory conditions have been corrected.

3.2 PROTECTION

- A. Protect elements surrounding work from damage and disfiguration.
- B. Protect installed roofing adjacent to work of this section.
 - 1. Cover roof surfaces with minimum 3/8 inch thick asphalt-coated fiberboard laid over minimum 6 mil plastic sheeting with ends and edges lapped 6 inches.
 - 2. If storage is necessary, cover roof surfaces with minimum 3/8 inch thick plywood over minimum 3/8 inch thick asphalt coated fiberboard over minimum 6 mil plastic sheeting with ends and edges lapped 6 inches; offset plywood and fiberboard joints.
- C. Repair damage to other surfaces caused by work of this section.

3.3 PREPARATION

- A. Remove protrusions and dust, dirt, loose nails and debris from surfaces to receive self-adhered sheet membrane flashing.
- B. Apply primer to concrete, masonry and gypsum sheathing substrates at rate recommended by manufacturer.

3.4 INSTALLATION

- A. Install self-adhering sheet membrane flashing in accordance with manufacturer's instructions and recommendations.
 - 1. Precut rolls and strips of flashing to easily handled lengths for each location.
 - 2. Peel back release paper and carefully position flashing against substrate.
 - 3. Press flashing firmly into place with steel hand roller or back of utility knife so that flashing is fully adhered to substrate.
 - 4. Install so that laps shed water with top membrane layer lapping over bottom layer; work from low point to high point. Overlap adjacent pieces 3 inches; roll overlap with steel hand roller.
 - 5. Mechanically fasten membrane at vertical terminations.
 - 6. Integrate self-adhering sheet membrane flashing with installation of weather resistive barrier; ensure weatherboard lap is maintained between self-adhering sheet membrane flashing and weather resistive barrier.

7. Coordinate installation of steel metal flashings and screeds installed in conjunction with self-adhering sheet membrane flashing. Ensure weatherboard lap is maintained between self-adhering sheet membrane flashing and adjacent sheet metal flashings and screeds.
8. Coordinate installation of final wall cladding and flashings; ensure rubberized asphalt self-adhering sheet membrane flashing is covered within 30 days after installation and butyl self-adhering sheet membrane flashing is covered within 60 days after installation.
9. Install self-adhering sheet membrane flashing:
 - a. Under sheet metal flashings and over concealed sheet metal flashing flanges.
 - b. At inside and outside corners over weather resistive membrane.
 - c. Around door opening perimeters occurring in exterior framed construction.
 - d. Over window and door head flashing occurring in exterior framed construction.
 - e. At other locations as indicated on Drawings.
10. Install rubberized asphalt self-adhering sheet membrane flashing or butyl self-adhering sheet membrane flashing at Contractor's option except at following locations:
 - a. Under Sheet Metal Copings, Exposed Sheet Metal Flashing and Other High Heat Locations: Install butyl self-adhering sheet membrane flashing; coordinate with installation of copings and flashings.

3.5 PROTECTION OF INSTALLED WORK

- A. Provide means necessary to protect self-adhering sheet membrane flashing until final wall cladding and flashing are installed.

END OF SECTION

SECTION 07840

FIRESTOPPING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Penetration firestopping systems.
- B. Fire-resistive joint systems.
- C. Perimeter fire barrier systems.
- D. Perimeter fire safing systems.

1.2 RELATED SECTIONS

- A. Section 03300 - Cast-In-Place Concrete: Structural concrete; concrete fill over steel decks.
- B. Section 05400 - Cold Formed Metal Framing: Metal stud framing in exterior walls and soffits.
- C. Section 09110 - Non-Load Bearing Metal Framing: Metal stud framing in interior partitions and ceilings.
- D. Section 09250 - Gypsum Board: Gypsum wallboard fireproofing.
- E. Section 09820 - Acoustical Insulation and Sealants: Mineral wool insulation used for acoustical isolation.
- F. Division 15 - Mechanical: Mechanical work requiring fire stopping.
- G. Division 16 - Electrical: Electrical work requiring fire stopping.

1.3 REFERENCES

- A. ASTM C612 - Specification for Mineral Fiber Block and Board Thermal Insulation.
- B. ASTM C920 - Specification for Elastomeric Joint Sealants.
- C. ASTM E84 - Test Method for Surface Burning Characteristics of Building Materials.
- D. ASTM E814 - Test Method for Fire Tests of Through-Penetration Fire Stops.
- E. ASTM E2174 - Standard Practice for On-Site Inspection of Installed Fire Stops.

- F. ASTM E2393 - Standard Practice for On-Site Inspection of Installed Fire Stop Joint Systems.
- G. CBC - California Building Code, 2010 edition.
- H. FM Standard 4991 - FM Approval Standard of Firestop Contractors.
- I. UL - Underwriter's Laboratories, Inc.
- J. UL 2079 - Tests for Fire Resistance of Building Joint Systems.

1.4 SYSTEM DESCRIPTION

- A. Firestopping: Systems consisting of material or combination of materials installed to retain integrity of fire-rated construction by maintaining effective barrier against spread of flame, smoke and hot gasses through penetrations, blank openings and construction joints in and adjacent to fire-rated barriers including:
 - 1. Through-penetrations of fire-rated partition assemblies and floor/ceiling assemblies, smoke barriers and smoke partitions including:
 - a. Empty openings.
 - b. Openings containing penetrations such as:
 - 1) Pipes.
 - 2) Ductwork without fire dampers, smoke dampers or smoke-fire dampers.
 - 3) Wiring, raceways, cables and conduits.
 - 2. Membrane-penetrations of fire-rated partition assemblies and floor/ceiling assemblies, smoke barriers and smoke partitions including:
 - a. Empty openings.
 - b. Openings containing penetrations such as:
 - 1) Pipes.
 - 2) Ductwork without fire dampers, smoke dampers or smoke-fire dampers.
 - 3) Wiring, raceways, cables and conduits.
 - 4) Electrical outlet boxes.

3. Joints in fire-rated partition assemblies and floor/ceiling assemblies, smoke barriers and smoke partitions including:
 - a. Joints to allow movement.
 - b. Joints between fire-rated and other construction.
 - c. Joints between fire-rated and fire-rated construction.
 4. Perimeter joints between rated floor assemblies and exterior wall construction.
 5. Other locations indicated, specified, or required by codes and authority having jurisdiction.
- B. Fire Safing: Systems consisting of material or combination of materials installed to resist free passage of flame and products of combustion through perimeter joints between non-rated floor assemblies and exterior wall construction.

1.5 PERFORMANCE REQUIREMENTS

- A. Penetration Firestopping:
1. Of Partition Assemblies: F ratings indicated when tested by third party testing agency in accordance with ASTM E814 but not less than 1 hour or fire-resistive rating of construction being penetrated.
 2. Of Floor/Ceiling Assemblies:
 - a. F ratings indicated when tested by third party testing agency in accordance with ASTM E814 but not less than 1 hour or fire-resistive rating of construction being penetrated.
 - b. T rating equivalent to and in addition to F rating when tested by third party testing agency in accordance with ASTM E814.
- B. Fire Resistive Joints: Fire resistive ratings as indicated when tested by third party testing agency in accordance with UL2079 but not less than 1 hour or fire-resistive rating of construction in which joint occurs.
- C. Perimeter Fire Barriers: Fire resistive ratings as indicated when tested by third party testing agency in accordance with ASTM E2307 but not less than 1 hour or fire-resistive rating of floor construction.
- D. Where there is not specific third party tested and classified firestop system available for particular firestop configuration, obtain Engineering Judgment or Equivalent Fire Resistance Rated Assembly from firestop manufacturer for submittal.

1.6 SUBMITTALS

- A. Shop Drawings: Indicate material installation details including reinforcement, anchorage and fastening.
 - 1. Include schedule showing each firestopping material.
 - 2. If required by officials having jurisdiction, submit shop drawings of each type of penetration indicating compliance with specified requirements.
- B. Product Data: Provide data on product characteristics, performance and limitation criteria.
- C. Test Reports: Submit complete test reports from independent laboratory attesting that firestopping materials and installation methods conform to ASTM E814 requirements.
- D. Manufacturer's Certificates:
 - 1. Certify that products meet or exceed specified requirements.
 - 2. Certify that materials comply with local regulations controlling use of volatile organic compounds and are non-toxic.
- E. Applicator's Certifications: Certify that applicator meets specified qualification requirements.

1.7 QUALITY ASSURANCE

- A. Source Limitation: Obtain firestop systems for each kind of penetration and construction condition indicated from single primary firestop systems manufacturer.
 - 1. Materials of different manufacture than allowed by tested and listed system shall not be intermixed in same firestop system or opening.
 - 2. Tested and listed firestop systems shall be used before Engineering Judgment or Equivalent Fire Resistance Rated Assembly is installed.
- B. Materials shall be VOC compliant and asbestos free.

1.8 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum 3 years documented experience and able to show evidence of minimum 10 projects where similar products have been installed and accepted.
- B. Applicator: Company specializing in performing work of this section with minimum 3 years documented experience, FM approved in accordance with FM Standard 4991 and able to show evidence of successful completions of minimum 5 comparable scale projects.

1.9 REGULATORY REQUIREMENTS

- A. Conform to CBC for fire resistance ratings and surface burning characteristics.
- B. Penetration Firestopping:
 - 1. Through-Penetration Firestopping: Comply with CBC Section 712.3.1 and Section 712.4.1.
 - 2. Membrane Firestopping: Comply with CBC Section 712.3.2.
- C. Fire Resistive Joint Systems: Comply with CBC Section 713.
- D. Perimeter Fire Barriers: Comply with CBC Sections 713.4 and 713.5.
- E. Provide certificate of compliance from authority having jurisdiction indicating approval of combustibility.

1.10 MOCK-UPS

- A. Construct mock-ups for each different firestop system indicated to verify selections made and to demonstrate qualities of materials and execution.
- B. Build mock-ups using materials indicated for final installations.
- C. Locate mock-ups on site in locations directed by Architect.
- D. Notify Architect in advance of dates and times when mock-ups will be installed; obtain Architect's acceptance of mockups prior to installing fire-stop work.
- E. Retain and maintain mockups during construction in undisturbed condition as standard for judging completed unit of work.
- F. Accepted mockups in undisturbed condition at Substantial Completion may remain as part of completed work.

1.11 PRE-INSTALLATION CONFERENCE

- A. Convene pre-installation conference minimum 1 week prior to beginning work of this section.
- B. Attendance: Contractor, firestop applicator, metal framing installer, gypsum board installer, plumbing installer, mechanical installer, electrical installer, Project Manager, Project Inspector, Architect and other involved parties.
- C. Agenda: Review construction documents, schedule of work, existing conditions, details of work, installation procedures, and coordination required with related work and

inspection. Educate parties involved with firestopping process of their role and how they can affect firestopping on project.

1.12 DELIVERY, STORAGE AND HANDLING

- A. Deliver products to site, store, handle and protect in accordance with manufacturer's instructions and recommendations.
- B. Deliver materials in manufacturer's original unopened containers or packages with manufacturer's name, trade name, testing agency labels, product identification, lot numbers and application instructions.
- C. Store materials in original unopened containers or packages under conditions recommended by manufacturers. Leave seals unbroken and labels intact until time of use.
- D. Remove from project site rejected or damaged packages found unsuitable for use.

1.13 ENVIRONMENTAL REQUIREMENTS

- A. Do not apply materials when temperature of substrate material and ambient air is below 60 degrees F.
- B. Maintain this minimum temperature before, during and for 3 days after installation of materials.
- C. Provide ventilation in areas to receive solvent cured materials.

1.14 SEQUENCING

- A. Sequence work so that partitions and other construction that conceals penetrations are not installed prior to installation of firestopping.
- B. Sequence work to ensure firestopping is not covered prior to inspection and approval.

PART 2 PRODUCTS

2.1 PENETRATION FIRESTOPPING SYSTEMS

- A. Manufacturers:
 - 1. 3M Fire Protection Products.
 - 2. Manufacturers Offering Acceptable Equivalent Products:
 - a. Hilti, Inc.
 - b. RectorSeal Corporation.

- c. Specified Technologies, Inc.
 - d. Tremco.
- 3. Substitutions: Under provisions of Division 1.
- B. Fill, Void and Cavity Materials:
 - 1. Firestopping Caulk: Latex-based intumescent type; endothermic; free from halogen and asbestos; non-sagging; fast drying; paintable; UL classified; 3M Brand "Fire Barrier" CP 25WB+ Caulk.
 - 2. Firestopping Sealants:
 - a. Firestopping Silicone Sealant: ASTM C920, Type S, Grade NS, Class 25; single component ready-to-use gun grade silicone elastomer; non-sagging; reenterable/repairable; UL classified; 3M Brand "Fire Barrier" 2000 Silicone Sealant.
 - b. Firestopping Intumescent Silicone Sealant: Single component ready-to-use intumescent silicone sealant; neutral cure; non-slumping; flexible; weather resistant; fungi resistant; re-enterable/repairable; UL classified; 3M Brand "Fire Barrier" 3000 WT Water Tight Sealant.
 - 3. Firestopping Putty: 100 percent solids intumescent firestopping putty; permanently pliable; free from halogen and asbestos; stick or pad form as required by UL system listing; re-enterable; UL classified; 3M Brand "Fire Barrier" Moldable Putty.
 - 4. Firestopping Intumescent Wrap: Intumescent elastomeric material faced one side with aluminum or stainless steel foil; bearing UL classification marking; 3M Brand Fire Barrier Wrap/Strip FS 195.
 - 5. Firestopping Composite Sheet: 100 percent solids intumescent firestopping sheet; thermally conductive; will not support flame; re-enterable; UL classified; 3M Brand "Fire Barrier" CS-195+ Composite Sheet.
 - 6. Firestopping Intumescent Mat: Graphite-based intumescent mat in roll form; largely inorganic; flexible; UL classified for plastic pipe; 3M Brand Interam™ Ultra GS Graphite Mat.
 - 7. Firestopping Duct Wrap: Fire resistant wrap consisting of inorganic blanket encapsulated with scrim-reinforced foil; asbestos free; 3M Brand "Fire Barrier" Duct Wrap 20A.

8. Firestopping Mortar: Lightweight cementitious firestopping mortar in factory-mixed powder ready for mixing with water at job site; free from manmade mineral fibers and asbestos; polypropylene fiber reinforced; variable mix ratio permitting self-leveling to non-sag consistencies with compressible strengths from 187 to 790 psi; re-enterable; 3M Brand "Fire Barrier" Mortar.

C. Forming Materials:

1. Fiber Type: Mineral wool; minimum 4.0 lbs/cu ft.
2. Foam Type: Foam backer rod.

D. Accessories:

1. Sleeves:
 - a. Steel Type: Cylindrical; gauge, seam lap, and length as required by UL system listing.
 - b. Wire Mesh Type: #8 steel wire cloth fabricated from galvanized steel wire that is 0.020 inch diameter by 1/8 inch on center in both directions.
2. Cover Plates and Strips: Sheet steel; gauge and dimensions as required by UL system listing.
3. Retaining Angles: Brake shape sheet steel angles; gauge and dimensions as required by UL system listing.

2.2 FIRE-RESISTIVE JOINT SYSTEMS

A. Manufacturers:

1. 3M Fire Protection Products.
2. Manufacturer Offering Acceptable Equivalent Products: Hilti, Inc.
3. Substitutions: Under provisions of Division 1.

B. Fill, Void and Cavity Materials:

1. Firestopping Caulks:
 - a. Latex-Based Elastomeric Type: Single component; non-sagging; air cure; re-entrable; paintable; UL classified; 3M Brand "FireDam" 150+ Acrylic latex Caulk.
 - b. Latex-Based Intumescent Type: Endothermic; free from halogen and asbestos; non-sagging; fast drying; paintable; UL classified; 3M Brand "Fire

Barrier" CP 25WB+ Caulk.

2. Firestopping Silicone Sealant: ASTM C920, Type S, Grade NS, Class 25; single component ready-to-use gun grade silicone elastomer; non-sagging; re-enterable/ repairable; UL classified; 3M Brand "Fire Barrier" 2000 Silicone Sealant.
3. Firestopping Elastomeric Coating: Water-based elastomeric material formulated for spray application; dries to highly elastic coating capable of maintaining performance with +25% joint movement; paintable; 3M Brand "FireDam" Spray 200.

C. Forming Materials:

1. Fiber Type: Mineral-fiber insulation material; unfaced; nominal 4.0 lbs/cu ft; 4 inches thick; cut to width with fibers running parallel to edge and allowing 50 percent compression in installed width.

2.3 PERIMETER FIRE BARRIER SYSTEM

A. Manufacturers:

1. 3M Fire Protection Products.
2. Manufacturer Offering Acceptable Equivalent Products: Thermafiber, Inc.
3. Substitutions: Under provisions of Division 1.

B. Packing Material: Mineral-fiber insulation material; unfaced; nominal 4.0 lbs/cu ft; 1 and 4 inch thicknesses; maximum flame spread of 0 and smoke developed of 0 when tested in accordance with ASTM E84.

C. Fill Materials: Water-based firestopping elastomeric material formulated for spray application; dries to highly elastic coating capable of maintaining performance with +25% joint movement; paintable; 3M Brand "FireDam" Spray 200.

D. Reinforcing Angles: Minimum 1-1/2 inch x 1-1/2 inch x 20 gauge galvanized steel angle; sized 12 inches longer than span between interior edges of vertical framing members and formed with 6 inch vertical leg on each end.

2.4 PERIMETER FIRE SAFING SYSTEMS

A. Manufacturers:

1. Thermafiber, Inc.
2. Manufacturer Offering Acceptable Equivalent Product: Rock Wool Manufacturing Company.

3. Substitutions: Under provisions of Division 1.

B. Components:

1. Safing Insulation: Mineral-fiber insulation material; unfaced; nominal 4.0 lbs/cu ft; 4 inches thick; maximum flame spread of 0 and smoke developed of 0 when tested in accordance with ASTM E84; Thermafiber Safing Insulation.
2. Safing Clips: Z-shaped galvanized steel clips formed from 1 inch wide strips of 20 gauge galvanized steel; 3 inches high with 2 inch and 3 inch upper and lower horizontal legs.

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 building is properly enclosed or protected against adverse weather conditions.
- C. Verify that supporting framing and surrounding construction is in thoroughly dry condition.
- D. Verify that pipes, conduits, cables, ducts and other items that penetrate fire rated construction have been permanently installed.
- E. Verify that field dimensions are as shown on Drawings and as recommended by manufacturer.
- F. Do not begin installation until unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Prepare surfaces designed to receive firestopping in accordance with manufacturer's installation instructions.
- B. Clean substrate surfaces of dirt, dust, grease, oil, loose material or other matter that may affect bond of fire stopping material.
- C. Remove incompatible materials that affect bond.
- D. Ensure surfaces designated to receive firestopping are dry; do not apply firestopping systems to wet or damp surfaces.

- E. Prime substrates where recommended by firestopping manufacturer using firestopping manufacturer's recommended products and methods.

1. Confine primers to area of bond.
2. Do not allow spillage or migration onto exposed surfaces.

3.3 PROTECTION

- A. Where firestopping is to be installed at location that will remain exposed in completed work, provide protection necessary to prevent damage to adjacent surfaces and finishes.
- B. Use masking tape to prevent firestopping from contacting adjoining surfaces that will remain exposed. Remove tape as soon as possible to do so without disturbing firestopping seal with substrate.

3.4 INSTALLATION - PENETRATION FIRESTOPPING

- A. Install materials in accordance with manufacturer's instructions and UL System Design.
- B. Install firestopping material as required to achieve rating equal to that of partition or floor/ceiling assembly in which firestopping is installed.
- C. Install material at partition openings, floor/ceiling openings that contain penetrating sleeves, piping, ductwork, conduit and other items and voids requiring firestopping.
- D. Install forming materials and other accessories in accordance with manufacturer's instructions. Use anchoring devices, back-up materials, clips, sleeves, supports and other materials used in fire tests for firestopping assembly.
- E. Install fill materials by proven techniques to:
 1. Completely fill voids and cavities formed by openings, forming materials, accessories and penetrating items.
 2. Contact and adhere to substrates formed by openings and penetrating items.
 3. Produce smooth uniform surface on fill materials to remain exposed in finished Work.
- F. Coordinate installation of firestopping with sound control requirements. Ensure permanently flexible firestopping sealants used around penetrations of sound rated construction and construction with sound attenuation batt insulation.
- G. Coordinate installation of escutcheons around penetrations through walls, parti-

tions and ceilings within finished areas.

3.5 INSTALLATION - FIRE RESISTIVE JOINT SYSTEMS

- A. Install fire resistive joint systems in accordance with manufacturer's instructions and UL System Design.
- B. Install forming materials and other accessories of types required to support fill materials during their application and in position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.
- C. Install systems by proven techniques that result in firestopping materials:
 - 1. Directly contacting and fully wetting joint substrates.
 - 2. Completely filling recesses provided for each joint configuration.
 - 3. Providing uniform cross-sectional shapes and depths relative to joint width that optimize movement capacity.
- D. Tool non-sag firestop materials immediately after application and prior to time skinning begins. Form smooth uniform beads of configuration indicated or required to:
 - 1. Produce fire-resistive rating.
 - 2. Eliminate air pockets.
 - 3. Ensure contact and adhesion with sides of joint.
- E. Coordinate installation of firestopping with sound control requirements. Ensure permanently flexible firestopping sealants used around head-of-wall and bottom-of-wall at joints in sound rated construction and construction with sound attenuation batt insulation.

3.6 INSTALLATION – PERIMETER FIRE BARRIER SYSTEMS

- A. Install perimeter fire barrier systems in accordance with manufacturer's instructions, UL System Designs and engineered judgments.
- B. Install reinforcing angles at mid-height of packing material installation; secure to vertical legs at each end to vertical framing with 3 #10 stainless steel self tapping sheet metal screws in triangular pattern spaced maximum 2 inches oc.
- C. Slab Edge at Glazed Aluminum Curtain Wall:
 - 1. Install minimum 1 inch thick packing material tightly packed and recessed minimum 4 inches from bottom of floor.

2. Install 1/8 inch thick wet layer of fill material over packing material; extend 1 inch onto adjacent surfaces. Protect glass from overspray.
3. Install minimum 4 inch thick packing material over fill material; compress packing material minimum 20 percent.

D. Slab Edge at Metal Stud Framed Curtain Wall

1. Install minimum 4 inch thick packing material between vertical framing members without voids.
 - a. Cut and install packing material with fibers running perpendicular to slab edge.
 - b. Cut minimum 1/4 inch longer than length between vertical framing members and 1/8 inch greater than depth of steel stud.
2. Install pieces of 4 inch thick packing material in longitudinal void between vertical face of concrete floor slab and packing material installed between vertical framing members.
 - a. Cut and install packing material with fibers running parallel to slab edge; compress 20 percent into void with top surfaces flush with top surface of slab.
 - b. Cut so that butt joints in lengths are compressed together minimum 1/2 inch.
3. Spray apply filler material to cover surface of packing material to minimum wet film thickness of 1/8 inch; extend minimum 1/2 inch onto adjacent surfaces and 1/8 inch onto previously sprayed and cured fill material.

3.7 INSTALLATION – PERIMETER FIRE SAFING SYSTEMS

- A. Install fire safing systems in accordance with manufacturer's instructions and recommendations.
- B. Cut insulation to width to fit between edge of floor slab and inside face of exterior wall sheathing with fibers running parallel to edge and allowing 50 percent compression in installed width.
- C. Compression fit safing insulation between edge of floor slab and inside face of exterior wall sheathing with no voids; support with safing clips at 24 inches oc maximum.

3.8 FIELD QUALITY CONTROL

- A. Field inspection will be performed by Owner's Testing Laboratory.

- B. Owner's Testing Laboratory will inspect firestopping to determine that firestopping has been installed in compliance with requirements of tested and listed firestop systems and installation process conforms to FM 4991.

- 1. Penetration firestopping will be inspected in accordance with ASTM E2174.
 - 2. Joint systems will be inspected in accordance with ASTM E2393.

- C. Ensure firestopping is not enclosed with other construction until Testing Laboratory has verified that installation complies with requirements.

- D. Where deficiencies are found, repair or replace deficient firestopping so that it complies with requirements of tested and listed systems design.

3.9 CLEANING

- A. Remove spilled and excess materials adjacent to firestopping as work progresses; remove without damaging adjacent surfaces.
- B. Leave finished work in neat, clean condition with no evidence of spillovers and damage to adjacent surfaces.

3.10 PROTECTION OF INSTALLED WORK

- A. Protect firestopping materials during and after curing period from contact with contaminating substances and damage until final acceptance.

3.11 SCHEDULE

- A. Provide and install firestopping systems listed in schedule and shown on Drawings with accessories necessary to maintain fire resistance of each assembly.
- B. Schedule is list of principal systems only. Refer to Drawings for conditions requiring systems not specifically scheduled.

- C. Penetration Firestopping Systems:

- 1. Penetrations of 1-Hour Fire Rated Gypsum Board/Stud Partition and Wall Assemblies:
 - a. Metal Penetrants:
 - 1) Steel Pipe Up to 12 Inches in Diameter: UL System WL1001.
 - 2) Copper Pipe Up to 4 Inches in Diameter: UL System WL1001.
 - 3) Rigid Steel Conduit Up to 6 Inches in Diameter: UL System

WL1001.

- 4) Electrical Metallic Tubing Up to 4 Inches in Diameter: UL System WL1001.
- 5) Flexible Metallic Conduit Up to 1 Inch in Diameter: UL System WL1001.

b. Non-Metal Penetrants:

- 1) Solid Core PVC Pipe Up to 6 Inches in Diameter: UL System WL2002.
- 2) Cellular Core PVC Pipe Up to 4 Inches in Diameter: UL System WL2002.
- 3) Solid Core ABS Pipe Up to 4 Inches in Diameter: UL System WL2002.
- 4) FRPP Pipe Up to 4 Inches in Diameter: UL System WL2002.
- 5) PVC Rigid Non-Metallic Conduit Up to 4 Inches in Diameter: UL System WL2002.
- 6) PVC Electrical Non-Metallic Tubing Up to 1 Inch in Diameter: UL System WL2002.
- 7) CPVC Pipe Up to 6 Inches in Diameter: UL System WL2002.

c. Cables, Cable Trays and Busways:

- 1) Individual Cables or Cables in Tight Bundles Having Up to 1 Inch Diameter: UL System WL3001.
- 2) Busways Up to 4 Inches Wide x 9 Inches Deep: UL System WL6002.

d. Insulated Pipe:

- 3) Steel Pipe Up to 12 Inches in Diameter with Up to 2 Inches of Insulation: UL System WL5001.
- 4) Copper Tubing Up to 6 Inches in Diameter with Up to 2 Inches of Insulation: UL System WL5001.
- 5) Copper Pipe Up to 6 Inches in Diameter with up to 2 Inches of Insulation: UL System WL5001.

- e. Ducts Up to 30 x 36 Inches: UL System WL7008.
- 2. Penetrations Through 1-Hour Fire Rated Concrete Walls:
 - a. Metal Penetrants:
 - 1) Steel Pipe Up to 10 Inches in Diameter: UL System CAJ1027.
 - 2) Iron Pipe Up to 10 Inches in Diameter: UL System CAJ1027.
 - 3) Copper Pipe Up to 3 Inches in Diameter: UL System CAJ1027.
 - 4) Copper Tubing Up to 3 Inches in Diameter: UL System CAJ1027.
 - 5) Rigid Steel Conduit Up to 6 Inches in Diameter: UL System CAJ1027.
 - 6) Electrical Metallic Tubing Up to 4 Inches in Diameter: UL System CAJ1027.
 - b. Non-Metal Penetrants:
 - 1) Solid Core PVC Pipe Up to 6 Inches in Diameter: UL System CBJ2002.
 - 2) Cellular Core PVC Pipe Up to 4 Inches in Diameter: UL System CBJ2002.
 - 3) Solid Core ABS Pipe Up to 4 Inches in Diameter: UL System CBJ2002.
 - 4) Cellular Core ASB Pipe Up to 4 Inches in Diameter: UL System CBJ2002.
 - 5) FRPP Pipe Up to 4 Inches in Diameter: UL System CBJ2002.
 - 6) PVC Rigid Non-Metallic Conduit Up to 4 Inches in Diameter: UL System CBJ2002.
 - 7) CPVC Pipe Up to 4 Inches in Diameter: UL System CBJ2002.
 - c. Cables, Cable Trays and Busways:
 - 1) Individual Cables Up to 3 Inches in Diameter: UL System CAJ3041.
 - 2) Cables in Tight Bundles Up to 40 Percent Opening Area: UL System CAJ3030.

- 3) Busways Up to 23 Inches Wide x 4-1/2 Inches Deep: UL System CAJ6001.
- d. Insulated Pipe:
 - 1) Steel Pipe Up to 12 Inches in Diameter with Up to 2 Inches of Insulation: UL System CAJ5001.
 - 2) Cast Iron Pipe Up to 12 Inches in Diameter with Up to 2 Inches of Insulation: UL System CAJ5001.
 - 3) Copper Pipe Up to 4 Inches in Diameter with Up to 2 Inches of Insulation: UL System CAJ5001.
- e. Ducts:
 - 1) Steel Duct Up to 16 Inch Diameter: UL System CAJ7003.
 - 2) Steel Duct Up to 12 x 30 Inches: UL System CAJ7016.
3. Penetrations Through 1-Hour Rated Concrete Filled Fluted Steel Deck Roof/Ceiling Assemblies and Through 1-Hour Rated Concrete Filled Steel Deck Floor/Ceiling Assemblies Within Wall Cavities:
 - a. Metal Penetrants:
 - 1) Steel Pipe Up to 10 Inches in Diameter: UL System CAJ1427.
 - 2) Iron Pipe Up to 10 Inches in Diameter: UL System CAJ1427.
 - 3) Copper Pipe Up to 4 Inches in Diameter: UL System CAJ1427.
 - 4) Copper Tubing Up to 4 Inches in Diameter: UL System CAJ1427.
 - 5) Rigid Steel Conduit Up to 6 Inches in Diameter: UL System CAJ1427.
 - 6) Electrical Metallic Tubing Up to 4 Inches in Diameter: UL System CAJ1427.
 - b. Non-Metal Penetrants:
 - 1) Solid Core PVC Pipe Up to 3 Inches in Diameter: UL System CAJ2228.
 - 2) Cellular Core PVC Pipe Up to 3 Inches in Diameter: UL System CAJ2228.

- 3) Solid Core ABS Pipe Up to 3 Inches in Diameter: UL System CAJ2228.
- 4) Cellular Core ASB Pipe Up to 3 Inches in Diameter: UL System CAJ2228.
- 5) FRPP Pipe Up to 3 Inches in Diameter: UL System CAJ2228.
- c. Cables and Busways:
 - 1) Cables in Bundles Having Aggregate Cross Sectional Area Up to 44 Percent of Cross Sectional Area of Opening: UL System CAJ3263.
 - 2) Busways Up to 23 Inches Wide x 4-1/2 Inches Deep: UL System CAJ6001.
- d. Insulated Pipe:
 - 1) Steel Pipe Up to 4 Inches in Diameter with Up to 1-1/2 Inches of Insulation: UL System CAJ5209.
 - 2) Cast Iron Pipe Up to 4 Inches in Diameter with Up to 1-1/2 Inches of Insulation: UL System CAJ5209.
 - 3) Copper Pipe Up to 2 Inches in Diameter with Up to 1-1/2 Inches of Insulation: UL System CAJ5209.
 - 4) Copper Tube Up to 2 Inches in Diameter with Up to 1-1/2 Inches of Insulation: UL System CAJ5209.
- e. Ducts:
 - 1) 24 Gauge Steel Duct Up to 12 x 30 Inches: UL System CAJ7016.
 - 2) 22 Gauge Steel Duct Up to 14 x 32 inches: UL System CAJ7016.
- 4. Penetrations Through 1-Hour Rated Concrete Filled Fluted Steel Deck Floor/Ceiling Assemblies:
 - a. Metal Penetrants:
 - 1) Steel Pipe Up to 10 Inches in Diameter: UL System FA1057.
 - 2) Iron Pipe Up to 10 Inches in Diameter: UL System FA1057.
 - 3) Copper Pipe Up to 4 Inches in Diameter: UL System FA1057.
 - 4) Copper Tubing Up to 4 Inches in Diameter: UL System FA1057.

b. Non-Metal Penetrants:

- 1) Solid Core PVC Pipe Up to 4 Inches in Diameter: UL System CAJ2002.
- 2) Cellular Core PVC Pipe Up to 4 Inches in Diameter: UL System CAJ2002.
- 3) CPVC Pipe Up to 4 Inches in Diameter: UL System CAJ2002.
- 4) Rigid Non-Metallic Conduit Up to 4 Inches in Diameter: UL System CAJ2002.

c. Insulated Pipe:

- 1) Copper Pipe Up to 2 Inches in Diameter with Minimum 1-1/2 Inches of Insulation: UL System CAJ5209.
- 2) Copper Tubing Up to 2 Inches in Diameter with Minimum 1-1/2 Inches of Insulation: UL System CAJ5209.

D. Joint Systems:

1. Bottom of Wall:

- a. Joint at Bottom of 1-Hour Fire Rated Gypsum Board/Stud Wall Assemblies to Concrete Filled Fluted Steel Deck or Concrete Slab Floor Assembly: UL System BWS0007.

2. Head of Wall:

- a. Nominal 5/8 Inch Joints at Head of 1-Hour Fire Rated Gypsum Board/Stud Wall Assemblies Perpendicular to Concrete Filled Fluted Steel Deck Floor or Roof Assembly: UL System HWD0001.
- b. Nominal 1 Inch Joints at Head of 1-Hour Fire Rated Gypsum Board/Stud Wall Assemblies Perpendicular to Concrete Filled Fluted Steel Deck Floor or Roof Assembly with Cementitious Fireproofing: UL System HWD0020.
- c. Nominal 1 Inch Joints at Head of 1-Hour Fire Rated Gypsum Board/Stud Wall Assemblies Parallel to Concrete Filled Fluted Steel Deck Floor or Roof Assembly with Cementitious Fireproofing: UL System HWD0029.
- d. Nominal 3/4 Inch Joints at Head of 1-Hour Fire Rated Gypsum Board/Stud Wall Assemblies Perpendicular to Concrete Filled Fluted Steel Deck Floor or Roof Assembly with Cementitious Fireproofing: UL System HWD0111.

- e. Nominal 3/4 Inch Joints at Head of 1-Hour Fire Rated Gypsum Board/Stud Wall Assemblies to Concrete Floor or Roof Deck: UL System HWD0134.
- f. Nominal 2 Inch Joints at Head of 1-Hour Fire Rated Gypsum Board/Stud Wall Assemblies Perpendicular to Concrete Filled Fluted Steel Deck Floor or Roof Assembly with Cementitious Fireproofing and Perpendicular or Parallel to Structural Steel Support with Cementitious Fireproofing: UL System HWD0192.
- g. Nominal 2 Inch Joints at Head of 1-Hour Fire Rated Gypsum Board/Stud Wall Assemblies Parallel to Concrete Filled Fluted Steel Deck Floor Assembly: UL System HWD0447.

E. Perimeter Fire Barrier Systems:

- 1. Edge of Slab at Glazed Aluminum Curtain Wall: Engineered judgment #531237 prepared for similar project by specified manufacturer on November 11, 2009 and based on UL System CEJ161P utilizing specified products.
- 2. Edge of Slab at Metal Stud Framed Curtain Wall: UL System CEJ370P.

END OF SECTION

SECTION 07900

JOINT SEALERS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Sealants and joint backing.
- B. Sealant types for sections referencing this section for products.

1.2 RELATED SECTIONS

- A. Section 07540 – Thermoplastic Membrane Roofing: Sealants used in conjunction with membrane roofing and sheet metal flashings incorporated into membrane roofing.
- B. Section 07620 - Sheet Metal Flashing and Trim: Sealants used in conjunction with sheet metal flashing.
- C. Section 07840 - Firestopping: Firestopping caulk and sealant.
- D. Section 09300 - Tile: Sealant used in conjunction with ceramic tile.
- E. Section 09820 - Acoustical Insulation and Sealants: Acoustical sealant.

1.3 REFERENCES

- A. ASTM C834 - Specification for Latex Sealing Compounds.
- B. ASTM C920 - Specification for Elastomeric Joint Sealants.
- C. ASTM C1311 - Specification for Solvent Release Sealants.
- D. ASTM D1056 - Specification for Flexible Cellular Materials - Sponge of Expanded Rubber.

1.4 DESIGN REQUIREMENTS

- A. Sustainable Design Requirements: Sealants for interior application 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™-NC 2009 Credit IEQ4.1.

1.5 SUBMITTALS

- A. Product Data: Submit data indicating chemical characteristics; performance criteria, limitations and color availability. Include accessory items necessary for successful completion of work and recommendations for primer.
- B. Samples: Submit samples of exposed sealant manufacturer's full range of colors for Architect's selection.
- C. Manufacturer's Instructions: Include manufacturer's requirements for surface preparation, temperature and humidity; application equipment and procedures for sealants and primers.
- D. Certificate of Compliance: Upon completion of work, submit certificate signed by Contractor, applicator, stating that sealant and caulking application complies with contract requirements and manufacturer's recommendations, and is proper and adequate for conditions requiring sealants and caulking.
- E. LEED Documentation:
 - 1. Submit letter or product data from manufacturer stating that sealants for interior application used in work of this section do not exceed VOC content limits established in South Coast Air Quality Management District Rule #1168.
 - 2. Submit hard copies of completed Online Documentation required for LEED™ Credit IEQ4.1.

1.6 ENVIRONMENTAL REQUIREMENTS

- A. Do not install solvent curing sealants in enclosed building spaces.
- B. Maintain temperature and humidity recommended by sealant manufacturer during and after installation.

1.7 DELIVERY, STORAGE AND HANDLING

- A. Deliver products to site, store, handle and protect in accordance with manufacturer's instructions and recommendations.
- B. Follow manufacturer's recommendations for storage temperature during and after installation.
- C. Use recommended solvents and cleaning agents for cleaning tools, equipment and skin.

1.8 SEQUENCING AND SCHEDULING

- A. Coordinate installation of sealants with work of sections referencing this section.

1.8 WARRANTY

- A. Provide 3 year warranty covering damage to work resulting from failure to resist penetration of moisture.
- B. Warranty: Replace sealants which fail because of loss of cohesion or adhesion, or do not cure.

PART 2 PRODUCTS

2.1 SEALANT MATERIALS

A. Exterior Non-Traffic Sealants:

- 1. Butyl or Polyisobutylene Type Sealant: ASTM C1311; butyl rubber or butyl rubber/polyisobutylene blend; single component; solvent release; ± 5 percent movement capacity; Pecora BC-158 One-Part Butyl Rubber Sealant or Tremco Butyl Sealant.
- 2. Polyurethane Type Sealant: ASTM C920, Type S, Grade NS, Class 25; polyurethane base; single component; moisture cured; non-sag; ± 25 percent movement capacity; Pecora Corporation "Dynatrol" I, Sika Corporation "Sikaflex-1a" or Tremco "Dymonic FC."
- 3. Silicone Type Sealant: ASTM C920, Type M or S, Grade NS, Class 50; multiple or single component silicone; neutral cure; non-staining; low modulus; non-sag; ± 50 percent joint movement capability; field-tintable to match color of curtainwall framing; Tremco Spectrem® 4-TS Field Tintable Silicone Sealant or Pecora 890 FTS.

B. Interior Sealants:

- 1. Acrylic Latex Type Sealant: ASTM C834; acrylic latex; single component; non-sag, mildew resistant, paintable; ± 7.5 percent movement capacity; Adco Products, Inc. Adco AL-800 Acrylic Latex Sealant, Pecora Corporation AC-20+Silicone, or Tremco "Tremflex" 834.
- 2. Silicone Type Sanitary Sealant: ASTM C920, Type S, Grade NS, Class 25; silicone; single component; mildew resistant; ± 25 percent movement capacity; Dow Corning Corporation 786 Mildew Resistant Silicone Sealant, GE Silicones Sanitary 1700 Sealant, Pecora Corporation 898 Silicone or Tremco "Tremsil 200."

C. Substitutions: Under provisions of Division 1.

2.2 ACCESSORIES

- A. Primer: Quick-drying, colorless, non-staining type, recommended by sealant manufacturer to suit application.
- B. Joint Cleaner: Non-corrosive and non-staining type, recommended by sealant manufacturer; compatible with joint forming materials.
- C. Joint Filler: ASTM D1056, round, closed cell polyethylene foam rod; oversized 30 to 50 percent; as recommended by joint sealer manufacturer.
- D. Bond Breaker: Pressure sensitive tape recommended by sealant manufacturer to suit application.
- E. Masking Tape: Non-staining, non-absorbent type compatible with joint sealants and surfaces adjacent to joints.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine substrate conditions to determine acceptability for installation. Verify that substrates are acceptable for product installation in accordance with manufacturer's instructions and recommendations.
- B. Verify joint dimensions, physical, and environmental conditions are acceptable to receive work of this section.
- C. Do not begin installation until unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean out joints immediately before installing sealants.
- B. Remove loose materials and other foreign matter which might impair adhesion of sealant.
- C. Verify proper surface and ambient temperatures.
- D. Verify that joint backing and release tapes are compatible with sealant.
- E. Protect elements surrounding the work of this section from damage or disfiguration. Use masking tape where required to prevent contact of sealant with adjoining surfaces.
- F. Prime joint surfaces where recommended by joint sealant manufacturers. Apply primer to comply with joint sealant manufacturer's recommendations.

3.3 INSTALLATION

- A. Install sealant in accordance with manufacturer's instructions and recommendations.
- B. Measure joint dimensions and size materials to achieve required width/depth ratios.
- C. Install joint backing to achieve neck dimension no greater than 1/3 the joint width.
- D. Apply sealant within recommended temperature ranges. Consult manufacturer when sealant cannot be applied within recommended temperature ranges.
- E. Install sealant free of air pockets, foreign embedded matter, ridges, and sags.
- F. Tool joints concave.
- G. Remove masking tape immediately after tooling joints without disturbing joint seal.

3.4 CLEANING AND REPAIRING

- A. Clean adjacent soiled surfaces.
- B. Repair or replace defaced or disfigured finishes caused by work of this section.

3.5 PROTECTION OF FINISHED WORK

- A. Protect sealants until cured.

3.6 SCHEDULE

- A. In addition to locations shown or specified, provide sealant at exterior intersections of dissimilar materials.

END OF SECTION

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SECTION 08110

STEEL DOORS AND FRAMES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Rolled steel hollow metal doors.
- B. Steel hollow metal door frames.
- C. Steel hollow metal door frames with sidelites and transoms.
- D. Steel hollow metal glazed lite frames.
- E. Grouting frames.

1.2 RELATED SECTIONS

- A. Section 05400 - Cold Formed Metal Framing: Framed openings in exterior walls.
- B. Section 07620 - Sheet Metal Flashing and Trim: Sheet metal head flashing.
- C. Section 08710 - Door Hardware.
- D. Section 08800 - Glazing: Site glazing of steel doors and frames.
- E. Section 09110 - Non-Load Bearing Metal Framing: Framed openings in interior partitions.
- F. Section 09900 - Paints and Coatings: Field painting of steel doors and frames.

1.3 REFERENCES

- A. ASTM A1008 - Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.
- B. ASTM C476 - Grout for Masonry.
- C. CBC - California Building Code, 2010 edition.
- D. HMMA 802 - Manufacturing of Hollow Metal Door and Frames.
- E. HMMA 810 - Hollow Metal Doors.
- F. HMMA 820 - Hollow Metal Frames.

- G. HMMA 830 - Hardware Preparation and Location for Hollow Metal Doors and Frames.
- H. HMMA 840 - Installation and Storage of Hollow Metal Doors and Frames.
- I. HMMA 850 - Fire Rated Hollow Metal Doors and Frames.
- J. HMMA 861 - Guide specifications for Commercial Hollow Metal Doors and Frames.
- K. NFPA 80 - Fire Doors and Windows.
- L. UL 10C - Positive Pressure Fire Tests of Door Assemblies.

1.4 DESIGN REQUIREMENTS

- A. Sustainable Design Requirements: Steel used in work of this section is intended to contribute to meeting requirements for recycled content outlined in LEED™-NC 2009 Credit MR4.

1.5 SUBMITTALS

- A. Shop Drawings: Indicate door and frame locations referenced to scheduled marks on Drawings.
 - 1. Steel Doors: Indicate door elevations, cores, internal reinforcement, closure method, and cut-outs for glazing and louvers, finish, door locations referenced to door mark on Drawings and hardware group.
 - 2. Steel Frames: Indicate frame elevations, reinforcement, finish, door locations referenced to door mark on Drawings, and method of anchorage to adjacent construction.
- B. Product Data:
 - 1. Steel Doors: Indicate door configurations and cut-outs for hardware reinforcement.
 - 2. Steel Frames: Indicate frame elevations, anchor types and spacings, location of cut-outs for hardware.
- C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- D. 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. Submit hard copies of completed Online Documentation required for LEED™ MR Credit 4.

1.6 QUALITY ASSURANCE

- A. Conform to requirements of HMMA 802, HMMA 810, HMMA 820, HMMA 830, HMMA 840, HMMA 850 and HMMA 861.

1.7 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing custom commercial steel doors and frames with minimum 10 years documented experience.
- B. Installer: Company specializing in installing custom commercial steel doors and frames with minimum 5 years documented experience.

1.8 REGULATORY REQUIREMENTS

- A. Fire-Rated Doors and Frames:
 - 1. Conform to NFPA 80 for fire rated class indicated in schedule when positive pressure tested in accordance with UL 10C.
 - 2. Comply with requirements of CBC Section 715.

1.9 DELIVERY, STORAGE AND PROTECTION

- A. Deliver products to site, store, handle and protect in accordance with manufacturer's instructions and recommendations.
- B. Identify type and size of each door before delivery to permit installation at correct location.
- C. Protect doors and frames with resilient packaging.
- D. Examine doors and frames upon delivery. Promptly clean scratches and disfigurements and touch up with rust inhibitive primer.
- E. Store doors and frames in dry area, under cover.
- F. Place doors and frames on planking or blocking, minimum 4 inches off ground and minimum 2 inches off paving and slabs.
- G. Do not stack material flat; store doors and frames in an upright position with heads uppermost.
- H. Place no more than 5 single opening or 3 multi-opening frames in each group.
- I. Provide, by means of wood strips, minimum space of 1/4 inch between door and between frames to permit air circulation.

- J. Do not permit packaging to become wet. Remove wet packaging immediately.
- K. Remove packaging from doors prior to storing.

1.10 FIELD MEASUREMENTS

- A. Verify that field measurements are as indicated on shop drawings.

1.11 COORDINATION

- A. Coordinate work with door opening construction and door hardware installation.
- B. Coordinate fabrication for fire-rated steel doors and frames with door hardware to ensure assemblies meet fire classes indicated when positive pressure tested in accordance with UL 10C.

PART 2 PRODUCTS

2.1 DOORS

- A. Door Type: HMMA Type A; flush with continuously welded edge seams; full flush, flush with vision panel and flush with louver configurations; fire ratings as indicated.
- B. Door Construction:
 - 1. Faces: Manufactured and fabricated in accordance with HMMA 802 and 810.
 - a. Exterior Doors: Minimum 16 gauge cold rolled steel conforming to ASTM A653 with G60 or A60 zinc or zinc-iron alloy coating.
 - b. Interior Doors: Minimum 18 gauge cold rolled steel conforming to ASTM A1008.
 - 2. Cores: Steel stiffened type; minimum 22 gauge continuous vertical formed steel section spanning full thickness of doors, spaced at 6 inches oc maximum, and spot welded to face sheets at 5 inches oc maximum; sound-deadened and insulated full height with inorganic non-combustible batt-type material.
 - 3. Top and Bottom Edges:
 - a. Exterior Doors: Flush type; minimum 16 gauge continuous recessed channel and flush closing channel full width of door.
 - b. Interior Doors: Standard type; minimum 16 gauge continuous recessed steel channel full width of door.
 - 4. Vertical Edges: Beveled 1/8 inch in 2 inches.

C. Vision Panel Moldings and Stops:

1. Fixed Moldings: Flush type; minimum 20 gauge roll formed steel.
2. Removable Stops: Minimum 20 gauge roll formed steel; channel shape; mitered corners; prepared for countersink style screws.
3. Screws: Tamper resistant spanner or torx head machine screws.

D. Louvers: Same material as door; minimum 14 gauge; stationary; sightproof, hood type with 50 percent free area; flush with door faces; welded blade construction.

2.2 FRAMES

A. Exterior Frames: Minimum 14 gauge cold rolled steel conforming to ASTM A653 with G60 or A60 zinc or zinc-iron alloy coating.

B. Interior Frames:

1. Material: Cold rolled steel conforming to ASTM A1008.
2. Material Thickness:
 - a. Openings Up to 4'-0" Wide: Minimum 16 gauge.
 - b. Openings 4'-0" Wide and Wider: Minimum 14 gauge.

C. Accessories:

1. Anchors:
 - a. Floor: Minimum 14 gauge roll formed steel.
 - b. Wall: Minimum 18 gauge roll formed steel.
 - c. Existing Opening Anchor Spacers: Minimum 12 gauge roll formed steel.
2. Expansion Bolts: Sleeve type; plated steel; minimum 3/8 inch diameter; length sufficient for minimum 2 inch embedment into concrete; flat head; Hilti Corp. Sleeve Anchors, ITW Ramset/Redhead Dynabolt Sleeve or equal product substituted under provisions of Division 1.
3. Removable Stops: Minimum 20 gauge roll formed steel; channel shape; butted corners; prepared for countersunk type screws.
4. Mortar Guards: Minimum 26 gauge roll formed steel.
5. Grout: ASTM C476; minimum compressive strength of 2000 psi at 28 days; maximum 4 inch slump.

2.3 FABRICATION - DOORS

- A. Fabricate doors in accordance with HMMA 861 with fully welded seamless construction and with no visible seams or joints on faces or vertical edges.
- B. Form doors to thickness and face dimensions indicated on Drawings.
- C. Grind, fill and dress welds smooth to make welds invisible and provide smooth flush surface.
- D. Mortise, reinforce, drill and tap doors for template hardware. Reinforce doors for surface mounted hardware. Weld hardware reinforcement in place. Minimum gauge for hardware reinforcing plates shall be as follows:
 - 1. Hinge Reinforcements: 7 gauge.
 - 2. Reinforcements for Lock Face, Flush Bolts, Concealed Holders, Concealed and Surface Mounted Closers: 12 gauge.
 - 3. Reinforcements for Other Surface Mounted Hardware: 16 gauge.
- E. Fabricate doors to provide following clearances:
 - 1. Between Doors and Frames at Head and Jambs: 1/8 inch.
 - 2. Between Edges of Pairs of Doors: 1/8 inch.
 - 3. Between Door Bottom and Nominal Surface of Floor Covering: 5/8 inch.
 - 4. Between Door Bottom and Top of Threshold: 3/8 inch.
- F. Close top and bottom edge of exterior doors with flush end channel closure. Seal joints weathertight.
- G. Provide openings in bottom closure of exterior doors to permit escape of entrapped moisture.
- H. Prepare openings in doors for vision panels. Securely weld fixed moldings to security side of doors.
- I. Prepare openings in doors for louvers; install louvers. Securely weld louvers in place flush with faces of doors without use of overlapping edge trim.
- J. Fabricate fire rated doors to HMMA 850. Attach label to each door assembly. Advise Architect, prior to commencing fabrication, of door assemblies indicated to be fire rated which cannot qualify for appropriate labeling.

2.4 FABRICATION FRAMES

- A. Fabricate frames in accordance with HMMA 861 as welded units with integral trim.
- B. Fabricate frames square, true, and free from defects, warp or buckle with depths, trim, profile and backbends as indicated on Drawings.
- C. Form corner joints of frames with contact edges closed tight, with faces mitered, and with stops butted; continuously weld full depth and width of frame.
- D. Form mullions and rails for multi-opening frames as closed tubular shapes with no visible seams or joints; butt and face weld joints. Seal joints that are not welded weather-tight; apply sealant to unexposed face of frame.
- E. Mortise, reinforce, drill and tap frames for template hardware. Reinforce frames for surface mounted hardware. Weld hardware reinforcement in place. Minimum gauge for hardware reinforcing plates shall be as follows:
 - 1. Hinge Reinforcements: 7 gauge; 1-1/4 x 10 inch minimum size.
 - 2. Strike Reinforcements: 12 gauge.
 - 3. Flush Bolt Reinforcements: 12 gauge.
 - 4. Closer Reinforcements: 12 gauge.
 - 5. Reinforcements for Surface Mounted Hardware, Hold Open Arms, and Surface Exit Devices: 12 gauge.
- F. Securely weld wall anchors inside each jamb of frames as follows:
 - 1. Frames Installed in Metal Stud Framed Walls and Partitions: Metal channel stud type anchors.
 - a. Frames up to 5'-0": 3 anchors at exterior frames; 2 anchors at interior frames.
 - b. Frames up to 5'-0" to 7'-6": 4 anchors.
 - c. Frames 7'-6" to 8'-0": 5 anchors.
 - d. Frames over 8'-0": 5 anchors plus 1 additional anchor for each 2 feet or fraction thereof of frame over 8'-0."
 - 2. Frames Installed in Concrete and Masonry Walls: Existing opening type anchors spaced maximum 6 inches from top and bottom of frames and at maximum 26 inches oc between top and bottom anchors.
- G. Securely weld floor anchors inside each jamb as follows:

1. Frames Installed in Metal Stud Walls without Concrete Curbs: Standard floor anchor with 2 holes in horizontal leg for fasteners.
 2. Frames Installed in Metal Stud Walls with Concrete Curbs: Existing opening type wall anchors in lieu of standard floor anchors.
- H. Dimple frames for existing opening anchors.
- I. Reinforce frames wider than 4'-0" with minimum 12 gauge steel angle or channel stiffener welded into head.
- J. Install mortar guards on mortises of frames to be installed in masonry and concrete walls.
- K. Drill door frames as scheduled in Section 08710 to receive silencers. Do not drill fire-rated frames or frames scheduled in Section 08710 to receive gasketing or weatherstripping.
1. Provide for 3 silencers for single doors on strike side.
 2. Provide for 2 silencers on frame head for double doors.
- L. Provide steel spreader temporarily attached to serve as brace during shipping and handling.
- K. Fabricate frames for fire-rated openings to HMMA 850. Attach fire label to each frame. Advise Architect, prior to commencing fabrication, of frames indicated to be fire rated cannot qualify for appropriate labeling.
- 2.5 FINISH
- A. Dress, fill and sand tool marks, surface imperfections and exposed faces of welded joints.
 - B. Thoroughly clean surfaces of oil, grease and other impurities.
 - C. Touch up abraded galvanizing.
 - D. Chemically treat steel surfaces to ensure paint adhesion.
 - E. Apply 1 coat of rust inhibitive primer to accessible surfaces; allow to fully cure prior to shipment.
 - F. Apply coat of bituminous water resistant paint to concealed back surfaces of frames to be grouted.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine substrate conditions to determine acceptability for installation. Verify that substrates are acceptable for product installation in accordance with manufacturer's instructions and recommendations.
- B. Verify that opening sizes and tolerances are acceptable.
- C. Verify that backing and support are properly sized and secured.
- D. Verify that adjacent installed work is free from defects that would adversely affect installation of doors and frames.
- E. Check door frames for size, swing, squareness, alignment, twist and plumbness.
- F. Do not begin installation until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install doors and frames in accordance with HMMA 840, final reviewed shop drawings and manufacturer's instructions.
- B. Coordinate with wall construction for anchor placement.
- C. Drill concrete curbs for installation of expansion bolts at existing opening anchors.
- D. Set frames accurately in position, plumb, aligned and attached securely to structure.
- E. Set frames before removing spreader bars.
- F. Fully grout frames installed in concrete and masonry walls. Grout frames installed in framed walls with concrete curbs from bottom of frame to top of curb.
 - 1. Hand trowel grout with 4 inch slump or less. Provide additional protection for tapped holes, electrical knockouts, lock pockets and mortar guards if grout with slump over 4 inches is used.
 - 2. Immediately remove grout or other bonding materials from door and frame surfaces.
- G. Install roll formed steel reinforcement channels between 2 abutting frames. Anchor to structure and floor.
- H. Putty dimpled recesses at existing opening anchors; prepare for painting.
- I. Coordinate installation of doors with installation of hardware specified in Section 08710. Ensure doors are installed at correct openings.
- J. Coordinate installation of glass and glazing.

- K. Touch-up scratched and otherwise marred surfaces.
- L. Coordinate painting of doors, panels and frames.

3.3 TOLERANCES

- A. Squareness: $+1/16$ inch measured on line 90 degrees from 1 jamb at upper corner of frame at other jamb.
- B. Alignment: $+1/16$ inch measured on jambs on horizontal line parallel to plane of wall.
- C. Twist: $+1/16$ inch measured at face corners of jambs on parallel lines perpendicular to plane of wall.
- D. Plumbness: $+1/16$ inch measured on jamb at floor.

3.4 ADJUSTING

- A. Adjust doors for smooth and balanced door movement.

END OF SECTION

SECTION 08212
FLUSH WOOD DOORS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Flush wood doors.
- B. Factory finishing.

1.2 RELATED SECTIONS

- A. Section 08110 – Steel Doors and Frames: Frames for flush wood doors.
- B. Section 08410 - Aluminum Door and Glazing Frames: Frames for flush wood doors.
- C. Section 08710 - Door Hardware.
- D. Section 08800 - Glazing: Site glazing of wood doors.

1.3 REFERENCES

- A. ANSI A208.1 - Mat Formed Wood Particleboard.
- B. HPVA HP-1 - Standard for Hardwood and Decorative Plywood.
- C. NFPA 80 - Fire Doors and Windows.
- D. NWWDA I.S.1 - Industry Standard For Wood Flush Doors.
- E. UL 10C - Positive Pressure Fire Tests of Door Assemblies.
- F. WI - Woodwork Institute "Manual of Millwork."
- G. WDMA - Window and Door Manufacturers Association.

1.4 DESIGN REQUIREMENTS

- A. Sustainable Design Requirements:
 - 1. Lumber used in work of this section is to come from forests that have been certified "Well Managed" forestry sources in accordance with programs of Forest Stewardship Council and is intended to contribute to meeting requirements for certified wood outlined in LEED™-NC 2009 Credit MR7.

2. Composite wood materials used in work of this section are intended to:
 - a. Contribute to meeting requirements for recycled content outlined in LEED™-NC 2009 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 added urea-formaldehyde resins outlined in LEED™-NC 2009 Credit IEQ4.4.
3. 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™-NC 2009 Credit IEQ4.1.

1.5 SUBMITTALS

- A. Shop Drawings: Indicate door locations referenced to scheduled marks on Drawings.
 1. Include door opening criteria, elevations, sizes, types, fire rating, handing, special beveling, special blocking for hardware, cutouts for glazing, construction details not covered on product data, hardware group and finish for each door.
 2. Affix WI Certified Compliance Label to first sheet of shop drawings.
- B. Product Data: Indicate door and core materials and constructions; veneer species and characteristics; factory machining characteristics.
- C. Samples:
 1. Veneers: Submit samples, minimum 12 x 12 inches in size; of specified veneer showing range of variation in grain pattern and color to be expected with specified finish applied.
 2. Door Construction: Submit samples, minimum 8 x 12 inches in size, of top corner section of each type of door illustrating of construction, core, bonding, veneer thickness, edge and top construction.
- D. Manufacturer's Certificates:
 1. Submit WI Certified Compliance Certificate prior to delivery of doors to site certifying compliance with specified grade requirements.
 2. Submit WI Certified Compliance Certificate for installation after completion of work of this section.

E. LEED Documentation:

1. Certified Wood: Submit Forest Stewardship Council chain-of-custody certificate number with each delivery.
2. Composite Wood Panels:
 - a. Recycled Content: Submit letter or product data from manufacturer indicating recycled contents. Designate percentage of post-consumer and post-industrial recycled content.
 - b. Urea-Formaldehyde Resin Content: Submit letter or product data from manufacturer stating that no materials used in this product contain urea-formaldehyde resins.
3. 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.
4. Submit hard copies of completed Online Documentation required for LEED™ MR Credit 4, IEQ Credit 4.1 and IEQ Credit 4.4.

1.6 QUALITY ASSURANCE

- A. Conform to requirements of WI Section 12 Doors - Flush, Custom Grade except where otherwise specified.
- B. Provide WI compliance certifications for grade and installation.

1.7 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing flush wood doors with minimum 5 years documented experience.
- B. Installer: Company specializing in installing flush wood doors with minimum 3 years documented experience.

1.8 REGULATORY REQUIREMENTS

- A. Fire Rated Doors: Conform to NFPA 80 for fire rated class indicated on Drawings when positive pressure tested in accordance with UL 10C.

1.9 DELIVERY, STORAGE, AND PROTECTION

- A. Package, deliver, and store doors in accordance with manufacturer's instructions and recommendations.
- B. Identify type and size of each door before delivery to permit installation at correct location.

- C. Provide temporary protective covers for doors during delivery, installation and until final acceptance.
- D. Protect doors to prevent warping and bowing during shipment and storage.
- E. Deliver doors to job site only after proper facilities are available for handling, sorting and protecting doors, after receiving areas are broom cleaned, after building is enclosed and after wet work is complete.
- F. Handle doors with clean hands or gloves. Do not drag doors across one another.

1.10 ENVIRONMENTAL REQUIREMENTS

- A. Provide proper heat and humidity in area of storage and installation to maintain equilibrium moisture content in wood until work is complete.
- B. Maintain relative humidity between 50 and 65 percent at 70 degrees F.

1.11 FIELD MEASUREMENTS

- A. Verify that field measurements are as indicated on shop drawings.

1.10 COORDINATION

- A. Coordinate work with door opening construction, door frame and door hardware installation.
- B. Coordinate fabrication of fire rated doors with fabrication of steel frames and with door hardware to ensure assembly meets fire class indicated when positive pressure tested in accordance UL 10C.

1.121 WARRANTY

- A. Manufacturer's Warranty: Provide for replacing, including cost of rehanging and refinishing, at no cost to Owner, interior wood doors exhibiting defects in materials or workmanship including delamination, warp and telegraphing exceeding specified tolerances within life of installation.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Eggers Industries.
 - 1. Non-Rated Doors: Master Flush - Particleboard.
 - 2. 20 Minute Rated Doors: Master Flush - 20 Minute Fire Door.
 - 3. 45, 60 and 90 Minute Rated Doors: FireGuard Plus.

B. Manufacturers Offering Equal Products:

1. Algoma Hardwoods, Inc.
2. Marshfield Door Systems, Inc.

C. Substitutions: Under provisions of Division 1.

2.2 DOOR TYPES

- A. Flush Interior Doors: 1-3/4 inches thick; WI Premium Grade; solid core; 5 ply construction; full flush and flush with vision panel configurations; fire rating as indicated.

2.3 DOOR CONSTRUCTION

A. Cores:

1. Non-Rated and 20 Minute Rated Doors: ANSI A208.1, Grade LD-2; mat-formed particleboard.
2. 45, 60 and 90 Minute Rated Doors: Asbestos-free incombustible mineral approved by labeling authority.

B. Stiles:

1. Non-Rated Doors: 2-ply with outer ply same species as face veneers and free from joints; mill option inner ply; 1-3/8 inch thick.
2. 20 Minute Rated Doors:
 - a. Single Doors: 2-ply with outer ply same species as face veneers and free from joints; mill option inner ply; 1-3/8 inch thick.
 - b. Pairs of Doors: 2 ply fire-treated with treated maple outer ply free from joints; mill option inner ply; 1-3/8 inch thick.
3. 45, 60 and 90 Minute Rated Doors: 3 ply intumescent edge strip as required to meet Positive Pressure Category A with veneer banded edge of same species as face veneers and free from joints; 5/8 inch thick.

C. Rails:

1. Non-Rated and 20 Minute Rated Doors: Mill option hardwood; 1-1/8 inch thick.
2. 45, 60 and 90 Minute Rated Doors: Minimum 1/2 inch top rail with concealed intumescent; minimum 1-1/2 inch 2-ply bottom rail; mill option material.

- D. Cross Bands: Hardwood or engineered fiber; minimum 1/16 inch thick; minimum 60 lbs/cu ft density.

- E. Facings: Hardwood veneer; minimum 1/50 inch thick after sanding; maximum 12 percent moisture content.
 - 1. Facing Quality: HPVA A Grade for transparent finish.
 - 2. Species: White Oak.
 - 3. Veneer Cut: Quarter Cut.
 - 4. Finish: Sealed satin finish, clear
 - 5. Matches:
 - a. Matching Between Individual Veneer Pieces: Book match.
 - b. Assembly of Spliced Veneer on Door Face: To be determined.
 - c. Matching Between Doors: Pair matched.
- F. Adhesives: W1 Type I or II; VOC content no to exceed limits established in South Coast Air Quality Management District Rule #1168.

2.4 ACCESSORIES

- A. Glass Stops:
 - 1. Non-Rated Doors: Solid stock close grain hardwood moldings; species to match face veneers; non-lipped profile; back beveled for glazing; mitered corners; 90 degree angle on glass; 5/8 inch high x 23/32 inch wide; Eggers #100 Stock Lite Bead Profile.
 - 2. 60 Minute Rated Doors: Veneer wrapped noncombustible material with recessed 2-part metal glazing stops; veneer species to match face veneer; non-lipped profile; mitered corners; 90 degree angle on glass; 5/8 inch high x 5/8 inch wide; Eggers 45, 60 & 90 Minute Veneer Wrapped Wood Bead.
- B. Sealer: Manufacturer's standard interior type compatible with specified finish system specified.

2.5 FABRICATION

- A. Fabricate non-rated doors in accordance with W1 quality standards requirements.
- B. Fabricate fire rated doors in accordance with W1 standards for label indicated on Drawings and to UL or Warnock-Hersey requirements.
 - 1. Attach fire rating label to door edge.
 - 2. Advise Architect, prior to commencing fabrication, of doors indicated to be fire rated which cannot qualify for appropriate labeling.

- C. Provide internal blocking to ensure surface mounted hardware can be installed without use of through bolts.
 - 1. Provide blocking for closers and exit devices in particleboard core doors.
 - 2. Provide noncombustible internal blocking for closers, exit devices, locks, door bottoms and flush bolts in mineral core doors.
- D. Construct stiles for meeting stiles of pairs of rated doors so that metal edges and astragals are not required.
- E. Bond stiles and rails to cores with adhesive under pressure.
- F. Bevel strike edge of single acting doors 1/8 inch in 2 inches.
- G. Factory machine doors for hardware in accordance with hardware requirements and dimensions. Do not machine for surface hardware.
- H. Factory cut openings for vision panels. Seal edges of cutouts with 2 coats sealer.
- I. Factory fit doors for frame dimensions identified on shop drawings.

2.6 FINISH

- A. Factory Finish for Hardwood Veneer Faced Doors: Factory finish in accordance with WI Section 5, System 4 - Conversion Varnish, Custom Grade:
 - 1. First Coat: Stain as required to match Architect's sample.
 - 2. Second Coat: Sanding sealer.
 - 3. Third Coat: Top coat of conversion varnish.
 - 4. Fourth Coat: Top coat of conversion varnish.
- B. Finish door edges to match faces.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine substrate conditions to determine acceptability for installation. Verify that substrates are acceptable for product installation in accordance with manufacturer's instructions and recommendations.
- B. Verify that opening sizes and tolerances are acceptable.
- C. Verify that frame openings that are plumb or are not out-of-tolerance for size or align-

ment.

- D. Do not begin installation until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install doors in accordance with final reviewed shop drawings and with manufacturer's instructions and recommendations.
 - 1. Install non-rated doors in accordance with WI Section 12 Custom Grade.
 - 2. Install fire rated doors in accordance with WI Section 12 Custom Grade, NFPA 80, and to UL or Warnock-Hersey requirements.
- B. Prepare doors to receive surface hardware in accordance with NWWDA requirements.
 - 1. Pilot drill screw holes.
 - 2. Use of threaded through bolts for surface hardware is not permitted.
- C. Coordinate installation of doors with installation of frames specified in Section 08124 and of hardware specified in Section 08710.
- D. Coordinate installation of glass and glazing.

3.3 INSTALLATION TOLERANCES

- A. Clearances:
 - 1. Non-Rated Doors:
 - a. Jambs and Heads: 1/8 inch.
 - b. Meeting Stiles of Pairs of Doors: 1/16 inch per leaf.
 - c. Bottom of Door to:
 - 1) Top of Raised Non-Combustible Sill: 3/8 inch maximum.
 - 2) Top of Rigid Floor Tile: 5/8 inch maximum.
 - 3) Nominal Top of Other Floor Covering Surface: 1/2 inch maximum.
 - 4) Top of Structural Substrate Where No Sill Exists: 3/4 inch maximum.
 - 2. 60 Minute Rated Doors: As required by labeling authority.

B. Warp:

1. Maximum Diagonal Distortion (Twist): 1/4 inch measured with straight edge, corner to corner.
2. Maximum Vertical Distortion (Bow): 1/4 inch measured with straight edge, top to bottom.
3. Maximum Width Distortion (Cup): 1/4 inch measured with straight edge, edge to edge.

C. Telegraphing: Not to exceed 1/100 inch in 3 inch span.

D. Delamination: None permitted.

3.4 ADJUSTING

A. Adjust door installation for correct function and smooth and balanced door movement.

B. Restore factory finish damaged during installation.

1. Restore in manner that results in door showing no evidence of restoration.
2. Replace doors on which finish restoration cannot be made to match factory finish.

3.5 PROTECTION

A. Protect doors from damage to surface or profile until final acceptance.

END OF SECTION

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SECTION 08410

ALUMINUM ENTRANCES AND STOREFRONTS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Aluminum storefront frames.
- B. Aluminum entrance doors and frames.
- C. Glass and glazing.
- D. Associated aluminum brake shape closures.
- E. Anchors, brackets and attachments.
- F. Installation of door hardware.

1.2 PRODUCTS INSTALLED BUT NOT SUPPLIED UNDER THIS SECTION

- A. Section 08710 - Door Hardware: Supply of door hardware for installation under this section.

1.3 RELATED SECTIONS

- A. Section 07900 - Joint Sealers: Perimeter sealant and backing materials between aluminum storefront frames and adjacent finishes.
- B. Section 08710 - Door Hardware.
- C. Section 08800 - Glazing: Glass types.
- D. Section 08911 – Glazed Aluminum Curtain Wall: Aluminum framing with matching finish for exterior glazing.
- E. Section 09110 – Non-Load Bearing Metal Framing: Framed openings

1.4 REFERENCES

- A. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels.
- B. ASTM A36 - Specification for Carbon Structural Steel.
- C. ASTM B209 - Specification for Aluminum and Aluminum Alloy Sheet and Plate.

- D. ASTM B221 - Specification for Aluminum-Alloy Extruded Bar, Rod, Wire, Shape and Tube.
- E. ASTM E283 - Rate of Air Leakage through Exterior Windows, Curtain Walls and Doors.
- F. ASTM E330 - Structural Performance of Exterior Windows, Curtain Walls and Doors by Uniform Static Air Pressure Difference.
- G. BHMA - Builders Hardware Manufacturing Association.
- H. CBC - California Building Code, 2010 edition.
- I. SSPC - Society for Protective Coatings.

1.5. SYSTEM DESCRIPTION

- A. Aluminum Entrance and Storefront System: Aluminum storefront system for interior glazing including shop-fabricated factory-finished aluminum sections with glass, glazing, closures, anchorage and attachment devices with related entrances.

1.6 DESIGN REQUIREMENTS

- A. Color and sheen of finish for aluminum sections specified under this section to match color and sheen of finish for aluminum framing sections specified in Section 08911.
- B. Sustainable Design Requirements: Aluminum and steel used in work of this section is intended to contribute to meeting requirements for recycled content outlined in LEED™-NC 2009 Credit MR4.

1.7 PERFORMANCE REQUIREMENTS

- A. System to provide for expansion and contraction within system components caused by cycling temperature range of 180 degrees F without causing detrimental effects to system or components.
- B. Design and size members to withstand dead loads and live loads caused by pressure and suction of wind as calculated in accordance with CBC.
- C. Drain water entering joints, condensation occurring in glazing channels, or migrating moisture occurring within system, to exterior.
- D. System to accommodate, without damage to system or components or deterioration of perimeter seal, movement within system, movement between system and perimeter framing components, dynamic loading and release of loads, and deflection of structural support framing.

E. Storefront Framing:

1. Air Infiltration: Air infiltration rate not to exceed 0.06 CFM per sq ft at 6.24 PSF static air pressure differential when tested in accordance with ASTM E283.
2. Mullion Lateral Load Deflection: Limit mullion deflection to L/175 with full recovery of glazing materials when measured in accordance with ASTM E330.
3. System Deflection: Limit to 1/8 inch at center point or 1/16 inch at center point of horizontal member once dead load points have been established.

1.8 SUBMITTALS

A. Shop Drawings: Indicate materials, finishes, system dimensions, framed opening requirements and tolerances, anticipated deflection under load, affected related work, expansion and contraction joint locations and details and anchorage details.

B. Product Data:

1. Provide component dimensions, describe components within assembly, anchorage and fasteners and glass and infill.
2. Provide framing member structural and physical characteristics, dimensional limitations, special installation requirements.

C. Samples:

1. Aluminum Finish: Submit samples, minimum 4 x 6 inches in size, illustrating specified color and sheen on aluminum extrusion.
2. Glass: Submit samples, minimum 12 x 12 inches in size, of each type of sealed insulated glass unit illustrating construction and color.

D. Test Reports: Submit results of previous tests by independent testing laboratory indicating that products meet or exceed specified performance requirements.

E. Manufacturer's Installation Instructions: Indicate special installation procedures.

F. LEED Documentation:

1. Aluminum: Submit letter or product data from manufacturer indicating recycled contents. Designate percentage of post-consumer and post-industrial recycled content.
2. Steel: Submit letter or product data from manufacturer indicating recycled contents. Designate percentage of post-consumer and post-industrial recycled content.
3. Submit hard copies of completed Online Documentation required for LEED™ MR Credit 4.

1.9 QUALITY ASSURANCE

- A. Source Limitations: Obtain primary system components from single manufacturer. Provide secondary components as recommended by manufacturer of primary components unless specified otherwise.

1.10 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing aluminum glazing systems with minimum 10 years documented experience.
- B. Installer: Company specializing in the installation of aluminum glazing systems with minimum 3 years documented experience and prequalified by manufacturer.

1.11 REGULATORY REQUIREMENTS

- A. Doors: Comply with requirements of CBC Sections 1008 and 1133B.2.
- B. Glass: Comply with requirements of CBC Chapter 24.

1.12 PREINSTALLATION CONFERENCE

- A. Convene preinstallation conference minimum 1 week prior to commencing work of this section.
- B. Attendance: Contractor, aluminum storefront and entrances installer, Project Inspector, Construction Manager and Architect.
- C. Agenda: Review shop drawings, installation procedures and coordination required with work of other trades. Conduct inspection of openings and substrates.

1.13 DELIVERY, STORAGE AND HANDLING

- A. Deliver products to site, store, handle and protect in accordance with manufacturer's instructions and recommendations.
- B. Deliver materials in manufacturer's original unopened and undamaged containers with identification labels intact.
- C. Store materials protected from exposure to harmful weather conditions and at temperature conditions recommended by manufacturer.
- D. Protect pre-finished aluminum surfaces with wrapping or strippable coating. Do not use adhesive papers or sprayed coatings that bond when exposed to sunlight or weather.

1.14 FIELD MEASUREMENTS

- A. Verify that field measurements are as indicated on shop drawings.

1.15 WARRANTY

A. Manufacturer's Warranties:

1. Entrances and Storefront System: Warrant against failure and deterioration of metals due to manufacturing process for period of 2 years from date of Substantial Completion.
2. Sealed Insulated Glass Units: Warrant units free from seal failure and interpane dusting for period of 5 years from date of Substantial Completion. Replace units that fail within warranty period.
3. Finish: Warrant fluoropolymer coating system against fading more than 10 percent, chalking, yellowing, peeling, cracking, pitting, corroding and non-uniformity of color and gloss deterioration beyond manufacturer's descriptive standards for period of 20 years from date of Substantial Completion.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Arcadia, Inc.:

1. Storefront Framing: A400 Series.
2. Stile and Rail Entrance Doors: WS512 HD Series.

B. Manufacturer Offering Acceptable Equivalent Products: Kawneer Company, Inc.

C. Substitutions: Under provisions of Division 1.

2.2 MATERIALS

- A. Extruded Aluminum: ASTM B221; 6063 alloy, T5 temper.
- B. Sheet Aluminum: ASTM B209; 5005 alloy.
- C. Steel Sections: ASTM A36; shapes to suit mullion sections.
- D. Primer: SSPC 15; red oxide; for shop application and field touch-up.

2.3 FABRICATED COMPONENTS

- A. Storefront Frames: Extruded aluminum; 1-3/4 x 4 inch nominal profile; without thermal break; captured centered glazing; glazing channel for 1/4 inch glass; reinforcing as required to withstand live and dead loads; screw spline/shear block construction system; framing members, transition members, mullions, corners and adaptors as indicated on Drawings and as required to attain configurations indicated on Drawings; Arcadia A400 Series 1-3/4 x 4 Inch Center Glazed System for 1/4 Inch Glass.

- B. Stile and Rail Entrance Doors: Wide stile; single acting; full glass configuration; 1-3/4 inches thick; face dimensions as indicated on Drawings; Arcadia WS512 HD Series Heavy Duty Wide Stile Door.
 - 1. Frame: Extruded aluminum; nominal 0.188 inch wall thickness; 5-5/16 inch top rail; 5 inch vertical stiles; 10 inch bottom rail.
 - 2. Glass Stops: Extruded aluminum; nominal 0.050 inch wall thickness; snap-in type; square profiles for 1/4 and 1 inch thick glass.
- C. Brake Shape Closures: 12 gauge aluminum sheet.
- E. Brake Shape Clips and Adaptors: Manufacturer's standard for configurations indicated on Drawings.
- F. Fasteners:
 - 1. Within System: Manufacturer's standard aluminum, stainless steel or zinc plated steel in accordance with ASTM A164.
 - 2. Perimeter Fasteners:
 - a. To Framing: Manufacturer's standard aluminum or steel screws; steel fasteners properly isolated from aluminum.
 - b. To Concrete: Sleeve type expansion anchors; stainless steel; Hilti Corp. Sleeve Anchor, ITW Ramset/Redhead "Dynabolt" Sleeve Anchor or equal product substituted under provisions of Division 1.
- G. Shims: Manufacturer's standard.

2.6 GLASS AND GLAZING MATERIALS

- A. Glass: Transparent Tempered Float Vision Glass as specified in Section 08800; 1/4 inch thick.
- B. Glazing Materials: Manufacturer's standard glazing gaskets; compression type design; replaceable; configured to lock securely into glazing reglet; molded or extruded santoprene, polyvinyl chloride or ethylene propylene diene monomer; gray color.

2.7 HARDWARE

- A. Entrance Door Hardware:
 - 1. Operating hardware and trim are specified and scheduled in Section 08710 - Door Hardware.
 - 2. Weatherstripping: Manufacturer's standard hard-backed poly pile.
 - 3. Sill Sweep Strips: Manufacturer's standard concealed brush strip.

2.9 FABRICATION

- A. Fabricate components allowing for minimum clearances and shim spacing around perimeter of assembly, yet enabling installation.
- B. Storefront Framing: Fabricate storefront framing components shear block reinforcement at joints and corners.
 - 1. Rigidly fit and secure storefront framing joints and corners.
 - 2. Make joints and connections flush, hairline and weatherproof.
 - 3. Prepare internal reinforcement for hardware using templates provided under Section 08710.
- C. Stile and Rail Entrance Doors: Fabricate stile and rail entrance doors of tubular sections with top and bottom rails joined to stiles by concealed reinforcement brackets secured with MIG welds.
 - 1. Provide with adjusting mechanisms in top rail near lock stile.
 - 2. Prepare internal reinforcement for hardware using templates provided under Section 08710.
- E. Prepare and reinforce components to receive anchor devices. Fabricate anchorage items.
- F. Arrange fasteners, attachments and jointing to ensure concealment from view.
- G. Prepare components with internal reinforcement for door hardware and door operator hinge hardware.
- H. Fabricate brake shape closures to indicated shapes.

2.10 FINISHES

- A. Extruded Aluminum Frames: AAMA 2605; factory-applied baked-on high performance organic coating formulated under license and containing not less than 70 percent Hylar 5000™ or Kynar 500® PVDF resin by weight; products of PPG Industries, Inc, Valspar Corporation or BASF; custom color to be determined.
 - 1. Pretreatment: Clean; apply chromium phosphate coating.
 - 2. Primer: Coating manufacturer's standard resin base compatible with coating; apply to minimum 0.2 mil dry film thickness.
 - 3. Color Coat: Apply to minimum 0.75 mil dry film thickness.
 - 4. Clear Coat: Apply to minimum 0.50 mil dry film thickness.

- B. Entrance Doors: Color and finish to match frames.
- C. Brake Shape Closures: Finish and color to match frames.
- D. Apply 1 coat of bituminous paint to concealed aluminum and steel surfaces in contact with cementitious materials and dissimilar metals.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine substrate conditions to determine acceptability for installation. Verify that substrates are acceptable for product installation in accordance with manufacturer's instructions and recommendations.
- B. Verify dimensions, tolerances and method of attachment with other work.
- C. Verify wall openings are ready to receive work of this section.
- D. Verify that hardware supplied under Section 08710 for installation under this section is of correct type, configuration, finish and quantity.
- E. Do not begin reinstallation until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install storefront framing, entrance doors, glazing and hardware in accordance with final reviewed shop drawings and with manufacturer's instructions and recommendations.
- B. Use anchorage devices to securely attach frame assembly to structure. Space perimeter fasteners 18 inches oc maximum.
- C. Align assembly plumb and level, free of warp or twist. Maintain assembly dimensional tolerances, aligning with adjacent work.
- D. Install brake shape closures. Connect closures to clips and clips to framing with concealed fasteners.
- E. Install hardware in accordance with hardware manufacturer's instructions and requirements of BHMA. Use templates provided by hardware item manufacturer.
 - 1. Conform to CBC Section 1133B.2.5.2 for hardware positioning requirements for persons with disabilities.
 - a. Ensure touchbars for panic hardware are mounted between 36 and 44 inches from finished floor.
 - b. Ensure other door operating hardware including levers, key cylinders and turn pieces is mounted between 30 and 44 inches from finished floor.

2. Set floor stops out of traffic pattern and as close to door jamb as is functionally possible.
3. Set thresholds in full bed of mastic and secure to slab with bolts and expansion shields.

- G. Install glass in doors and storefront framing using manufacturer's recommended method of glazing.
- H. Coordinate installation of perimeter sealant and backing materials specified in Section 07900.

3.3 TOLERANCES

- A. Variation from Plane: 0.03 inches per foot maximum or 0.25 inches per 30 feet, whichever is less.
- B. Misalignment of 2 Adjoining Members Abutting in Plane: 0.015 inches.

3.4 ADJUSTING

- A. Adjust door operating hardware for smooth operation.
- B. Adjust manual door closers so that opening effort does not exceed 5 pounds.

3.5 CLEANING

- A. Remove protective material from prefinished aluminum surfaces.
- B. Wash down exposed aluminum surfaces using a solution of mild detergent in warm water, applied with soft, clean wiping cloths. Take care to remove dirt from corners. Wipe surfaces clean.
- C. Remove excess sealant by moderate use of mineral spirits or other solvent acceptable to sealant manufacturer.
- D. Clean glass as specified in Section 08800.

3.6 PROTECTION OF FINISHED WORK

- A. Protect finished work from damage.
- B. Protect exposed portions of aluminum surfaces from damage by grinding and polishing compounds, plaster, lime, acid, or other contaminants.
- C. Protect glass as specified in Section 08800.

END OF SECTION

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SECTION 08710
DOOR HARDWARE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes commercial door hardware for the following:
1. Swinging doors.
 2. Other doors to the extent indicated.
- B. Door hardware includes, but is not necessarily limited to, the following:
1. Mechanical door hardware.
 2. Automatic operators.
 3. Cylinders specified for doors in other sections.
- C. Related Sections:
1. Section 06 10 00 – Rough Carpentry
 2. Section 06 20 00 – Finish Carpentry
 3. Section 08 11 13 – Hollow Metal Doors and Frames
 4. Section 08 14 16 – Flush Wood Doors
 5. Section 08 41 13 – Aluminum-Framed Entrances and Storefronts.
 6. Section 08 81 00 – Glass and Glazing
 7. Section 09 90 00 – Painting
- D. Codes and References: Comply with the version year adopted by the Authority Having Jurisdiction.
1. ANSI A117.1 - Accessible and Usable Buildings and Facilities.
 2. NFPA 70 - National Electrical Code.
 3. NFPA 80 - Fire Doors and Other Opening Protectives.
 4. NFPA 101 - Life Safety Code.
 5. NFPA 105 - Installation of Smoke Door Assemblies.
 6. 2010 California Building Code

- E. Standards: All hardware specified herein shall comply with the following industry standards:

1. ANSI/BHMA Certified Product Standards - A156 Series
2. UL10C – Positive Pressure Fire Tests of Door Assemblies

1.3 DELIVERY, STORAGE, AND HANDLING

- A. Inventory door hardware on receipt and provide secure lock-up and shelving for door hardware delivered to Project site. Do not store electronic access control hardware, software or accessories at Project site without prior authorization.
- B. Tag each item or package separately with identification related to the final Door Hardware Schedule, and include basic installation instructions with each item or package.
- C. Deliver, as applicable, permanent keys, cylinders, cores, access control credentials, software and related accessories directly to Owner via registered mail or overnight package service. Instructions for delivery to the Owner shall be established at the "Keying Conference".

1.4 COORDINATION

- A. Templates: Obtain and distribute to the parties involved templates for doors, frames, and other work specified to be factory prepared for installing standard and electrified hardware. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing hardware to comply with indicated requirements.
- B. Door Hardware and Electrical Connections: Coordinate the layout and installation of scheduled electrified door hardware and related access control equipment with required connections to source power junction boxes, low voltage power supplies, detection and monitoring hardware, and fire and detection alarm systems.
- C. Door and Frame Preparation: Related Division 08 Sections (Steel, Aluminum and Wood) doors and corresponding frames are to be prepared, reinforced and pre-wired (if applicable) to receive the installation of the specified electrified, monitoring, signaling and access control system hardware without additional in-field modifications.

1.5 WARRANTY

- A. General Warranty: Reference Division 01, General Requirements. Special warranties specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

- B. Warranty Period: Written warranty, executed by manufacturer(s), agreeing to repair or replace components of standard and electrified door hardware that fails in materials or workmanship within specified warranty period after final acceptance by the Owner. Failures include, but are not limited to, the following:
 - 1. Structural failures including excessive deflection, cracking, or breakage.
 - 2. Faulty operation of the hardware.
 - 3. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
 - 4. Electrical component defects and failures within the systems operation.
- C. Standard Warranty Period: One year from date of Substantial Completion, unless otherwise indicated.
- D. Special Warranty Periods:
 - 1. Ten years for mortise locks and latches.
 - 2. Ten years for manual door closers.

1.6 MAINTENANCE SERVICE

- 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.
- B. Continuing Service: Beginning at Substantial Completion, and running concurrent with the specified warranty period, provide continuous (6) months full maintenance including repair and replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper door opening operation. Provide parts and supplies as used in the manufacture and installation of original products.

PART 2 - PRODUCTS

2.1 SCHEDULED DOOR HARDWARE

- A. General: Provide door hardware for each door to comply with requirements in Door Hardware Sets and each referenced section that products are to be supplied under.
 - 1. Designations: Requirements for quantity, item, size, finish or color, grade, function, and other distinctive qualities of each type of door hardware are indicated in the Door Hardware Sets at the end of Part 3. Products are identified by using door hardware designations, as follows:
 - a. Named Manufacturer's Products: Product designation and manufacturer are listed for each door hardware type required for the purpose of establishing requirements. Manufacturers' names are abbreviated in the Door Hardware Schedule.

2. Products furnished, but not installed, under this Section include the following. Coordinating, purchasing, delivering, and scheduling remain requirements of this Section.

- a. Permanent cylinders, cores, and keys to be installed by Owner.

- B. Substitutions: Requests for substitution and product approval for inclusive mechanical and electromechanical door hardware in compliance with the specifications must be submitted in writing and in accordance with the procedures and time frames outlined in Division 01, Substitution Procedures. Approval of requests is at the discretion of the architect, owner, and their designated consultants.

2.2 HANGING DEVICES

- A. Hinges: ANSI/BHMA A156.1 certified butt hinges with number of hinge knuckles as specified in the Door Hardware Sets.

1. Quantity: Provide the following hinge quantity, unless otherwise indicated:

- a. Two Hinges: For doors with heights up to 60 inches.
 - b. Three Hinges: For doors with heights 61 to 90 inches.
 - c. Four Hinges: For doors with heights 91 to 120 inches.
 - d. For doors with heights more than 120 inches, provide 4 hinges, plus 1 hinge for every 30 inches of door height greater than 120 inches.

2. Hinge Size: Provide the following, unless otherwise indicated, with hinge widths sized for door thickness and clearances required:

- a. Widths up to 3'0": 4-1/2" standard or heavy weight as specified.
 - b. Sizes from 3'1" to 4'0": 5" standard or heavy weight as specified.

3. Hinge Weight and Base Material: Unless otherwise indicated, provide the following:

- a. Exterior Doors: Heavy weight, non-ferrous, ball bearing hinges unless Hardware Sets indicate standard weight.
 - b. Interior Doors: Standard weight, steel, ball bearing hinges unless Hardware Sets indicate heavy weight.

4. Hinge Options: Comply with the following where indicated in the Hardware Sets or on Drawings:

- a. Non-removable Pins: Provide set screw in hinge barrel that, when tightened into a groove in hinge pin, prevents removal of pin while door is closed; for the following applications:
 - 1) Out-swinging exterior doors.
 - 2) Out-swinging access controlled doors.

5. Acceptable Manufacturers:

a. McKinney Products (MK).

B. Continuous Geared Hinges: ANSI/BHMA A156.26 certified continuous geared hinge with minimum 0.120-inch thick extruded 6060 T6 aluminum alloy hinge leaves and a minimum overall width of 4 inches. Hinges are non-handed, reversible and fabricated to template screw locations. Provide concealed flush mount (with or without inset), full surface, or half surface, in standard and heavy duty models, as specified in the Hardware Sets. Concealed continuous hinges to be U.L. listed for use on up to and including 90 minute rated door installations. Factory cut hinges for door size and provide with removable service power transfer panel where indicated at electrified openings.

1. Acceptable Manufacturers:

a. McKinney Products (MK).

b. Pemko Manufacturing (PE).

2.3 DOOR OPERATING TRIM

A. Locking Pull System: Post-mount style door pulls with integrated deadbolt locking system in type and design as specified in the Hardware Sets. Pulls available in multiple head, floor, or combination locking options, with outside keyed rim cylinder operation and inside turn piece activation. Mounting applications for aluminum, glass, steel and wood doors, with customized sizing and configuration options. Pull finishes include brass, bronze, and stainless steel. Provide pulls standard with dustproof strike and auxiliary door stop as specified.

1. Acceptable Manufacturers:

a. Rockwood Manufacturing (RO) – LP Series.

2.4 CYLINDERS AND KEYING

A. General: Cylinder manufacturer to have minimum (10) years experience designing secured master key systems and have on record a published security keying system policy.

B. Source Limitations: Obtain each type of keyed cylinder and keys from the same source manufacturer as locksets and exit devices, unless otherwise indicated.

C. Cylinders: Original manufacturer cylinders complying with the following:

1. Mortise Type: Threaded cylinders with rings and straight- or clover-type cam.
2. Rim Type: Cylinders with back plate, flat-type vertical or horizontal tailpiece, and raised trim ring.

3. Mortise and rim cylinder collars to be solid and recessed to allow the cylinder face to be flush and be free spinning with matching finishes.
- D. Permanent Cores: Manufacturer's standard; finish face to match lockset; complying with the following:
 1. Removable Cores: Core insert, removable by use of a special key, and for use with only the core manufacturer's cylinder and door hardware. Provide removable core (small or large format) as specified in Hardware Sets.
- E. High Security Cylinders: High security cylinder conforming to UL437, including both pick and drill resistance. Pick resistance incorporates two or more independent locking mechanisms including a pin tumbler device with six top pin chambers, mushroom-shaped driver pins, and coded sidebar locking mechanism operated independently from the six top pin tumbler device. Drill resistance incorporates cylinder housing with fixed case-hardened inserts protecting the pin tumbler shear line, cylinder plugs with case-hardened inserts protecting both the pin tumbler shear line and the side bar, mushroom-shaped stainless steel driver pins, and stainless steel sidepins. Cylinders to be factory keyed.
 1. Acceptable Manufacturers:
 - a. Medeco (MC) –Match Owner's existing key system.
- F. Keying System: Each type of lock and cylinders to be factory keyed. Conduct specified "Keying Conference" to define and document keying system instructions and requirements. Furnish factory cut, nickel-silver large bow permanently inscribed with a visual key control number as directed by Owner. Incorporate decisions made in keying conference, and as follows:
 1. Existing System: Master key or grand master key locks to Owner's existing system.
- G. Key Quantity: Provide the following minimum number of keys:
 1. Top Master Key: One (1)
 2. Change Keys per Cylinder: Two (2)
 3. Master Keys (per Master Key Group): Two (2)
 4. Grand Master Keys (per Grand Master Key Group): Two (2)
 5. Construction Control Keys (where required): Two (2)
 6. Permanent Control Keys (where required): Two (2)
- H. Construction Keying: Provide construction master keyed cylinders or temporary keyed construction cores where specified. Provide construction master keys in quantity as required by project Contractor. Replace construction cores with permanent cores. Furnish permanent cores for installation as directed under specified "Keying Conference".
- I. Key Registration List: Provide keying transcript list to Owner's representative in the proper format for importing into key control software.

2.5 MECHANICAL LOCKS AND LATCHING DEVICES

- A. Mortise Locksets, Grade 1 (Heavy Duty): ANSI/BHMA A156.13, Series 1000, Operational Grade 1 certified mortise locksets furnished in the functions as specified in the Hardware Sets. Locksets to be manufactured with a corrosion resistant, stamped 12 gauge minimum formed steel case and be field-reversible for handing without disassembly of the lock body. Lockset trim (including knobs, levers, escutcheons, roses) to be the product of a single manufacturer. Furnish with standard 2 3/4" backset, 3/4" throw anti-friction stainless steel latchbolt, and a full 1" throw stainless steel bolt for deadbolt functions.
 - 1. Acceptable Manufacturers:
 - a. Corbin-Russwin (CR) – ML2000 Series.
- B. Lock Trim Design: As specified in Hardware Sets.

2.6 LOCK AND LATCH STRIKES

- A. Strikes: Provide manufacturer's standard strike with strike box for each latch or lock bolt, with curved lip extended to protect frame, finished to match door hardware set, unless otherwise indicated, and as follows:
 - 1. Flat-Lip Strikes: For locks with three-piece antifriction latchbolts, as recommended by manufacturer.
 - 2. Extra-Long-Lip Strikes: For locks used on frames with applied wood casing trim.
 - 3. Aluminum-Frame Strike Box: Provide manufacturer's special strike box fabricated for aluminum framing.
- B. Standards: Comply with the following:
 - 1. Strikes for Mortise Locks and Latches: BHMA A156.13.
 - 2. Strikes for Bored Locks and Latches: BHMA A156.2.
 - 3. Strikes for Auxiliary Deadlocks: BHMA A156.5.
 - 4. Dustproof Strikes: BHMA A156.16.

2.7 DOOR CLOSERS

- A. All door closers specified herein shall meet or exceed the following criteria:
 - 1. General: Door closers to be from one manufacturer, matching in design and style, with the same type door preparations and templates regardless of application or spring size. Closers to be non-handed with full sized covers including installation and adjusting information on inside of cover.
 - 2. Standards: Closers to comply with UL-10C and UBC 7-2 for Positive Pressure Fire Test and be U.L. listed for use of fire rated doors.

3. Size of Units: Comply with manufacturer's written recommendations for sizing of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Where closers are indicated for doors required to be accessible to the physically *disabled*, provide units complying with ANSI ICC/A117.1 provisions for door opening force and delayed action closing.
 4. Closer Arms: Provide heavy duty, forged steel closer arms unless otherwise indicated in Hardware Sets.
 - a. Where closers are indicated to have mechanical dead-stop, provide heavy duty arms and brackets with an integral positive stop.
 - b. Where closers are indicated to have mechanical hold open, provide heavy duty units with an additional built-in mechanical holder assembly designed to hold open against normal wind and traffic conditions. Holder to be manually selectable to on-off position.
 - c. Where closers are indicated to have a cushion-type stop, provide heavy duty arms and brackets with spring stop mechanism to cushion door when opened to maximum degree.
 5. Closer Accessories: Provide door closer accessories including custom templates, special mounting brackets, spacers and drop plates, and through-bolt or security type fasteners as specified in the door Hardware Sets.
- B. Door Closers, Surface Mounted (Heavy Duty): ANSI/BHMA A156.4, Grade 1 surface mounted, heavy duty door closers with complete spring power adjustment, sizes 1 thru 6; and fully operational adjustable according to door size, frequency of use, and opening force. Closers to be rack and pinion type, one piece cast iron or aluminum alloy body construction, with adjustable backcheck and separate non-critical valves for closing sweep and latch speed control. Provide non-handed units and high impact, non-corrosive plastic covers standard.
1. Acceptable Manufacturers:
 - a. Corbin Russwin Hardware (RU) - DC8000 Series.
 - b. Sargent Manufacturing (SA) - 351 Series.
 - c. Norton Door Controls (NO) - 7500 Series.
 - d. Yale Locks and Hardware (YA) - 4400 Series.
 - e. LCN (LC) - 4040XP

2.8 ARCHITECTURAL TRIM

A. Door Protective Trim

1. General: Door protective trim units to be of type and design as specified below or in the Hardware Sets.
2. Size: Fabricate protection plates (kick, armor, or mop) not more than 2" less than door width (LDW) on stop side and not more than 1" less than door width on pull

side. Coordinate and provide proper width and height as required where conflicting hardware dictates. Height to be as specified in the Hardware Sets.

3. Metal Protection Plates: ANSI/BHMA A156.6 certified metal protection plates (kick, armor, or mop), beveled on four edges (B4E), fabricated from the following.
 - a. Stainless Steel: .050-inch thick, with countersunk screw holes (CSK).
 - b. Brass or Bronze: .050-inch thick, with countersunk screw holes (CSK).
 - c. Laminate Plastic or Acrylic: 1/8-inch thick, with countersunk screw holes (CSK).
4. Fasteners: Provide manufacturer's designated fastener type as specified in the Hardware Sets.
5. Metal Door Edging: Door protection edging fabricated from a minimum .050-inch thick metal sheet, formed into an angle or "U" cap shapes, surface or mortised mounted onto edge of door. Provide appropriate leg overlap to account for protection plates as required. Height to be as specified in the Hardware Sets.
6. Acceptable Manufacturers:
 - a. McKinney Architectural Hardware (MK).
 - b. Rockwood Manufacturing (RO).

2.9 DOOR STOPS AND HOLDERS

- A. General: Door stops and holders to be of type and design as specified below or in the Hardware Sets.
- B. Door Stops and Bumpers: ANSI/BHMA A156.16, Grade 1 certified door stops and wall bumpers. Provide wall bumpers, either convex or concave types with anchorage as indicated, unless floor or other types of door stops are specified in Hardware Sets. Do not mount floor stops where they will impede traffic. Where floor or wall bumpers are not appropriate, provide overhead type stops and holders.
 1. Acceptable Manufacturers:
 - a. McKinney Architectural Hardware (MK).
 - b. Rockwood Manufacturing (RO).

2.10 ARCHITECTURAL SEALS

- A. General: Thresholds, weatherstripping, and gasket seals to be of type and design as specified below or in the Hardware Sets. Provide continuous weatherstrip gasketing on exterior doors and provide smoke, light, or sound gasketing on interior doors where indicated. At exterior applications provide non-corrosive fasteners and elsewhere where indicated.

- B. Smoke Labeled Gasketing: Assemblies complying with NFPA 105 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for smoke control ratings indicated, based on testing according to UL 1784.
 - 1. Provide smoke labeled perimeter gasketing at all smoke labeled openings.
- C. Fire Labeled Gasketing: :Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to UL-10C.
 - 1. Provide intumescent seals as indicated to meet UL10C Standard for Positive Pressure Fire Tests of Door Assemblies, and UBC 7-2, Fire Tests of Door Assemblies.
- D. Sound-Rated Gasketing: Assemblies that are listed and labeled by a testing and inspecting agency, for sound ratings indicated, based on testing according to ASTM E 1408.
- E. Replaceable Seal Strips: Provide only those units where resilient or flexible seal strips are easily replaceable and readily available from stocks maintained by manufacturer.
- F. Acceptable Manufacturers:
 - 1. McKinney Weatherstripping Products (MW).
 - 2. Pemko Manufacturing (PE).

2.11 FABRICATION

- A. Fasteners: Provide door hardware manufactured to comply with published templates generally prepared for machine, wood, and sheet metal screws. Provide screws according to manufacturers recognized installation standards for application intended.

2.12 FINISHES

- A. Standard: Designations used in the Hardware Sets and elsewhere indicate hardware finishes complying with ANSI/BHMA A156.18, including coordination with traditional U.S. finishes indicated by certain manufacturers for their products.
- B. Provide quality of finish, including thickness of plating or coating (if any), composition, hardness, and other qualities complying with manufacturer's standards, but in no case less than specified by referenced standards for the applicable units of hardware.
- C. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine scheduled openings, with Installer present, for compliance with requirements for installation tolerances, labeled fire door assembly construction, wall and floor construction, and other conditions affecting performance.
- B. Notify architect of any discrepancies or conflicts between the door schedule, door types, drawings and scheduled hardware. Proceed only after such discrepancies or conflicts have been resolved in writing.

3.2 PREPARATION

- A. Hollow Metal Doors and Frames: Comply with ANSI/DHI A115 series.
- B. Wood Doors: Comply with ANSI/DHI A115-W series.

3.3 INSTALLATION

- A. Install each item of mechanical and electromechanical hardware and access control equipment to comply with manufacturer's written instructions and according to specifications.
 - 1. Installers are to be trained and certified by the manufacturer on the proper installation and adjustment of fire, life safety, and security products including: hanging devices; locking devices; closing devices; and seals.
- B. Mounting Heights: Mount door hardware units at heights indicated in following applicable publications, unless specifically indicated or required to comply with governing regulations:
 - 1. Standard Steel Doors and Frames: DHI's "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames."
 - 2. Wood Doors: DHI WDHS.3, "Recommended Locations for Architectural Hardware for Wood Flush Doors."
 - 3. Where indicated to comply with accessibility requirements, comply with ANSI A117.1 "Accessibility Guidelines for Buildings and Facilities."
 - 4. Provide blocking in drywall partitions where wall stops or other wall mounted hardware is located.
- C. Retrofitting: Install door hardware to comply with manufacturer's published templates and written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work specified in Division 9 Sections. Do not install surface-mounted items until finishes have been completed on substrates involved.

- D. Thresholds: Set thresholds for exterior and acoustical doors in full bed of sealant complying with requirements specified in Division 7 Section "Joint Sealants."
- E. Storage: Provide a secure lock up for hardware delivered to the project but not yet installed. Control the handling and installation of hardware items so that the completion of the work will not be delayed by hardware losses before and after installation.

3.4 FIELD QUALITY CONTROL

- A. Field Inspection: Supplier will perform a final inspection of installed door hardware and state in report whether work complies with or deviates from requirements, including whether door hardware is properly installed, operating and adjusted.

3.5 ADJUSTING

- A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

3.6 CLEANING AND PROTECTION

- A. Protect all hardware stored on construction site in a covered and dry place. Protect exposed hardware installed on doors during the construction phase. Install any and all hardware at the latest possible time frame.
- B. Clean adjacent surfaces soiled by door hardware installation.
- C. Clean operating items as necessary to restore proper finish, and provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of owner occupancy.

3.7 DEMONSTRATION

- A. Instruct Owner's maintenance personnel to adjust, operate, and maintain mechanical and electromechanical door hardware.

3.8 DOOR HARDWARE SCHEDULE

- A. The hardware sets represent the design intent and direction of the owner and architect. They are a guideline only and should not be considered a detailed hardware schedule. Discrepancies, conflicting hardware and missing items should be brought to the attention of the architect with corrections made prior to the bidding process. Omitted

items not included in a hardware set should be scheduled with the appropriate additional hardware required for proper application and functionality.

B. Manufacturer's Abbreviations:

1. MK - McKinney
2. PE - Pemko
3. CR – Corbin-Ruswin
4. MC – Medeco
5. RO – Rockwood
6. NO - Norton
7. AR – Adams Rite
8. RX - Rixson

Hardware Schedule

Set: 01

Doors: 100A

2	Floor Closer	PH27 NHO LFP	613	RX
4	Intermediate Pivot	M19	613	RX
2	CVR Exit Device	8900C	313	AR
1	Entry Trim	8066	313	AR
3	Mortise Cylinder	10-0500	613	MC
2	Offset Pull	RM202, or as selected by architect	613	RO
2	Overhead Stop	1 Series	613	RX
2	Sweep	29326DNB	313	PE
1	Threshold Assembly	Type 13 x 2748B, per detail, as required	613	PE

Notes: Seals are furnished by the door supplier.

Set: 02

Doors: 100B

1	Floor Closer	PH27 NHO LFP	613	RX
2	Intermediate Pivot	M19	613	RX
1	Rim Exit Device	8800C	313	AR
1	Entry Trim	8066	313	AR
2	Mortise Cylinder	10-0500	613	MC
1	Offset Pull	RM202, or as selected by architect	613	RO
1	Overhead Stop	1 Series	613	RX
1	Sweep	29326DNB	313	PE
1	Threshold Assembly	Type 13 x 2748B, per detail, as required	613	PE

Notes: Seals are furnished by the door supplier.

Set: 03

Doors: 101B

1 Continuous Hinge	KDFM	313	PE
1 NS Lockset	2190 x Lever as selected by architect	613	AR
1 Mortise Cylinder	10-0500	613	MC
1 Surface Closer	7500	690	NO
1 Door Stop	406	613	RO
1 Sweep	29326DNB	313	PE
1 Threshold	272B, per detail, as required	613	PE

Notes: Seals are furnished by the door supplier.

Set: 04

Doors: 102B, 106A

1 Continuous Hinge	DFM	313	PE
1 Classroom Lock	ML2055 ESB L/CYL	613	CR
1 Mortise Cylinder	10-0500	613	MC
1 Surface Closer	7500	690	NO
1 Protection Plate	K1050 10" x 2" LDW 4BE	613	RO
1 Door Stop	406	613	RO
1 Gasketing	S773BL (Head & Jamb)		PE
1 Sweep	29326DNB	313	PE
1 Threshold	272B, per detail, as required	613	PE

Set: 05

Doors: 101A

2 Floor Closer	PH28 NHO	613	RX
2 Patch Fit Top Pivot	By Door Manufacturer	613	
2 Mortise Cylinder	10-0500	613	MC
2 Locking Pull	LP3301DBU*	613	RO

* CYLINDER AND THUMB TURN
LOCATED AT 44" ABOVE FLOOR
TO MEET CA TITLE 24.

Set: 06

Doors: 102A

4 Hinge	TA714 4-1/2" x 4-1/2"	640	MK
1 Classroom Lock	ML2055 ESB L/CYL	613	CR
1 Mortise Cylinder	10-0500	613	MC
1 Door Stop	406	613	RO
3 Silencer	608	Gry	RO

Set: 07

Doors: 103A, 105A

4 Hinge	TA714 4-1/2" x 4-1/2"	640	MK
1 Office Lock	ML2051 ESB L/CYL	613	CR
1 Mortise Cylinder	10-0500	613	MC
1 Door Stop	406	613	RO
3 Silencer	608		RO

Set: 08

Doors: 104A

4 Hinge	TA714 4-1/2" x 4-1/2"	640	MK
1 Classroom Lock	ML2055 ESB L/CYL	613	CR
1 Mortise Cylinder	10-0500	613	MC
1 Surface Closer	7500	690	NO
1 Protection Plate	K1050 10" x 2" LDW 4BE	613	RO
1 Door Stop	406	613	RO
3 Silencer	608		RO

Set: 09

Doors: 107A

4 Hinge	TA2714 4-1/2" x 4-1/2"	US26D	MK
1 Storeroom Lock	ML2057 ESB L/CYL	613	CR
1 Mortise Cylinder	10-0500	613	MC
1 Door Stop	406	613	RO
3 Silencer	608		RO

Set: 10

Gate: 104B

1 Gate Pivot Set

356/357, as required

613 RX

END OF SECTION 08710

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SECTION 08800

GLAZING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Glass and glazing for steel and wood doors.
- B. Flat glass types and sealed insulated unit types for sections referencing this section for products.

1.2 RELATED SECTIONS

- A. Section 07900 - Joint Sealers: Sealant and back-up materials.
- B. Section 08110 - Steel Doors and Frames: Steel glass stops.
- C. Section 08410 - Aluminum Entrances and Storefronts: Glass and glazing for aluminum sidelights and glazed openings.
- D. Section 08212 - Flush Wood Doors: Wood glass stops.
- E. Section 08410 - Aluminum-Framed Entrances and Storefronts: Glass and glazing for aluminum storefronts and entrance doors.
- F. Section 08830 - Mirrors: Unframed glass wall mirrors.

1.3 REFERENCES

- A. ASTM C1036 - Specification for Flat Glass.
- B. ASTM C1048 - Specification for Heat Treated Flat Glass - Kind HS, Kind FT Coated and Uncoated Glass.
- C. ASTM C1172 - Specification for Laminated Architectural Flat Glass.
- D. ASTM C1376 - Specification for Pyrolytic and Vacuum Deposition Coatings on Flat Glass.
- E. ASTM E1300 - Practice for Determining Load Resistance of Glass in Buildings.
- F. ASTM E2190 - Specification Insulating Glass unit Performance and Evaluation.
- G. CBC - California Building Code, 2010 edition.
- H. GANA - Glass Association of North America "Glazing Manual."

- I. IGMA - Insulating Glass Manufacturers Alliance.
- J. UL 10C - Positive Pressure Fire Tests of Door Assemblies.

1.4 PERFORMANCE REQUIREMENTS

- A. Provide glazing systems capable of withstanding normal thermal movements, wind loads and impact loads without failure including loss due to defective manufacture, fabrication and installation.
 - 1. Glass and glazing assembly to withstand dead loads and live loads caused by pressure and suction of wind as calculated in accordance with CBC.
 - 2. Glass thickness and strength required to meet or exceed following criteria based on project loads and in-service conditions when analyzed in accordance with ASTM E1300:
 - a. Minimum thickness of glass to be selected so worst case probability of failure does not exceed:
 - 1) 8 breaks per 1,000 for glass installed vertically and not 15 degrees or more from vertical plane and under wind action.
 - 2) 1 break per 1,000 for glass installed 15 degrees or more from vertical plane and under action of wind/snow.
 - b. Deflection limited to prevent disengagement from frame and less than or equal to 1 inch.

1.5 SUBMITTALS

- A. Shop Drawings: Show details of each type of glazing system in conjunction with framing system indicating type of glass, sizes, shapes, glass material and quantity. Include details indicating glass material, thickness, bite on glass and glass edge clearance.
- B. Product Data:
 - 1. Flat Glass, Laminated Glass, Fire-Rated Glass and Sealed Insulated Glass Units: Provide structural, physical and environmental characteristics, size limitations, special handling or installation requirements.
 - 2. Glazing Accessories: Provide chemical, functional, and environmental characteristics, limitations, special application requirements. Identify available colors.

C. Samples:

1. Laminated Glass and Sealed Insulated Units: Submit samples, minimum 12 x 12 inches in size, of each type of laminated glass and sealed insulated glass unit illustrating construction and color.
2. Glazing Accessories: Submit samples, minimum 12 inches long, of each color required for each type glazing accessory exposed to view.

D. Manufacturer's Certificate: Certify that sealed insulated glass units meet or exceed specified requirements.

1.6 QUALITY ASSURANCE

- A. Flat Glass: Conform to GANA for glazing installation methods.
- B. Sealed Insulated Glass Units: Conform to IGMA for glazing installation methods.

1.7 REGULATORY REQUIREMENTS

- A. Comply with requirements of CBC Chapter 24.
 1. Identification: Label glass in accordance with CBC Section 2403.1.
 2. Glazing Subject to Human Impact: Comply with Section 2406.1.
- B. Glazing in Fire Rated Doors and Frames: Conform to NFPA 80 for fire rated class indicated on schedule on Drawings when tested in accordance with UL 10C.

1.8 DELIVERY, STORAGE AND PROTECTION

- A. Deliver products to site, store, handle and protect in accordance with manufacturers' and fabricators' instructions and recommendations.
- B. Deliver, store, and handle materials in manner to prevent damage.
 1. Protect glass from edge damage.
 2. For insulated glass units exposed to substantial altitude changes, comply with fabricator's written recommendations for venting and sealing to avoid hermetic seal failures.
- C. Deliver and store packaged materials in original containers bearing manufacturer's name.
- D. Deliver glass affixed with manufacturer's labels and do not remove labels prior to installation, inspection or final approval.

- E. Store materials off ground, under cover and protected from weather and construction activities; store at temperature conditions recommended by manufacturers and fabricators.

1.9 ENVIRONMENTAL REQUIREMENTS

- A. Do not install glazing when ambient temperature is less than 50 degrees F.
- B. Maintain minimum ambient temperature before, during and 24 hours after installation of glazing compounds.

1.10 FIELD MEASUREMENTS

- A. Verify actual measurements for openings by field measurement before fabrication. Indicate recorded measurements on shop drawings.
- B. Coordinate field measurements and fabrication schedule with construction progress to avoid construction delays.

1.11 COORDINATION

- A. Coordinate the work with glazing frames, wall openings, and perimeter air and vapor seal to adjacent work.
- B. Coordinate fabrication and installation of glass in fire rated doors and frames with fabrication and installation of doors and frames to ensure assembly meets fire class indicated when tested in accordance with UL 10C.

1.12 WARRANTY

- A. Manufacturer's Warranties:
 - 1. Laminated Glass: Warrant laminated glass free from defects developed from normal use attributable to manufacturing process including edge separation, delaminating materials obstructing vision through glass and blemishes exceeding those allowed by referenced standards for period of 5 years from date of Substantial Completion. Provide for replacement of laminated glass that fails within warranty period.
 - 2. Fire-Rated Glass: Warrant fire-rated glass free from defects in materials and workmanship for period of 5 years from date of Substantial Completion.
 - 3. Sealed Insulated Units: Warrant sealed insulated glass units free from defects developed from normal use attributable to manufacturing process resulting in failure of hermetic seal and interpane dusting and misting for period of 10 years from date of Substantial Completion. Provide for replacement of sealed insulated units that fail within warranty period.

- a. Low-E Glass Within Sealed Insulated Units: Warrant low-e glass free from defects developed from normal use attributable to manufacturing process including peeling, cracking and other indications of deterioration of coating for period of 10 years from date of substantial completion. Provide for replacement of sealed insulated units with low-e glass that fails within warranty period.
- b. Spandrel Glass Within Sealed Insulated Units: Warrant ceramic fritted glass free from deterioration developed from normal use attributable to manufacturing process for period of 5 years from date of substantial completion. Provide for replacement of sealed insulated units with ceramic fritted glass that fails within warranty period.

PART 2 PRODUCTS

2.1 FLAT GLASS MATERIALS

A. Manufacturers:

1. Pilkington Libby-Owens-Ford.
2. PPG Industries, Inc.
3. Substitutions: Under provisions of Division 1.

B. Flat Glass Types:

1. Transparent Float Glass: ASTM C1036, Type I, Class 1, Quality q3; annealed float, uncoated, clear, glazing select quality glass; 1/4 inch thick.
2. Transparent Tempered Float Vision Glass: ASTM C1048, Kind FT, Condition A, Type I, Class 1, Quality q³; clear uncoated fully tempered glazing select quality glass; 1/4 inch thick.

2.2 FIRE RATED GLASS MATERIALS

A. Manufacturers:

1. Technical Glass Products, Inc.
2. Substitutions: Under provisions of Division 1.

2.3 SEALED INSULATED UNIT MATERIALS

A. Fabricators:

1. Viracon.

2. Fabricator Offering Acceptable Equivalent Products: Oldcastle Glass.
3. Substitutions: Under provisions of Division 1.

B. Sealed Insulated Unit Types:

1. Translucent Low-E Insulated Units with Silkscreened Patterned Frit: ASTM E2190; double pane with sealed edge; clear low-e glass and silkscreened clear glass; 1 inch overall thickness.
 - a. Outboard Panes:
 - 1) For Units Subject to Human Impact: ASTM C1048, Kind FT, Condition A, Type I, Class 1, Quality q³; clear uncoated fully tempered glazing select quality glass with custom patterned ceramic frit and neutral low-e coating applied to #2 surface in accordance with ASTM C1376; 1/4 inch thick.
 - 2) For Units Not Subject to Human Impact: ASTM C1048, Kind HS, Condition A, Type I, Class 1, Quality q³; clear uncoated heat strengthened glazing select quality glass with custom patterned ceramic frit and with neutral low-e coating applied to #2 surface in accordance with ASTM C1376; 1/4 inch thick.
 - b. Inboard Panes:
 - 1) For Units Subject to Human Impact: ASTM C1048, Kind FT, Condition A, Type I, Class 1, Quality q³; clear uncoated fully tempered glazing select quality glass; 1/4 inch thick.
 - 2) For Units Not Subject to Human Impact: ASTM C1048, Kind HS, Condition A, Type I, Class 1, Quality q³; clear uncoated heat strengthened glazing select quality iron glass; 1/4 inch thick.
 - c. Sealed Edge:
 - 1) Spacer Finish: Mill.
 - 2) Sealant Color: Gray.

2.4 GLAZING ACCESSORIES

A. For Non-Labeled Assemblies:

1. Setting Blocks: Neoprene; 70-90 Shore A durometer hardness; 4 inches long x 3/8 inch wide x 1/4 inch high.
2. Glazing Tape: Preformed butyl compound with integral resilient tube spacing

device; fully cured; 10-15 Shore A durometer hardness; coiled on release paper; black color.

2.5 FABRICATION

- A. Cut glass accurately to size at factory in accordance with manufacturer's recommendations.
- B. Cut glass slightly scant to prevent binding.
- C. Provide cutouts for fittings and hardware as indicated.
- D. Flat Glass:
 - 1. Fabricate tempered glass lights less than 400 square inches with tong marks in perfect alignment.
 - 1. Fabricate lights greater than 400 square inches with local kinks along tong edge not to exceed 0.20 in 12 inch span measured at distance 2 inches from edge irrespective of glass thickness.
 - 2. Distortion Tolerances: Heat treated glass to be by horizontal (roller hearth) process with inherent roller wave distortion parallel to bottom edge of glass as installed.
 - a. Maximum Peak to Valley Rollerwave: 0.003 inch in central area; 0.008 inch within 10.5 inches of leading and trailing edges.
 - b. Maximum Bow and Warp: 1/32 inch per lineal foot.
- E. Laminated Glass: Fabricate free from foreign substances and air or gas pockets in autoclave with heat plus pressure.
- F. Sealed Insulated Units: Fabricate sealed insulated units to provide hermetically sealed and dehydrated space between panes.
 - 1. Separate panes by aluminum spacer with 3 bent corners and 1 keyed-soldered corner or 4 bent corners and 1 straight butyl injected zinc-plated steel straight key joint
 - 2. Double seal units with primary seals and secondary seals with primary and secondary sealants exhibiting continuous, tenacious adhesion to both glass and spacer.
 - a. Primary Seal: Polyisobutylene; 5/32 inch target width; free from voids and skips.
 - b. Secondary Seal: Silicone; minimum 1/16 inch thickness.

3. Provide continuous contact between primary and secondary seals to greatest extent possible. Where not possible ensure gaps between primary and secondary sealant do not exceed 1/16 inch wide x 2 inches long with gaps separated by at least 18 inches.
4. Delete low-e coating along edges of low-e glass within sealed insulated units to completely seal low-e coating within unit. Edge deletion to be visually straight and uniform in appearance and remove 95 percent of coating.
5. Fabrication Tolerances: Overall units thickness not more than 1/16 inch less than specified thickness and 1/32 inch more than specified thickness.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine substrate conditions to determine acceptability for installation. Verify that substrates are acceptable for product installation.
- B. Examine openings to receive glass for defects that would affect glass and glazing work.
- C. Verify that openings for glazing are correctly sized and within tolerance.
- D. Verify that surfaces of glazing channels or recesses are clean, free of obstructions, and ready to receive glazing.
- E. Do not start glazing until unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean contact surfaces with solvent and wipe dry.

3.3 INSTALLATION INTERIOR GLAZING - DRY METHOD

- A. Install glass and glazing in interior locations by dry method. Install glass and glazing for fire labeled interior assemblies in accordance with labeling agencies listing for ratings indicated on Drawings.
- B. Cut glazing tape to length and set against permanent stops, projecting 1/16 inch above sightline. Ensure that tape is continuous without gaps or voids.
- C. Place setting blocks at 1/4 points.
- D. Rest glass on setting blocks and push against tape for full contact tape at perimeter of pane.
- E. Place glazing tape on free perimeter of pane in same manner described above.

F. Install removable stop without displacement of tape. Exert pressure on tape for full continuous contact.

G. Knife trim protruding tape.

3.4 FIELD QUALITY CONTROL

A. Project Inspector will monitor quality of glazing.

3.5 CLEANING

A. Remove excess glazing compound from finished surfaces.

B. Remove glass manufacturer's temporary labels after work is completed.

C. Clean glass.

3.6 PROTECTION OF FINISHED WORK

A. After installation, mark glass pane with an "X" by using removable plastic tape or paste. Remove when glass is cleaned prior to project completion.

END OF SECTION

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SECTION 08911

GLAZED ALUMINUM CURTAIN WALL

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Aluminum tube framing system.
- B. Aluminum entrance doors and adapters.
- C. Glass and glazing.
- D. Associated aluminum flashings and brake shape closures.
- E. Anchors, brackets and attachments.
- F. Perimeter sealant.
- G. Installation of door hardware.
- H. System design.

1.2 PRODUCTS INSTALLED BUT NOT SUPPLIED UNDER THIS SECTION

- A. Section 08710 - Door Hardware: Supply of door hardware for installation under this section.

1.3 RELATED SECTIONS

- A. Section 05400 - Cold Formed Metal Framing: Framed openings and blocking in exterior framed walls.
- B. Section 05500 - Metal Fabrications: Metal fabricated attachment devices other than specified in this section.
- C. Section 07900 - Joint Sealers: Sealant types.
- D. Section 08410 - Aluminum Entrances and Storefronts: Aluminum framing with matching finish for interior glazing; aluminum entrance doors other than specified in this section.
- E. Section 08710 - Door Hardware.
- F. Section 08800 - Glazing: Glass types.

1.4 REFERENCES

- A. AAMA 503 – Voluntary Test Method for Field Testing of Metal Storefronts, Curtain Walls and Sloped Glazing Systems.
- B. AAMA 1503.1 - Voluntary Test Method for Thermal Transmittance and Condensation Resistance of Windows, Doors and Glazed Wall Sections.
- C. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels.
- D. AAMA - CW-10 - Care and Handling of Architectural Aluminum from Shop to Site.
- E. ASTM A36 - Specification for Carbon Structural Steel.
- F. ASTM A164 - Specification for Electrodeposited Coatings of Zinc on Steel.
- G. ASTM B209 - Specification for Aluminum and Aluminum Alloy Sheet and Plate.
- H. ASTM B221 - Specification for Aluminum-Alloy Extruded Bar, Rod, Wire, Shape, and Tube.
- I. ASTM C920 - Specification for Elastomeric Joint Sealants.
- J. ASTM E283 - Test Method for Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors.
- K. ASTM E330 - Test Method for Structural Performance of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference.
- L. ASTM E331 - Test Method for Water Penetration of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference.
- M. ASTM E1105 - Test Method for Field Determination of Water Penetration of Installed Exterior Windows, Curtain Walls, and Doors by Uniform or Cyclic Static Air Pressure Difference.
- N. CBC - California Building Code, 2010 edition.
- O. FS FF-325 - Shield, Expansion, Nail, Expansion and Nail, Drive Screw (Devices, Anchoring, Masonry).
- P. SSPC - Society for Protective Coatings.

1.5 SYSTEM DESCRIPTION

- A. Glazed Aluminum Curtain Wall System: Aluminum curtain wall system for exterior glazing including shop-fabricated factory prefinished tubular aluminum sections with supplementary support framing, glass, glazing, flashings and closures, anchorage and attachment devices with related entrances.

1.6 DESIGN REQUIREMENTS

- A. Color and sheen of finish for extruded aluminum sections specified under this section to match color and sheen of finish for aluminum framing sections specified in Section 08410.
- B. Color of perimeter sealant specified under this section to match color of finish of extruded aluminum sections specified under this section.
- C. Where steel reinforcement is required within aluminum mullions, steel reinforcement shall extend full height of mullion.
- D. Sustainable Design Requirements: Aluminum and steel used in work of this section is intended to contribute to meeting requirements for recycled content outlined in LEED™-NC 2009 Credit MR4.

1.7 PERFORMANCE REQUIREMENTS

- A. Curtain Wall Framing:
 - 1. Air Infiltration: No more than 0.06 CFM per sq ft of fixed area at 6.24 PSF pressure differential when tested in accordance with ASTM E283.
 - 2. Water Leakage: No uncontrolled leakage at static 15 PSF pressure differential when tested in accordance with ASTM E331.
 - 3. Dynamic Water Leakage: No uncontrolled leakage with dynamic 15 PSF pressure differential when tested in accordance with AAMA 501.1.
 - 4. Structural Performance: Design and size members to withstand dead loads and live loads caused by pressure and suction of wind as calculated in accordance with CBC.
 - a. Uniform Load Deflection: Not to exceed L/175 of clear span and 3/4 inch when tested in accordance with ASTM E330.
 - b. Uniform Load Structural: Not less than 1.5 times design wind pressure in accordance with ASTM E330.
 - c. Maximum Deflection: Not to exceed 1/8 inch at center point and 1/16 at center point of horizontal member once deadload points have been established.

5. Thermal Movement: System to accommodate expansion and contraction due to surface temperature differential of 180 degrees F.
 6. Condensation Resistance Factor: Not less than 55 in accordance with AAMA 1503.1.
 7. Thermal Transmittance: Not to exceed 0.65 BTUH/°F/SF in accordance with AAMA 1503.1.
 8. Drain water entering joints, condensation occurring in glazing channels, or migrating moisture occurring within system, to exterior by weep drainage network.
 9. Maintain continuous air and vapor barrier throughout assembly, primarily in line with inside pane of glass and heel bead of glazing compound.
 10. Not Permitted: Vibration harmonics, wind whistles, noises caused by thermal movement, thermal movement transmitted to other building elements, loosening, weakening, or fracturing of attachments or components of system.
- B. Glass and Glazing Assembly: To withstand dead loads and live loads caused by pressure and suction of wind as calculated in accordance with CBC.

1.8 SUBMITTALS

- A. Shop Drawings and Structural Calculations:
1. Submit shop drawings and structural calculations signed by Structural Engineer registered in State of California.
 2. Indicate materials, finishes, system dimensions, framed opening requirements and tolerances, anticipated deflection under load, affected related work, weep drainage network, expansion and contraction joint locations and details, anchorage details and welding required.
- B. Product Data: Provide component dimensions, describe components within assembly, anchorage and fasteners, glass and infill, internal drainage details, water flow diagrams and perimeter sealant.
1. Framing Members: Provide structural and physical characteristics, dimensional limitations, special installation requirements.
 2. Glass: Provide structural, physical and environmental characteristics, size limitations, special handling or installation requirements.
 3. Perimeter Sealant: Submit data indicating chemical characteristics, performance criteria, limitations and color availability. Include accessory items necessary for successful completion of work.

C. Samples:

1. Finish for Framing Members: Submit samples, minimum 4 x 6 in size, illustrating color and sheen of specified finish on aluminum extrusion.
2. Glass: Submit samples, minimum 12 x 12 inches in size, of each type of sealed insulated glass unit illustrating construction and color.
3. Perimeter Sealant: Submit samples, minimum 3 inches long, of sealant set in aluminum channel illustrating color match to framing member finish.

D. Test Reports: Submit substantiating engineering data, test results of previous tests by independent laboratory which purport to meet performance criteria, and other supportive data.

E. Manufacturer's Installation Instructions: Indicate special installation procedures.

F. LEED Documentation:

1. Aluminum: Submit letter or product data from manufacturer indicating recycled contents. Designate percentage of post-consumer and post-industrial recycled content.
2. Steel: Submit letter or product data from manufacturer indicating recycled contents. Designate percentage of post-consumer and post-industrial recycled content.
3. Submit hard copies of completed Online Documentation required for LEED™ MR Credit 4.

1.9 QUALITY ASSURANCE

- A. Source Limitations: Obtain primary system components from single manufacturer. Provide secondary components as recommended by manufacturer of primary components unless specified otherwise.
- B. Curtain Wall Framing: Perform work in accordance with AAMA "Metal Curtain Wall, Window, Store Front and Entrance - Guide Specifications Manual" and AAMA "Aluminum Curtain Wall Design Guide Manual."

1.10 QUALIFICATIONS

- A. Manufacturer: Company specializing in designing and manufacturing aluminum curtain wall systems with minimum 5 years documented experience.
- B. Installer: Company specializing in installing aluminum curtain wall with minimum 3 years documented experience.

1.11 REGULATORY REQUIREMENTS

- A. Doors: Comply with requirements of CBC Sections 1008 and 1133B.2.
- B. Glass: Comply with requirements of CBC Chapter 24.

1.12 MOCK-UPS

- A. Construct mock-ups of curtain wall framing joinery assemblies using materials and methods specified herein demonstrating aesthetic effects and qualities of materials and execution. Construct mock-up minimum 2 feet high x 2 feet wide incorporating following joints:
 - 1. Head to jamb.
 - 2. Intermediate horizontal mullion to jamb.
 - 3. Sill to jamb.
 - 4. Intermediate vertical mullion to head.
 - 5. Intermediate horizontal mullion to intermediate vertical mullion.
 - 6. Intermediate vertical mullion to sill.
- B. Rebuild panels not meeting specified requirements as directed by Architect.
- C. Joinery of accepted mock-ups will establish minimum standard of quality and workmanship of glazed curtain wall framing work.
- D. Retain accepted mock-ups in undisturbed condition until work of this section is complete.
- E. Remove mock-ups upon completion of project.

1.13 PREINSTALLATION CONFERENCE

- A. Convene preinstallation conference minimum one week prior to commencing work of this section.
- B. Attendance: Contractor, aluminum curtain wall installer, Construction Manager, Project Inspector and Architect.
- C. Agenda: Review shop drawings, installation procedures and coordination required with work of other trades. Conduct inspection of openings and substrates.

1.14 DELIVERY, STORAGE AND HANDLING

- A. Deliver products to site, store, handle and protect in accordance with manufacturer's instructions and recommendations.

- B. Deliver materials in manufacturer's original unopened and undamaged containers.
- C. Store materials protected from exposure to harmful weather conditions and at temperature conditions recommended by manufacturer.
- D. Handle work of this section in accordance with AAMA – CW-10.
- E. Protect prefinished aluminum surfaces with wrapping. Do not use adhesive papers or sprayed coatings which bond when exposed to sunlight or weather.
- F. Deliver glass affixed with manufacturer's labels and do not remove labels prior to installation, inspection or final approval. Store glass off ground, under cover and protected from weather and construction activities.
- G. Store sealant materials in sealed and labeled containers until installation. Follow manufacturer's recommendations for storage temperature.

1.15 ENVIRONMENTAL REQUIREMENTS

- A. Do not install sealants when ambient temperature is less than 40 degrees F.
- B. Maintain this minimum temperature during and after installation of sealants.

1.16 FIELD MEASUREMENTS

- A. Verify that field measurements are as indicated on shop drawings.

1.17 WARRANTY

- A. Manufacturer's Warranties:
 - 1. Complete System: Cover complete system for failure to meet specified requirements for period of 2 years from date of Substantial Completion.
 - 2. Sealed Insulated Glass Units: Warrant sealed insulated glass units free from seal failure and interpane dusting for period of 5 years from date of Substantial Completion. Replace units that fail within warranty period.
 - 3. Framing Finish: Warrant fluoropolymer coating system against fading more than 10 percent, chalking, yellowing, peeling, cracking, pitting, corroding and non-uniformity of color and gloss deterioration beyond manufacturer's descriptive standards for period of 20 years from date of Substantial Completion.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Arcadia, Inc.:
 - 1. Curtain Wall Framing: T500 Series (OPG-1900) Pressure Plate Glazed System.
 - 2. Stile and Rail Entrance Doors: WS512 HD Series.
- B. Manufacturer Offering Acceptable Equivalent Products: Vistawall Architectural Products.
- C. Substitutions: Under provisions of Division 1.

2.2 MATERIALS

- A. Extruded Aluminum: ASTM B221; 6063 alloy, T5 temper.
- B. Sheet Aluminum: ASTM B209; 5005 alloy.
- C. Steel Sections: ASTM A36; shaped to suit mullion sections.
- D. Shop and Touch-Up Primer for Steel Components: SSPC 15, Type 1, red oxide.

2.3 FABRICATED COMPONENTS

- A. Curtain Wall Framing: Extruded aluminum; 2-1/4 x 7 inch nominal profile; non-thermal; outside-glazed self-supporting system with captured horizontals and verticals; structural silicone glazed corners; 3-part construction consisting of pressure plate and covers attached to tongues of back members; shear block construction; no projecting glass stops; seamless exterior covers; configured for 1 inch thick infill; steel supplementary support framing as required to withstand live and dead loads; framing members, transition members, mullions, mullion extensions, corners and adapters as indicated on drawings and as required for to attain configurations indicated on Drawings; Arcadia T500 Series (OPG-1900) Pressure Plate Glazed System for 1-Inch Glass.
- B. Stile and Rail Entrance Doors: Wide stile; single acting; full glass configuration; 1-3/4 inches thick; face dimensions as indicated on Drawings; Arcadia WS512 HD Series Heavy Duty Wide Stile Door.
 - 1. Frame: Extruded aluminum; nominal 0.188 inch wall thickness; 5-5/16 inch top rail; 5 inch vertical stiles; 10 inch bottom rail.
 - 2. Glass Stops: Extruded aluminum; nominal 0.050 inch wall thickness; snap-in type; square profile for 1 inch thick glass.
- C. Brake Shape Closures and Flashings: Aluminum sheet; 12 gauge thickness.

D. Brake Shape Clips and Adaptors: Manufacturer's standard for configurations indicated on Drawings.

E. Fasteners:

1. Within System: Manufacturer's standard aluminum, stainless steel or zinc plated steel in accordance with ASTM A164.

2. Perimeter Fasteners:

a. To Metal Framing: Manufacturer's standard aluminum or steel screws; steel fasteners properly isolated from aluminum.

b. To Concrete: Expansion anchors; stainless steel; diameter and embedment required by system design.

1) Wedge Type: FS FF-325(3), Group II, Type 4; wedge type expansion anchor; size as noted on Drawings; ITW Ramset/Red Head "Trubolt+" Seismic Wedge, Hilti Corp. "Kwik-Bolt TZ," or equal product substituted under provisions of Division 1.

2) Sleeve Type: Size as noted on Drawings; Hilti Corp. Sleeve Anchor, ITW Ramset/Redhead Dynabolt Sleeve or equal product substituted under provisions of Division 1.

F. Shims: Manufacturer's standard.

2.4 GLASS AND GLAZING MATERIALS

A. Glass: Glass Type GL1 – Translucent Low-E Insulated Units with Silkscreened Pattern Frit as specified in Section 08800; 1 inch total thickness.

B. Glazing Materials: Manufacturer's standard glazing gaskets; compression type design; replaceable; configured to lock securely into glazing reglet; molded or extruded santoprene, polyvinyl chloride or ethylene propylene diene monomer; gray color.

2.5 SEALANT MATERIALS

A. Sealants:

1. Within System: Curtain wall manufacturer's standard.

2. Structural Glazing: Silicone structural adhesive formulated for structural glazing and recommended by curtain wall manufacturer for specific application.

3. Perimeter Sealant: ASTM C920, Type M, Grade NS, Class 50; multiple component silicone; neutral cure; non-staining; low modulus; non-sag; ± 50 percent joint movement capability; field-tintable to match color of curtainwall framing; Tremco Spectrem® 4-TS Field Tintable Silicone Sealant or equal product substituted under provisions of Division 1.

- B. Accessories: Backer rod, primer, joint cleaner, bond breaker and masking tape as specified in Section 07900.

2.6 HARDWARE

A. Entrance Door Hardware:

1. Operating hardware and trim are specified and scheduled in Section 08710 - Door Hardware.
2. Weatherstripping: Manufacturer's standard hard-backed poly pile.
3. Sill Sweep Strips: Manufacturer's standard concealed brush strip.
4. Thresholds: Manufacturer's standard aluminum saddle; finish to match hardware specified in Section 08710.

2.7 FABRICATION

- A. Fabricate components allowing for minimum clearances and shim spacing around perimeter of assembly, yet enabling installation and dynamic movement of perimeter seal.
- B. Curtain Wall Framing: Fabricate curtain wall framing components with shear block internal reinforcement at joints and corners.
 1. Rigidly fit and secure curtain wall framing joints and corners.
 2. Make joints and connections flush, hair line and weatherproof.
 3. Provide 2-piece horizontal framing so that fasteners at intersection of horizontal and vertical members will be concealed.
 4. Prepare internal reinforcement for hardware using templates provided under Section 08710.
- C. Fabricate stile and rail entrance doors of tubular sections with top and bottom rails joined to stiles by concealed reinforcement brackets secured with MIG welds.
 1. Provide with adjusting mechanisms in top rail near lock stile.
 2. Prepare internal reinforcement for hardware using templates provided under Section 08710.
- D. Develop drainage holes with moisture pattern to exterior.
- E. Prepare components to receive anchor devices. Fabricate anchors.
- F. Arrange fasteners and attachments to ensure concealment from view.
- G. Reinforce framing members for external imposed loads.

- H. Fabricate brake shape flashings and closures to indicated shapes for anchoring with concealed fasteners.

2.8 FINISHES

- A. Extruded Aluminum Frames and Flashings: AAMA 2605; factory-applied baked-on high performance organic coating formulated under license and containing not less than 70 percent Hylar 5000TM or Kynar 500® PVDF resin by weight; products of PPG Industries, Inc, Valspar Corporation or BASF; Standard color to be determined.
 - 1. Pretreatment: Clean; apply chromium phosphate coating.
 - 2. Primer: Coating manufacturer's standard resin base compatible with coating; apply to minimum 0.2 mil dry film thickness.
 - 3. Color Coat: Apply to minimum 0.75 mil dry film thickness.
 - 4. Clear Coat: Apply to minimum 0.50 mil dry film thickness.
- B. Entrance Doors: Color and finish to match extruded aluminum frames and flashings.
- C. Brake Shape Closures and Flashing: Finish and color to match extruded aluminum frames and flashings.
- D. Concealed Steel Items: Primed with iron oxide paint.
 - 1. Clean surfaces of rust, scale, dirt, grease, and foreign matter prior to finishing.
 - 2. Apply prime paint to minimum 1.5 mil dry film thickness in accordance with paint manufacturer's instructions and recommendations.
- E. Apply 1 coat of bituminous paint to concealed aluminum and steel surfaces in contact with cementitious materials and dissimilar metals; apply to minimum 15 mil dry film thickness.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine substrate conditions to determine acceptability for installation. Verify that installed work of other trades is sufficiently complete and that substrates are acceptable for product installation in accordance with manufacturer's instructions and recommendations.
- B. Verify dimensions, tolerances, and method of attachment with other work.

- C. Verify wall openings and adjoining air and vapor seal materials are ready to receive work of this section.
- D. Verify that hardware furnished under Section 08710 - Door Hardware for installation under this section is of correct type, configuration, finish and quantity.
- E. Do not begin installation until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install curtain wall system, entrance doors, glazing and hardware in accordance with final reviewed shop drawings and with manufacturer's instructions.
- B. Attach to metal fabricated attachment devices in manner to permit sufficient adjustment to accommodate construction tolerances and other irregularities. Provide alignment attachments and shims to permanently fasten system to building structure.
- C. Align assembly plumb and level, free of warp or twist. Maintain assembly dimensional tolerances, aligning with adjacent work.
- D. Coordinate attachment and seal of air and vapor barrier materials.
- E. Install sill and head flashings. Anchor with concealed fasteners.
- F. Install brake shape closures and flashings. Connect closures to clips and clips to framing with concealed fasteners.
- G. Install hardware in accordance with manufacturer's instructions and requirements of BHMA. Use templates provided by hardware item manufacturer.
 - 1. Conform to CBC Section 1133B.2.5.2 for hardware positioning requirements for persons with disabilities.
 - a. Ensure touchbars for panic hardware are mounted between 36 and 44 inches from finished floor.
 - b. Ensure other door operating hardware including levers, key cylinders and turn pieces is mounted between 30 and 44 inches from finished floor.
 - 2. Set floor stops out of traffic pattern and as close to door jamb as is functionally possible.
 - 3. Set thresholds in full bed of mastic and secure to slab with bolts and expansion shields.
- H. Install glass in curtain wall framing and entrances using manufacturer's standard glazing procedures.
- I. Install perimeter type sealant and backing materials in accordance with Section 07900.

3.3 TOLERANCES

- A. Maximum Variation from Plumb: 0.06 inches every 3 feet non-cumulative or 0.5 inches per 100 feet, whichever is less.
- B. Maximum Misalignment of 2 Adjoining Members Abutting in Plane: 1/32 inch.

3.4 FIELD QUALITY CONTROL

- A. Field test curtain wall systems to AAMA 503 with manufacturer's representative present.
 - 1. Perform field water test in compliance with ASTM E 1105 on completed portions of curtain wall.
 - 2. Perform 1 test each at 10 percent, 50 percent and 80 percent of curtain wall completion with repeat tests when failures occur.
 - 3. When testing results in leakage, eliminate causes of leaks and retest until no leaks occur.

3.5 MANUFACTURER'S FIELD SERVICES

- A. Curtain wall product manufacturers to provide field surveillance of installation of their products.
- B. Monitor and report installation procedures and unacceptable conditions.

3.6 ADJUSTING

- A. Adjust operating door hardware for smooth operation.
- B. Adjust manual door closers so that opening effort does not exceed 5 pounds for exterior doors.

3.7 CLEANING

- A. Remove protective material from prefinished aluminum surfaces.
- B. Wash down surfaces with solution of mild detergent in warm water, applied with soft, clean wiping cloths. Take care to remove dirt from corners. Wipe surfaces clean.
- C. Remove excess sealant by moderate use of mineral spirits or other solvent acceptable to sealant manufacturer.
- D. Clean glass as specified in Section 08800.

3.8 PROTECTION OF FINISHED WORK

- A. Protect finished work from damage.

- B. Protect exposed portions of aluminum surfaces from damage by grinding and polishing compounds, plaster, lime, acid, cement and other contaminants.
- C. Protect glass as specified in Section 08800.

END OF SECTION

SECTION 09110

NON-LOAD BEARING METAL FRAMING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Steel stud/joist framing for interior partitions, ceilings and soffits.
- B. Steel stud wall furring.
- C. Framing accessories.

1.2 PRODUCTS INSTALLED BUT NOT SUPPLIED UNDER THIS SECTION

- A. Section 07213 – Thermal Batt Insulation: Supply of thermal batt insulation for installation in boxed jamb, header and sill construction.
- B. Section 09820 – Acoustical Insulation and Sealants: Supply of acoustical batt insulation for installation in boxed jamb, header and sill construction.

1.3 RELATED SECTIONS

- A. Section 05400 - Cold Formed Metal Framing: Load bearing metal stud framing in exterior walls and soffits.
- C. Section 06100 - Rough Carpentry: Lumber blocking, backing and nailers.
- D. Section 09250 - Gypsum Board: Gypsum board finish over metal studs.

1.4 REFERENCES

- A. ASTM A653 - Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron-Alloy Coated (Galvannealed) by the Hot-Dip Process.
- B. ASTM A1003 - Specification for Steel Sheet, Carbon, Metallic- and Non-Metallic-Coated for Cold-Formed Framing Members.
- C. ASTM C754 - Installation of Steel Framing Members to Receive Screw-Attached Gypsum Board.
- D. ASTM E119 - Method of Fire Tests of Building Construction and Materials.
- E. AWS D1.1 - Structural Welding Code.

- F. CBC - California Building Code, 2010 edition.
- G. FS FF-S-325 - Shield, Expansion; Nail, Expansion; and Nail, Drive Screw (Devices, Anchoring, Masonry).

1.5 SYSTEM DESCRIPTION

- A. Non-Load Bearing Metal Framing: Non-load bearing steel stud/joist framing systems complete with tracks, clips, braces, backing, hangers, straps, fastening devices and other accessories required for proper installation of interior walls, wall furring, ceilings and soffits with finishes specified in other sections.

1.6 DESIGN REQUIREMENTS

- A. Sustainable Design Requirements: Steel used in work of this section is intended to contribute to meeting requirements for recycled content outlined in LEED™-NC 2009 Credit MR4.

1.7 PERFORMANCE REQUIREMENTS

- A. Maximum Allowable Deflection:
 - 1. Wall Framing and Furring:
 - a. Supporting Tile: 1/360 of wall height.
 - b. Supporting Cabinets, Shelving, Lockers and Equipment: 1/360 of wall height.
 - c. Other Wall Framing and Furring: 1/240 of wall height.
 - 2. Soffit Framing: 1/240 of span.
 - 3. Ceiling Framing: 1/360 of span.
- B. System installation to accommodate construction tolerances, deflection of building structural members and clearances of intended openings.

1.8 SUBMITTALS

- A. Shop Drawings: Indicate component details, stud layout, framed openings, anchorage to structure, type and location of fasteners, and accessories or items required of other related work. Describe method for securing studs to track, splicing, and for blocking and reinforcement to framing connections.
- B. Product Data: Provide data describing standard framing member materials and finish, product criteria, load charts and limitations.

C. 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. Submit hard copies of completed Online Documentation required for LEED™ MR Credit 4.

1.9 QUALITY ASSURANCE

- A. Furnish framing materials in accordance with SSMA Product Technical Information.
- B. Perform work in accordance with ASTM C754 and AWS D1.1.
- C. Fire-Resistance Ratings: Comply with fire resistance ratings as indicated and as required by governing authorities and codes. Provide materials, accessories, and application procedures which have been listed by UL or tested according to ASTM E119 for type of construction shown.

1.10 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum 5 years documented experience and maintaining current membership with Steel Stud Manufacturers Association.
- B. Installer: Company specializing in performing work of this section with minimum 5 years documented experience.

1.11 REGULATORY REQUIREMENTS

- A. Supports for Horizontal and Vertical Gypsum Board Finishes: Comply with requirements of CBC Section 2504.

1.12 PREINSTALLATION CONFERENCE

- A. Convene pre-installation conference minimum 1 week prior to commencing work of this section.
- B. Attendance: Contractor, metal stud installer, Project Manager, Project Inspector and Architect.
- C. Agenda: Review Construction Documents, shop drawings, schedule of work, existing conditions, details of work, installation procedures and coordination with related work. Conduct walkover inspection of substrate.

1.13 PRODUCT DELIVERY AND STORAGE

- A. Deliver to site, store and protect products in accordance with manufacturer's instructions and recommendations.
- B. Deliver in manufacturer's unopened containers and bundles fully identified with name, brand, type and grade.
- C. Protect metal framing systems from rusting and damage.
- D. Store inside in dry, ventilated space.

1.14 COORDINATION

- A. Coordinate with other work supporting, adjoining, or fastening to metal stud framing work.
- B. Coordinate details and requirements of other work which adjoins and fastens to metal framing and requires backing and special support framing.
 - 1. Provide backing support as required.
 - 2. Items requiring backing support include casework, countertops, grab bars, handrails, wall hung equipment; toilet partitions, wall mounted door hardware, toilet and bath accessories, miscellaneous specialties and other similar items.
- C. Coordinate installation of partition framing with head of wall fire stopping.

PART 2 PRODUCTS

2.1 METAL STUDS

- A. Manufacturers:
 - 1. Dietrich Industries, Inc.
 - 2. Manufacturers Offering Acceptable Equivalent Products:
 - a. California Expanded Metal Products Co.
 - b. Clark Western Building Systems.
 - c. Consolidated Fabricators Corp.
 - d. Design Shapes in Steel.
 - e. Quail Run Building Materials, Inc.

- f. SAFCO Corporation.
 - g. United Metal Products, Inc.
 - 3. Substitutions: Under provisions of Division 1.
- B. Studs/Joists: Formed from hot or cold rolled steel sheet conforming to ASTM A1003 with minimum 33,000 psi yield point; C-shape; punched webs at vertical framing, unpunched at horizontal framing; minimum G40 galvanized finish per ASTM A653.
 - 1. Member Depths: As scheduled and indicated on Drawings.
 - 2. Flange Widths: Minimum 1-5/8 inches.
 - 3. Return Depth: Minimum 1/2 inch.
 - 4. Material Thicknesses: As scheduled and indicated on Drawings, but never less than 0.0346 inches (20 gauge structural).
- C. Runners: Formed from same steel as studs; G40 galvanized finish per ASTM A653.
 - 1. Base Tracks:
 - a. Member Depths: To match adjacent typical vertical framing except where specifically indicated otherwise.
 - b. Leg Height: Minimum 1-1/4 inches.
 - c. Material Thicknesses: Equivalent to or thicker than adjacent typical vertical framing except where specifically indicated otherwise.
 - 2. Top Tracks:
 - a. Member Depths: To match adjacent typical vertical framing except where specifically indicated otherwise.
 - b. Leg Height: Minimum 2 inches.
 - c. Material Thicknesses: Equivalent to or thicker than adjacent typical vertical framing except where specifically indicated otherwise.
 - 3. Header and Other Tracks:
 - a. Member Depths: To match adjacent typical vertical framing except where specifically indicated otherwise.
 - b. Leg Height: Minimum 1-1/2 inches.

- c. Material Thicknesses: Equivalent to or thicker than adjacent typical vertical framing except where specifically indicated otherwise.
- 4. Alternate Slotted Head Track: Deep leg track with 1-1/2 inch long x 1/4 inch wide slots at 1 inch oc in each leg; same as Dietrich SLP-TRK® Slotted Track, Cemco Slotted Track and Clark Western MaxTrak™.
 - a. Member Depths: To match adjacent typical vertical framing except where specifically indicated otherwise.
 - b. Leg Height: 2-1/2 inches.
 - c. Material Thicknesses: Equivalent to or thicker than adjacent typical vertical framing except where specifically indicated otherwise.
- D. Backing Plates:
 - 1. Metal Strap: Formed from same steel as studs; galvanized finish; flat strap.
 - a. Member Depth: 6 inches.
 - b. Material Thicknesses: 0.0566 inches (16 gauge).
 - 2. Metal Track: Formed from same steel as studs; galvanized finish; unpunched web.
 - a. Member Depth: 6 inches.
 - b. Leg Height: Minimum 1-1/4 inches.
 - c. Material Thicknesses: 0.0346 inches (20 gauge structural), 0.0566 inches (16 gauge), 0.0713 inches (14 gauge) and 0.1017 (12 gauge) as scheduled and indicated on Drawings.
- E. Metal Straps, Angles and Bracing Members: Formed from same steel as studs; G40 galvanized finish per ASTM A653.
- F. Metal Deflection Clips: Head-of-wall type curtain wall deflection clip for vertical movement; formed from hot or cold rolled steel sheet conforming to ASTM A1003 with minimum 50,000 psi yield point; configured to attach exterior curtain wall studs to building structure and provide for vertical movements of minimum 1-1/4 inches up and 1-1/4 inches down independent of wall studs; adjustable standoff; capable of being installed to structure with screws, welds or powder-actuated fasteners; secured to curtain wall stud through slotted holes with screws fabricated for frictionless slip connections; minimum G90 galvanized finish per ASTM A653.

1. Length: Manufacturer's standard as required for configurations indicated on Drawings.
2. Height: Minimum 4-1/2 inch.
3. Material Thickness: Minimum 14 gauge (0.068 inches).

2.2 ACCESSORIES

A. Fasteners:

1. Screws: Self-drilling and self-tapping sheet metal screws; zinc plated steel; pan head or hex head with washer; point as required to drill 12 gauge stock; #10 x by length sufficient to penetrate through second surface minimum 3/8 inch unless otherwise indicated or specified.
2. Expansion Bolts:
 - a. Wedge Type: FS FF-325(3), Group II, Type 4; wedge type expansion anchor; zinc plated carbon steel; size as noted on Drawings; ITW Ramset/Red Head "Trubolt+" Seismic Wedge, Hilti Corp. "Kwik-Bolt TZ" Expansion Anchor or equal product substituted under provisions of Division 1.
 - b. Sleeve Type: Plated steel; size as indicated on Drawings; Hilti Corp. Sleeve Anchor, ITW Ramset/Redhead Dynabolt Sleeve or equal product substituted under provisions of Division 1.
3. Powder-Actuated Fasteners: Tempered steel pins with corrosion resistant plating or coating; size as indicated on Drawings; guide washers to control penetration; Hilti Fastening Systems, Impex Tool Corp. or equal product substituted under provisions of Division 1.
4. Welding Electrodes: AWS low hydrogen; rod number and diameter as approved by Owner's Testing Laboratory.

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 insulation supplied under Sections 07213 and 09820 for installation under this section has been delivered, is of correct characteristics, dry and free from damage.

- C. Do not proceed with installation of metal framing systems until unsatisfactory conditions have been corrected.

3.2 INSTALLATION - WALL AND PARTITION FRAMING

- A. Install interior metal framing and furring in accordance with ASTM C754 unless otherwise shown or specified and with final reviewed shop drawings.
- B. Install metal framing components and accessories plumb, square and true to line and with connections securely fastened.
 - 1. Cut framing members by sawing and shearing or with plasma cutter; do not torch cut.
 - 2. Fasten metal components by welding or screw fastening.
- C. Install framing members in 1-piece lengths unless splice connections are indicated.
- D. Install thermal and acoustical batt insulation supplied to this section for installation in built up framing members such as headers, sill, boxed hoists and multiple studs at openings that are inaccessible on completion of framing work.
 - 1. Install thermal batt insulation in built-up framing members occurring in exterior walls.
 - 2. Install acoustical batt insulation in built-up framing members occurring in interior partitions designated to receive acoustical insulation.
- E. Runners:
 - 1. Base Tracks: Layout and securely attach to concrete slabs and concrete filled steel decks per details shown on Drawings.
 - 2. Top Tracks: Install track-within-track deflection assembly or alternate slotted head track.
 - a. Track-Within-Track Deflection Assembly: Accurately align top track assembly and base runner track. Securely attach upper track of track assembly to structure per details shown on Drawings; nest lower track in upper track.
 - b. Alternate Slotted Head Track: Accurately align slotted head track and base runner track; securely attach to structure per details shown on Drawings.
 - 3. Do not miter runner track at corners.

F. Studs:

1. Cut studs nominal 3/4 inch short of web of head track. Space studs maximum 16 inches on center unless otherwise noted.
2. Securely attach studs to base runner tracks. Weld studs to track where specifically noted.
3. Attach studs to lower track in track-within-track deflection assembly or to alternate slotted head track.
 - a. Do not attach studs to upper track in track-within-track deflection assembly.
 - b. Do not attach studs to alternate slotted head track in manner that will impair movement; attach only with screws through center point of slots in side of head track.
4. Locate studs maximum 2 inches from opening jambs abutting partitions or other construction.
5. At corners, partition stud to form outside corner and locate another stud within 2 inches from inside corner along each wall.
6. Cut Studs: If stud web is cut more than 50 percent or stud flange cut to any degree, restore stud to original strength to the Architect's satisfaction by welding or screwing on steel reinforcement.

G. Completely frame openings.

1. Vertical Framing:
 - a. Install 2 boxed studs at each jamb of framed opening continuous from structure to structure as indicated on Drawings.
 - b. Weld boxed studs together.
2. Framing Over Openings:
 - a. Provide header track in combination with stud or boxed header as indicated and scheduled on Drawings.
 - b. Secure header tracks and headers to adjacent jamb studs with clips or clips in combination with track sections as indicated on Drawings.
 - c. Install cut-to-length infill studs, as required, between horizontal header track and head track.

3. Framing Under Openings:

- a. Provide single horizontal sill track and sill track in combination with stud as indicated on Drawings.
- b. Secure sill tracks and studs to adjacent jamb studs with clips as indicated on Drawings.
- c. Install cut-to-length infill studs, as required, between horizontal sill track and base track.

H. Backing in Stud Partitions: Install metal backing in partitions as required for support of cabinets, grab bars, handrails, cabinets, countertops, wall hung equipment, fixtures, toilet partitions, toilet accessories, hardware, miscellaneous specialties and other similar items.

1. Fabricate backing plates for welded face mount and for mechanically fastened face mount as indicated on Drawings.
 - a. Notch legs of face mounted track plates to let-in partition studs. Ensure each plate is continuous over minimum 3 partition studs; weld to studs.
 - b. Extend face mounted strap plates over minimum 3 partition studs; secure to partition studs with 3 screws to each stud.
2. Verify that pre-drilling of backing and attachment of spacers to prevent crushing of collateral material is done prior to application of collateral material.
3. If it is determined by Architect that backing was not provided for items as required, remove finish material and install backing. Patch and refinish surface to match adjacent area and surface.

3.3 INSTALLATION - CEILING AND SOFFIT FRAMING

- A. Install ceiling and soffit framing per ASTM C754 unless otherwise shown or specified.
- B. Align runners and secure to walls and fascia at 24 inches oc maximum.
- C. Install studs horizontally at 16 inches oc. Install studs in single lengths without splices and with web openings aligned. Secure studs to runners with sheet metal screws.
- D. Install studs at openings not more than 2 inches from each side of opening. Completely frame openings.
- E. Brace as indicated on Drawings.

3.4 TOLERANCES

- A. Install members to provide surface plane with maximum variation of 1/8 inch in 10 feet in any direction.

END OF SECTION

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SECTION 09115

METAL CHANNEL FURRING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Hat furring channels.
- B. Zee furring channels.
- C. Resilient furring channels.
- D. Framing accessories.

1.2 RELATED SECTIONS

- A. Section 03300 - Cast-In-Place Concrete: Concrete walls and columns.
- C. Section 05400 - Cold Formed Metal Framing: Exterior steel stud and joist framing.
- D. Section 09110 - Non-load Bearing Metal Framing: Interior steel stud and joist framing.
- E. Section 09250 - Gypsum Board: Gypsum board wall and ceiling finishes.

1.3 REFERENCES

- A. ASTM C754 - Installation of Steel Framing Members to Receive Screw-Attached Gypsum Board.
- B. ASTM C954 - Specification for Steel Drive Screws for the Application of Gypsum Board or Metal Plaster Bases to Studs from 0.33 in. to 0.112 in. Thickness.
- C. ASTM C1002 - Specification for Steel Drill Screws for the Application of Gypsum Board.
- D. ASTM E119 - Method of Fire Tests of Building Construction and Materials.
- E. SSMA - Steel Stud Manufacturers Association.

1.4 SYSTEM DESCRIPTION

- A. Hat Furring Channels: Metal double leg rigid hat-shaped channels secured to structure to provide suitable base for attaching finishes specified in other sections.
- B. Zee Furring Channels: Metal zee-shaped channels secured to structure to provide suitable base for attaching finished specified in other sections.

- C. Resilient Channel Furring: Metal single leg resilient channels secured to structure for attaching finishes specified in other sections.

1.5 DESIGN REQUIREMENTS

- A. Sustainable Design Requirements: Steel used in work of this section is intended to contribute to meeting requirements for recycled content outlined in LEED™-NC 2009 Credit MR4.

1.6 PERFORMANCE REQUIREMENTS

- A. Maximum Allowable Deflection:
 - 1. Wall Furring Supporting Tile: Horizontal deflection of 1/360 of span.
 - 2. Wall Furring Supporting Cement Plaster: Horizontal deflection of 1/360 of span.
 - 3. Wall Furring Supporting Cabinets, Shelving, Lockers and Equipment: Horizontal deflection of 1/360 of span.
 - 4. Other Wall Furring: Horizontal deflection of 1/240 of span.
 - 5. Soffit and Ceiling Furring: Vertical deflection of 1/240 of span.

1.7 SUBMITTALS

- A. Product Data: Provide data describing furring member materials and finish, product criteria, load charts and limitations.
- B. LEED Documentation:
 - 1. Steel: Submit letter or product data from manufacturer indicating recycled contents. Designate percentage of post-consumer and post-industrial recycled content.
 - 2. Submit hard copies of completed Online Documentation required for LEED™ MR Credit 4.

1.8 QUALITY ASSURANCE

- A. Furnish furring materials in accordance with SSMA Product Technical Information.
- B. Perform work in accordance with ASTM C754.
- C. Fire-Resistance Ratings: Comply with fire resistance ratings as indicated and as required by governing authorities and codes. Provide materials, accessories, and application procedures that have been listed by UL or tested according to ASTM E119 for type of construction shown.

1.9 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing furring channels with minimum 5 years documented experience and maintaining current membership with Steel Stud Manufacturer's Association.
- B. Installer: Company specializing in installing furring channels with minimum 5 years documented experience.

1.10 PREINSTALLATION CONFERENCE

- A. Convene preinstallation conference minimum 1 week prior to commencing work of this section.
- B. Attendance: Contractor, metal furring installer, Project Manager, Project Inspector and Architect.
- C. Agenda: Review Construction Documents, shop drawings, schedule of work, existing conditions, details of work, installation procedures and coordination with related work. Conduct walkover inspection of substrate.

1.11 PRODUCT DELIVERY AND STORAGE

- A. Deliver products to site, store and protect products in accordance with manufacturer's instructions and recommendations.
- B. Deliver in manufacturer's unopened containers and bundles fully identified with name, brand, type and grade.
- C. Protect metal channels from rusting and damage.
- D. Store inside in dry, ventilated space.

1.12 COORDINATION

- A. Coordinate with other work supporting, adjoining, or fastening to metal furring work.

PART 2 PRODUCTS

2.1 HAT FURRING CHANNELS

- A. Manufacturers:
 - 1. California Expanded Metal Products Co.
 - 2. Consolidated Fabricators Corp.
 - 3. Dietrich Industries, Inc.

4. SAFCO Corporation.
5. Substitutions: Under provisions of Division 1.

B. Hat Furring Channels: Hot or cold rolled sheet steel formed from steel having 33,000 psi yield point; G40 galvanized finish per ASTM A653; hat shape; knurled face.

1. Furring Height: 7/8 and 1-1/2 inch as indicated on Drawings.
2. Face Width: Minimum 1-1/4 inch.
3. Overall Width: Minimum 2-1/2 inches.
4. Material Thicknesses: 0.0312 inches (20 gauge drywall).

2.2 ZEE FURRING CHANNELS

A. Manufacturers:

1. California Expanded Metal Products Co.
2. Consolidated Fabricators Corp.
3. Dietrich Industries, Inc.
4. SAFCO Corporation.
5. Substitutions: Under provisions of Division 1.

B. Zee Furring Channels: Hot or cold rolled sheet steel formed from steel having 33,000 psi yield point; G40 galvanized finish per ASTM A653; zee shape; toed-in attachment leg predrilled for fasteners.

1. Furring Heights: Custom and standard heights as scheduled and indicated on Drawings.
2. Attachment Leg Width: Minimum 3/4 inch.
3. Holding Leg Width: Minimum 1-1/4 inches.
4. Material Thicknesses: 0.0312 inches (20 gauge drywall).

2.3 RESILIENT FURRING CHANNELS

A. Manufacturers:

1. Unimast Incorporated: RC Deluxe Resilient Channel.
2. Other Manufacturers Offering Acceptable Equivalent Products:

- a. California Expanded Metals Company.
 - b. Dietrich Industries Inc.
- 3. Substitutions: Under provisions of Division 1.
- B. Resilient Channels: Roll formed sheet steel; corrosion resistant finish; single flange decoupled type; inner flange prepunched for screw attachment.
 - 1. Furring Height: 1/2 inch
 - 2. Overall Width: 2-1/2 inches.
 - 3. Steel Thickness: 0.0188 inches (25 gauge).

2.3 ACCESSORIES

- A. Fasteners:
 - 1. Screws: Self-drilling and self-tapping sheet metal screws; zinc plated steel; pan head or hex head with washer; point as required to drill 12 gauge stock; #10 by length sufficient to penetrate through second surface minimum 3/8 inch unless otherwise indicated or specified.
 - 2. Powder-Actuated Fasteners: Tempered steel pins with corrosion resistant plating or coating; guide washers to control penetration; Hilti Fastening Systems, Impex Tool Corp. or equal product substituted under provisions of Division 1.
 - a. Sheet Steel to Structural Steel Shapes: Zinc plated steel; 0.145 diameter knurled shank; 7/8 inch length; plastic guide washer to accurately control penetration to minimum 3/4 inch; Hilti Corporation #EDNI22P8.
 - b. Sheet Steel to Concrete: Zinc plated steel powder driven fasteners; 0.145 inch diameter shank; length sufficient for minimum 1-1/2 inch penetration into concrete; Hilti Corp. DX Powder Actuated Fastening System "DNI 27 P8T."

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. Do not proceed with installation of metal framing systems until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Rigid Furring Channels: Install hat furring channels and Z-furring channels in accordance with ASTM C754.
1. Attach furring channels directly to face of structure running horizontally and vertically as indicated on Drawings.
 2. Space furring channels as indicated on Drawings but never more than 24 inches oc.
 3. For furring positioned horizontally, ensure center line of furring members closest to floor and ceiling is within 3 inches from floor and ceiling lines.
 4. Secure furring channels to structure at 24 inches o/c maximum; alternate fasteners on flanges of hat furring channels.
- B. Resilient Channels: Install resilient channels in accordance with manufacturer's instructions and as specified herein.
1. Attach furring channels directly to face of structure running horizontally and vertically as indicated on Drawings.
 2. Space channels as indicated on Drawings but never more than 24 inches oc.
 3. Locate channels installed horizontally maximum 2 inches up from floor and within 6 inches of ceiling. Hold ends of channels back 1 to 3 inches from intersecting surfaces. Ensure channels are located so that gypsum board will not be cantilevered more than 6 inches.
 4. Attach resilient channels with flanges facing in only 1 direction unless otherwise indicated. Except at floor, attach resilient channels installed horizontally with attachment flange down; attach bottom channel nearest floor with attachment flange up.
 5. Secure resilient channels to structure at 24 inches oc maximum.

END OF SECTION

SECTION 09120
CEILING SUSPENSION SYSTEM

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Suspended metal grid ceiling system for gypsum board ceilings.
- B. Framing accessories.

1.2 RELATED SECTIONS

- A. Section 03300 – Cast-In-Place Concrete: Concrete fill at floor and roof decks supporting suspended ceilings.
- B. Section 05120 - Structural Steel Framing: Steel beams supporting floor decks, roof decks and suspended ceilings.
- C. Section 07540 – Thermoplastic Membrane Roofing: Gypsum roof board and rigid insulation over roof decks supporting suspended ceilings.
- D. Section 09511 - Acoustical Panel Ceilings: Suspended metal grid system for acoustic panels.
- E. Division 15 - Mechanical: Fire protection devices in soffits.
- F. Division 16 - Electrical: Light fixtures and fire alarm smoke detectors in soffits.

1.3 REFERENCES

- A. ASTM A641 - Specification for Zinc Coated Galvanized Steel Wire.
- B. ASTM A653 - Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron-Alloy Coated (Galvannealed) by the Hot-Dip Process.
- C. ASTM C635 - Specification for Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings.
- D. ASTM E580 - Practice for Application of Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels in Areas Requiring Seismic Restraint.
- E. CBC – California Building Code, 2010 edition.
- F. DSA IR 25-1 - Division of State Architect Interpretation of Regulations Document "Maximum Allowable Load for 10 Gage and 12 Gauge Wires."

- G. DSA IR 25-3 - Division of State Architect Interpretation of Regulations Document "Dry-wall Ceiling Suspension Conventional Construction – One Layer."
- H. DSA IR 25-5 - Division of State Architect Interpretation of Regulations Document "Metal Suspension Systems for Lay In Panel Ceilings."
- I. FF S-325 - Shield, Expansion, Nail, Expansion and Nail, Drive Screw (Devices, Anchoring, Masonry).

1.4 SYSTEM DESCRIPTION

- A. Suspended Metal Grid Ceiling System: Pre-engineered ceiling suspension system consisting of straight main tees and straight cross tees suspended from structure to support screw attached gypsum board ceilings. Gypsum board specified in separate sections.
 - 1. Maximum Allowable Deflection: 1/360 span.
 - 2. System installation to accommodate construction tolerances.

1.5 DESIGN REQUIREMENTS

- A. Locations of elements in suspended ceilings and soffits shall conform to locations shown on Architectural Reflected Ceiling Plans. Architectural Reflected Ceiling Plans govern over Mechanical Drawings and Electrical Drawings.
- B. Sustainable Design Requirements: Steel used in work of this section is intended to contribute to meeting requirements for recycled content outlined in LEED™-NC3.0 Credit MR4.

1.6 SUBMITTALS

- A. Shop Drawings:
 - 1. Layout: Indicate complete reflected ceiling layout at 1/4 inch = 1'-0" scale with every element penetrating or contacting ceiling including, but not limited to, lighting fixtures, mechanical diffusers and registers, speakers, smoke detectors, access panels and ceiling mounted equipment and supports.
 - 2. Assembly: Indicate installation details, accessory attachments and installation of lighting fixtures and mechanical system components.
- B. Product Data: Submit manufacturer's catalog cuts or standard drawings showing details of system with project conditions clearly identified. Include technical data for system components.

C. LEED Documentation:

1. Steel: Submit letter or product data from manufacturer indicating recycled contents. Designate percentage of post-consumer and post-industrial recycled content.
2. Submit hard copies of completed Online Documentation required for LEED™ Credit MR4.

1.7 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing suspended metal grid systems for gypsum ceilings with minimum 5 years documented experience.
- B. Installer: Company specializing in installing suspended metal grid systems for gypsum ceilings with minimum 5 years documented experience.

1.8 REGULATORY REQUIREMENTS

- A. Conform to DSA IR 25-1, DSA IR 25-3 and DSA IR 25-5 for suspension of ceiling grid.

1.9 PRODUCT DELIVERY AND STORAGE

- A. Deliver products to site, store, handle and protect in accordance with manufacturer's instructions and recommendations.
- B. Deliver products in manufacturer's unopened containers and bundles fully identified with name, brand, type and grade.
- C. Inspect delivered products for damage; promptly remove damaged products from site.
- D. Protect metal components from rusting and damage.
- E. Store inside in dry, ventilated space.

1.10 ENVIRONMENTAL REQUIREMENTS

- A. Do not install suspension system until building is enclosed with windows and exterior doors are in place and glazed and with roof watertight.
- B. Do not install suspension system until interior temperature can be maintained between 60 degrees F and 104 degrees F and relative humidity can be maintained below 90 percent.

1.11 COORDINATION

- A. Coordinate work of this section with installation of mechanical, electrical and other equipment, materials or work penetrating or that could conflict with installation of suspended gypsum ceilings.

- B. Coordinate suspension system installation with installation of mechanical work specified under Division 15 - Mechanical; ensure ductwork above soffits is complete.
- C. Coordinate suspension system installation with installation of electrical work specified under Division 16 - Electrical; ensure conduit above ceiling is complete.

PART 2 PRODUCTS

2.1 SUSPENDED CEILING FRAMING

- A. Manufacturers:
 - 1. Armstrong World Industries, Inc.: Drywall/Stucco/Plaster Grid Systems.
 - 2. Manufacturer Offering Acceptable Equivalent Product: USG Interiors, Inc.
 - 3. Substitutions: Under provisions of Division 1.
- B. Grid: ASTM C635; heavy duty; components die cut and interlocking; commercial quality cold rolled steel; galvanized finish.
 - 1. Main Tees: Double web construction; 1-11/16 inch profile height with peaked roof top bulb; 1-1/2 inch knurled face; 144 inches long with 51 routs starting 2-1/4 inch from each end; fire notch expansion relief in web; #HD8906.
 - 2. Cross Tees: Double web construction; 1-1/2 inch profile height with peaked roof top bulb; 1-1/2 inch knurled face; 36 inches long with no routs; #XL7936G90.
 - 3. Accessory Cross Tees: Double web construction; 1-1/2 inch profile height with peaked roof top bulb; 1-1/2 inch knurled face; lengths as required.
 - 4. Moldings: Channel molding with unequal legs; unhemmed edges; 1-9/16 inches high with 3/4 inch upper leg and 1-1/4 inch lower leg; 120 inches long; #7838.
 - 5. Angle Clips: Flat plates configured to create positive and secure angles on main or cross tees; #DW90C.
 - 6. Direct Load Ceiling Clip: Bent stirrup type clip configured for hanging lower suspension system below upper suspension system and transferring weight directly to hanger wire and not to upper suspension system without modifying upper suspension system; #DLCC.

2.2 ACCESSORIES

- A. Auxiliary Trapeze Framing: 12 gauge framing channel; 1-5/8 x 1-5/8 inch size; galvanized finish; P1000 as manufactured by Unistrut Corporation, or equal product substituted under provisions of Division 1.
- B. Wire: ASTM A641 Class 1 coating; mild steel; soft temper; galvanized.
 - 1. Bracing Wire: Minimum 12 gauge.
 - 2. Hanger Wire: Minimum 8 gauge.
- C. Fasteners:
 - 1. Screws: Self-drilling and self-tapping sheet metal screws; zinc plated steel; pan head or hex head with washer; point as required to drill 12 gauge stock; #8 by length sufficient to penetrate through second surface minimum 1/4 inch unless otherwise indicated or specified.
 - 2. Expansion Anchors: FF S-325, Group II, Type 4, Class 1; stud type expansion anchor with single-piece three-section wedge; zinc plated steel; 3/8 inch diameter; length sufficient for minimum 1-5/8 inch embedment into concrete; Hilti Corporation "Kwik Bolt TZ" Expansion Anchor, ITW Ramset/Redhead "Trubolt+" Seismic Wedge Anchors or equal product substituted under provisions of Division 1.
 - 3. Powder-Actuated Fasteners:
 - a. Sheet Steel to Concrete: Zinc plated steel; 0.145 shank diameter; 1 inch length; plastic guide washer to accurately control penetration to minimum 3/4 inch; Hilti Corporation #DNI27P8 or equal product substituted under provisions of Division 1.
 - b. Sheet Steel to Structural Steel Shapes: Zinc plated steel; 0.145 diameter knurled shank; 7/8 inch length; plastic guide washer to accurately control penetration to minimum 3/4 inch; Hilti Corporation #EDNI22P8 or equal product substituted under provisions of Division 1.
 - 4. Rivets: Blind pop rivets; steel body; steel mandrel; 1/8 inch diameter rivet; 1/4 inch head diameter domed head; 0.063 to 0.125 inch grip range; galvanized finish.
- D. Hanger Wire Anchors:
 - 1. Clips: Bent steel plates; 13 gauge; right angle; minimum 3/4 inch wide; 5/16 inch diameter eye in vertical leg for hanger wire; hole in horizontal leg for shot in anchor with centerline not more than 5/8 inch from vertical leg; Hilti Corporation CC27 Ceiling Clips or equal product substituted under provisions of Division 1.
 - 2. Fasteners: Powder-actuated fasteners as specified above for fastening sheet metal to steel and to concrete, as applicable.

E. Bracing Wire Anchors:

1. Clips: Custom bent steel angle plates with profile as required to set bracing wires at required angle; 12 gauge; minimum 1 inch wide; 5/16 inch diameter eye in splayed leg for bracing wire; hole in horizontal leg for expansion anchor with centerline not more than 5/8 inch from angle break.
2. Fasteners:
 - a. For Steel Beams: Powder-actuated fasteners as specified above for fastening sheet metal to steel.
 - b. For Concrete Decks with Concrete Fill: Expansion anchors as specified above.

F. Compression Strut Assembly:

1. Vertical Members: Compression Struts: Hot or cold rolled metal studs; formed from steel complying with ASTM A653 with minimum 33,000 psi yield point; G40 galvanized finish; "Cee" shape; 20 gauge; 3-5/8 inch deep web; 1-5/8 inch flanges; 1/2 inch returns; minimum radius of gyration about y-axis of 0.104; 1/r ratio of 200 maximum; Dietrich CSJ 3-5/8 Inch C-Studs or equal product substituted under provisions of Division 1.
2. Clips: Custom bent steel angle bracket with right angle break; 13 gauge; dimensions as indicated on Drawings.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine condition of substrate to determine acceptability for installation. Verify that substrate conditions are acceptable for product installation in accordance with manufacturer's instructions and recommendations.
- B. Verify that installation of building components above ceiling is complete, inspected and approved.
- C. Verify that layout of hangers will not interfere with other work.
- D. Do not begin installation until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install suspension system in accordance with ASTM E580, final reviewed shop drawings and manufacturer's instructions and recommendations.

- B. Install system according to Reflected Ceiling Plan and final reviewed shop drawings after major above ceiling work is complete.
- C. Coordinate location of hanger and bracing wires with other work. Separate hanger and bracing wires minimum 6 inches from unbraced ducts, pipes and conduits.
- D. Install system capable of supporting imposed loads to deflection of 1/360 maximum.
 - 1. Install main tees at maximum 48 inches oc; install cross tees at maximum 24 inches oc.
 - 2. Provide hanger wires at 48 inch centers along main tees, at ends of main and cross tees and within 12 inches of each side of splice clips.
 - 3. Provide sets of 4 splayed bracing wires oriented 90 degrees to each other at spacing not more than 12 feet by 12 feet on center in field and not more than 6 feet by 6 feet from each perimeter wall and at edge of vertical ceiling offsets.
 - 4. Provide minimum 4 hanger wires at each air terminal. Attach hanger wire terminal above to support terminal independently from ceiling grid.
- E. Install hanger and bracing wires taut without causing ceiling to lift.
 - 1. Install hanger and bracing wires so that direction of wire aligns as closely as possible with direction of forces acting on wire.
 - a. Install hanger wires plumb; provide counter sloping wires at hanger wires that are more than 1 in 6 out of plumb.
 - b. Install bracing wires within 45 degrees of plane of ceiling.
 - 2. Secure hanger wires to structure and to suspension system.
 - a. Secure hanger wires to steel beams and concrete decks with clips; secure clips to bottom of beam flange and to bottom deck with powder-actuated fasteners. Thread hanger wire through eyes in clips; secure with 3 tight turns in 1-1/2 inches.
 - b. Secure hanger wires to suspension system by threading through eyes in runners and fastening with 3 tight turns in 1-1/2 inches.
 - 3. Secure bracing wires to structure and to suspension system.
 - a. Secure bracing wires to steel beams and concrete decks with clips. Thread bracing wires through eyes in clips; secure with 4 tight turns in 1-1/2 inches.
 - 1) Secure clips to bottom of beam flanges with powder-actuated fasteners.

- 2) Secure clips to bottom of concrete filled steel decks with expansion anchors.
- b. Secure bracing wires to suspension system by threading through eyes in runners and fastening with 4 tight turns in 1-1/2 inches.
4. Do not splice hanger or bracing wires.
- F. Provide compression struts at each set of bracing wires to resist vertical component induced by bracing wires.
 1. Fasten clips to decks with powder actuated fasteners; provide minimum 2 fasteners per clip.
 2. Fasten struts to clips with screws; provide minimum 2 fasteners per strut.
 3. Fasten struts to main runners with screws; provide minimum 2 fasteners per strut.
- G. Hang system independent of walls, columns, ducts, pipes and conduit.
- H. Use carrying members using longest practical lengths; do not use scraps and short cut members. Where carrying members are spliced, avoid visible displacement of face panel of adjacent members.
- I. Where ducts or other equipment prevent regular spacing of hangers, provide trapeze framing or other supplementary support members. Provide additional hanger struts or braces as required at ceiling breaks, soffits, or discontinuous areas.
- J. Do not support components on main tees or cross tees if weight causes total dead load to exceed deflection capability. Support fixture loads by supplementary hangers located within 6 inches of each corner or support components independently.
- K. Do not eccentrically load system or produce rotation of runners.
- L. Level suspension system in each area after installation of mechanical and electrical equipment.
- M. Coordinate installation of gypsum board finish.
- 3.3 TOLERANCES
 - A. Install members to provide surface plane with maximum variation of 1/8 inch in 10 feet in any direction.
- 3.4 FIELD QUALITY CONTROL
 - A. Field testing will be performed by Owner's Testing Laboratory.

- B. Owner's Testing Laboratory will test powder-actuated fasteners and expansion anchors for tension.
1. When used for hanger wires; 10 percent of anchors will be tested for minimum 200 pound.
 2. When used for bracing wires; 50 percent of anchors will be tested for 440 pounds.

END OF SECTION

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SECTION 09250

GYPSUM BOARD

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Gypsum board and gypsum backing board.
- B. Trim and accessories.
- C. Taped and sanded joint treatment.

1.2 RELATED SECTIONS

- A. Section 05400 - Cold Formed Metal Framing: Load bearing exterior metal framing receiving gypsum board.
- B. Section 06100 - Rough Carpentry: Wood nailers and miscellaneous blocking.
- C. Section 07540 - Thermoplastic Membrane Roofing: Gypsum roof board.
- D. Section 07900 - Joint Sealers.
- E. Section 08110 - Steel Doors and Frames: Steel door frames.
- F. Section 09110 - Non-Load Bearing Metal Framing: Non-load bearing interior framing receiving gypsum board.
- G. Section 09115 - Metal Channel Furring: Metal hat furring channels and "Z" furring channels receiving gypsum board.
- H. Section 09120 - Ceiling Suspension Framing: Suspended metal framing system to receive gypsum board.
- I. Section 09253 - Gypsum Sheathing.
- J. Section 09820 - Acoustical Insulation and Sealants.
- K. Section 09900 - Paints and Coatings: Finish painting.

1.3 REFERENCES

- A. ASTM C36 - Specification for Gypsum Wallboard.
- B. ASTM C442 - Specification for Gypsum Backing Board.

- C. ASTM C475 - Specification for Joint Compound and Joint Tape for Finishing Gypsum Board.
- D. ASTM C954 - Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs from 0.033 in. (0.84mm) to 0.112 in. (2.84mm) in Thickness.
- E. ASTM C1002 - Specification for Steel Drill Screws for the Application of Gypsum Board.
- F. ASTM C1047 - Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base.
- G. ASTM C1178 - Specification for Glass Mat Water-Resistant Gypsum Backing Board.
- H. CBC - California Building Code, 2010 edition.
- I. GA 214 - Recommended Specifications for Levels of Gypsum Board Finish.
- J. GA 216 - Recommended Specifications for the Application and Finishing of Gypsum Board.

1.4 DESIGN REQUIREMENTS

- A. Sustainable Design Requirements: Products used in work of this section is intended to contribute to meeting requirements for recycled content outlined in LEED™-NC 2009 Credit MR4.

1.5 SUBMITTALS

- A. Product Data: Provide product data on gypsum board panels, gypsum board trim, control joints and fasteners, joint tape and compound.
- B. Samples: Submit samples, minimum 24 x 24 inches in size, of each textured finishes specified applied to gypsum board substrate illustrating depth, surface texture and consistency of finish.
- C. LEED Documentation:
 - 1. Submit letter or product data from manufacturer indicating recycled contents. Designate percentage of post-consumer and post-industrial recycled content.
 - 2. Submit hard copies of completed Online Documentation required for LEED™ MR Credit 4.

1.6 QUALITY ASSURANCE

- A. Perform gypsum board systems work in accordance with recommendations of GA 214 and GA 216 unless otherwise specified in this section.

1.7 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturer of gypsum board with minimum 10 years documented experience.
- B. Applicator: Company specializing in application of commercial gypsum board systems work with minimum 5 years documented experience.

1.8 REGULATORY REQUIREMENTS

- A. Fire Rated Partitions and Ceilings:
 - 1. Walls and Partitions: Comply with CBC Section 705 and Section 708.
 - 2. Floor/Ceiling and Roof/Ceiling Assemblies: Comply with CBC Section 711.

1.9 MOCK-UPS

- A. Construct mock-ups of taped and sanded gypsum board surfaces using materials and methods specified herein demonstration aesthetic effects and qualities of materials and execution.
- B. Construct mock-up of Level 4 taped and sanded finish extending full height and width of wall not less than 10 feet wide x 10 feet high.
- C. Locate mock-ups where directed by Architect.
- D. Rebuild panels not meeting specified requirements as directed by Architect.
- E. Surface finishes of accepted mock-ups will establish minimum standard of quality and workmanship of cement plaster work.
- F. Retain accepted mock-ups in undisturbed condition until work of this section is complete.
- G. Accepted mock-ups may remain as part of work.

1.10 DELIVERY, STORAGE AND HANDLING

- A. Deliver products to site, store, handle and protect in accordance with manufacturer's instruction and recommendations.
- B. Deliver materials to site in original unopened containers or bundles clearly marked with manufacturer's name, brand name, size, grade, testing agency listing if applicable and other pertinent data.

- C. Store materials in original packaging with seal unbroken and labels intact until time of use.
- D. Protect materials from damage, dirt and moisture.
- E. Stack gypsum board neatly, flat, with care to avoid damage to edges, ends and surfaces.

1.11 ENVIRONMENTAL REQUIREMENTS

- A. Maintain room temperature at not less than 40 degrees F during application of gypsum board except when adhesive is used for attachment of gypsum board.
- B. For bonding of adhesive and joint treatment, maintain room temperature at not less than 50 degrees for 48 hours prior to application and continuously thereafter until adhesive and joint treatment are completely dry.
- C. When temporary heat source is used, ensure temperature does not exceed 95 degrees F during application of gypsum board and joint finishing.
- D. Provide adequate ventilation to eliminate excessive moisture minimum 24 hours before, during and after gypsum board application and joint finishing.
 - 1. Under slow drying conditions, allow additional drying time between coats of joint treatment.
 - 2. During hot, dry weather, protect installed materials from drafts.

1.12 COORDINATION

- A. Coordinate installation of gypsum board with installation of framing and with installation of electrical and mechanical work.
- B. Coordinate installation of gypsum backer boards with installation of ceramic tile specified under Section 09300. Ensure gypsum backer boards are installed within tolerances required and with joint treatment required for specified tile installation.

PART 2 PRODUCTS

2.1 GYPSUM BOARD

- A. Provide gypsum board materials in accordance with recommendations of GA 216.
- B. Fire Rated Gypsum Board: ASTM C36; UL rated with Type X fire resistant core; 5/8 inch thick; maximum permissible length; ends square cut; tapered edges.

- C. Water-Resistant Gypsum Board: ASTM C1178; coated glass mat water resistant gypsum backing board; 5/8 inch thick; maximum permissible length; ends square cut; square edges; silicone treated water resistant core penetrated front and back by inorganic glass mats; water barrier coating; Georgia-Pacific Corporation "Dens-Shield" Tile Backer or equal product substituted under provisions of Division 1.
- D. Gypsum Backing Board: ASTM C442; UL rated with Type X fire resistant core; 5/8 inch thick; square edges, ends square cut, maximum permissible length.

2.2 ACCESSORIES

- A. Provide gypsum board accessories in accordance with GA 216.
- B. Metal Trim: All-metal; flanges perforated for mechanical face attachment.
 - 1. Corner Beads: Galvanized sheet steel; 1-1/4 perforated flanges; 1/8 inch nose; United States Gypsum's Dur-A-Bead Corner Bead #103, Western's Drywall Corner Bead, or Gold Bond's Wallboard Corner Bead.
 - 2. Edge Trim: Galvanized sheet steel; minimum 7/8 inch perforated flanges; 1/8 inch bead.
 - a. Locations with Exposed Gypsum Board Edges: "LC" bead; United States Gypsum's #200-A, Western's #108 U-Metal, or Gold Bond's #100 Wallboard Casing.
 - b. Other Locations: "L" bead; United States Gypsum's #200-B, Western's "L" Metal #202, or Gold Bond's #200 Wallboard Casing.
- C. Control Joints: ASTM C1047; roll formed zinc or galvanized steel; 3/32 inch grounds; 1/4 inch wide x 7/16 inch deep "V" reveal; removable strip protection.
- D. Fasteners:
 - 1. To Metal:
 - a. For Cold Formed Light Gauge Steel Framing up to 20 Gauge: ASTM C1002, Type S bugle head drywall screws; 1-1/4 inch or length sufficient to penetrate through framing minimum 1/4 inch, whichever is greater.
 - b. For Cold Formed Light Gauge Steel Framing Over 20 Gauge: ASTM C954; length sufficient to penetrate through second surface minimum 1/4 inch.
 - 2. To Wood: ASTM C1002; bugle head drywall screws; 1-1/4 inch or length sufficient to penetrate framing minimum 5/8 inch, whichever is greater.
 - a. Single Ply Gypsum Board Applications: Type W.
 - b. Multiple Ply Gypsum Board Applications: Type W or Type S.

3. To Gypsum Base Ply: ASTM C1002; Type G; 1-1/2 inches long.
- E. Laminating Adhesive: GA 216; setting type powder gypsum board joint compound; rapid chemical hardening; low shrinkage; high bond strength; recommended by manufacturer for laminating multiple layer fire-rated assemblies.
- F. Reinforcing Tape:
1. For Coated Glass Mat Water-Resistant Backer Board: 10 x 10 glass mesh tape; 2 inches wide.
 2. For Other Gypsum Boards: GA 216; cross-fibered paper tape.
- G. Joint Compound:
1. For Taping Coated Glass Mat Water-Resistant Backer Board: Latex-Portland cement mortar as specified in Section 09310 - Ceramic Tile.
 2. For Taping Other Gypsum Boards: ASTM C475; ready-mixed type or powder type for field mixing.
 - a. For Embedding Tape: Taping joint compound.
 - b. For Intermediate Coats Over Tape: Lightweight joint compound.
 - c. For Final Coat Over Tape: Topping joint compound.

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 recommendation.
- B. Verify that metal framing and furring is installed and is properly secured, spaced and aligned so that specified tolerances can be achieved.
- C. Verify that blocking, backing and bracing for fixtures, equipment, accessories, hardware and other items secured to walls are installed and are properly secured and aligned so that specified tolerances can be achieved.
- D. Verify that steel door frames have been properly set for thickness of board to be used and opening dimensions are as instructed by manufacturer.
- E. Verify that mechanical, plumbing, electrical and other items to be enclosed in walls and partitions are installed, inspected and approved.

- F. Do not begin installation until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install gypsum board in accordance with recommendations of GA 216.
- B. Install gypsum board in sound rated and fire rated partitions, walls and roof/ceiling assemblies in accordance with listed designs indicated on Drawings.
- C. Where listed designs are proprietary, use products of the listed manufacturer throughout system. Do not mix components of alternate proprietary design.
- D. For non-rated partitions, install single layer gypsum board in most economical direction with ends and edges occurring over firm bearing.
- E. For double layer applications, use gypsum backing board or gypsum board for first layer.
- F. Install 5-sided rated gypsum board enclosures at recessed light fixtures in fire rated ceilings.
- G. Use screws when fastening gypsum board to furring and framing. Use screws in combination with laminating adhesive at double layer applications in accordance with listed design.
- H. In rated assemblies, space fasteners in accordance with listed designs. In non-rated partitions, space fasteners in accordance with CBC Section 2508.
- I. Install water resistant coated glass mat gypsum backing board behind thinset ceramic tile and where indicated on Drawings. Treat cut edges and holes in gypsum backing board with sealant.
- J. Make cut-outs in gypsum board regular; do not fracture core or tear covering of gypsum board.
- K. Minimize penetrations of sound rated and acoustically insulated construction. Penetrate only where necessary; coordinate application of acoustical sealant to fully seal annular space.
 - 1. Where ducts, conduit and piping greater than 3-inches in diameter penetrate acoustically insulated partitions and ceilings, provide clearance of 1 inch $\pm$ 1/4 inch at perimeter of penetration.
 - 2. Where conduit and piping less than 3-inches in diameter penetrate acoustically insulated partitions and ceilings, provide clearance of 1/4 inch $\pm$ 1/8 inch at perimeter of penetration.
- L. Place corner beads at external corners. Place edge trim where gypsum board terminates, abuts dissimilar materials and as details.

1. Use longest practical lengths.
 2. Secure to framing with screws through face of flanges.
- M. Place control joints consistent with lines of building spaces as indicated. Space control joints as indicated and:
1. Where partition, wall or ceiling traverses a construction joint in base building structure.
 2. Where partition or wall runs in uninterrupted straight plane exceeding 30 linear feet.
 3. In ceilings with perimeter relief so that distance between control joints does not exceed 50 feet and total area between joints does not exceed 2500 sq ft.
 4. In ceilings with perimeter relief where ceiling members change direction and intermediate blocking is not installed.
 5. In ceilings without perimeter relief so that distance between control joints does not exceed 30 feet and total area between joints does not exceed 900 sq ft.
 6. In ceilings without perimeter relief where ceiling members change direction.

3.3 GYPSUM BOARD JOINT TREATMENT

- A. Tape, fill and sand joints, fastener heads, edges and corners in wallboard to following levels in accordance with GA 214:
1. Level 1: Gypsum board concealed above ceilings except as required otherwise by listed designs for fire and sound construction.
 - a. Embed tape in joint compound at joints and interior angles.
 - b. Remove excessive joint compound; tools marks and ridges are acceptable.
 2. Level 2: Gypsum board concealed behind tile finishes, paneling and casework.
 - a. Embed tape in joint compound at joints and interior angles.
 - b. Apply separate coat of joint compound over joints, angles, fastener heads and accessories.
 - c. Remove excessive joint compound; tool marks and ridges are acceptable.
 3. Level 4: Gypsum board to receive paint finish and wallcovering.
 - a. Embed tape in joint compound at joints and interior angles.

- b. Apply 3 separate coats of joint compound over joints, angles, fastener heads, and accessories.
 - c. Finish joint compound smooth and free of tool marks and ridges.
- B. Feather each successive coat beyond edge of previous coat so that maximum camber is 1/32 inch.
 - 1. At tapered edges of gypsum board, feather each successive coat 2 inches beyond edge of previous coat.
 - 2. On square edges of gypsum board, feather each successive coat 4 inches beyond edge of previous coat.
 - 3. At fastener heads, feather each successive coat 2 inches beyond edge of previous coat.
 - 4. At corner beads and edge trim, feather each successive coat 2 inches beyond edge of previous coat.
- C. Allow joint compound to thoroughly dry between coats.
- D. Sand joint compound between coats. Lightly sand last coat to eliminate laps and to smooth surface while taking care not to roughen face paper of gypsum board.
- E. Backfill cutouts with joint compound so that annular space does not exceed 1/8 inch.

3.4 TOLERANCES

- A. Maximum Variation from True Flatness:
 - 1. Coated Glass Mat Water-Resistant Gypsum Backing Board: 1/8 inch in 8 feet in any direction.
 - 2. Gypsum Board Behind Tile: 1/8 inch in 8 feet in any direction.
 - 3. Other Gypsum Board: 1/8 inch in 10 feet in any direction.

3.5 ADJUSTING

- A. Repair evidence of popping or ridging fasteners.

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SECTION 09251

CEMENTITIOUS BACKING BOARD

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Cementitious backing board.
- B. Taped joint treatment.
- C. Underlying water resistive barrier.

1.2 RELATED SECTIONS

- A. Section 07213 – Thermal Batt Insulation: Thermal batt insulation installed in exterior walls.
- B. Section 07900 - Joint Sealers.
- C. Section 09110 – Non-Load Bearing Metal Framing: Interior partition framing and backing; support for interior cementitious backing board.
- D. Section 09300 - Tile: Tile finish over cementitious backer board and underlying water resistive barrier within toilets.
- E. Section 09820 – Acoustical Insulation and Sealants: Acoustical batt insulation installed in interior partitions.

1.3 REFERENCES

- A. ANSI A108.11 – Interior Installation of Cementitious Backer Units.
- B. ANSI A118.4 – Latex Portland Cement Mortar.
- C. ANSI A118.9 – Test Methods and Specifications for Cementitious Backer Units.
- D. ASTM C473 – Test Methods for Physical Testing of Gypsum Panel Products.
- E. ASTM C666 – Test Method for Resistance of Concrete to Rapid Freezing and Thawing.
- F. ASTM C947 – Test Method for Flexural Properties of Thin-Section Glass-Fiber-Reinforced Concrete (Using Simple Beam with Third-Point Loading).
- G. ASTM D226 - Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing.

- H. ASTM D2394 – Method for Simulated Service Testing of Wood and Wood-Base Finish Flooring.
- I. ASTM E84 – Test Method for Surface Burning Characteristics of Building Materials.
- J. ASTM E136 – Test Method for Behavior of Materials in a Vertical Tube Furnace at 750°C.
- K. ASTM G21 – Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.

1.5 SUBMITTALS

- A. Product Data: Provide product data on cementitious backer board, water resistive barrier, fasteners, joint tape and compound.

1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturer of cementitious backing boards with minimum 10 years documented experience.
- B. Applicator: Company specializing in application of cementitious backing board work with minimum 5 years documented experience.

1.7 DELIVERY, STORAGE AND HANDLING

- A. Deliver products to site, store, handle and protect in accordance with manufacturer's instruction and recommendations.
- B. Deliver materials to site in original unopened containers or bundles clearly marked with manufacturer's name, brand name, size, grade, testing agency listing if applicable and other pertinent data.
- C. Store materials in original packaging with seal unbroken and labels intact until time of use.
- D. Protect materials from damage, dirt and moisture.
- E. Stack cementitious backing board neatly, flat, with care to avoid damage to edges, ends and surfaces.

1.8 COORDINATION

- A. Coordinate installation of cementitious backing board with installation of framing and with installation of electrical and mechanical work.

PART 2 PRODUCTS

2.1 CEMENTITIOUS BACKING BOARD

A. Manufacturers:

1. United States Gypsum Company: Durock® Cement Board.
2. Manufacturer Offering Acceptable Equivalent Product: National Gypsum Company.
3. Substitutions: Under provisions of Division 1.

- B. Cementitious Backer Board: ANSI A118.9; aggregated Portland cement slurry with polymer-coated glass fiber mesh completely encompassing edges, front and back surfaces; rounded wrapped edges; square cut ends; 1/2 inch nominal thickness.

Property	Test	Result
Weight	ASTM C473	Maximum 3 psf
Flexural Strength	ASTM C947	Minimum 750 psi
Compressive Strength	ASTM D2394	Minimum 1250 psi
Shear Bond Strength	ANSI A118.4	Minimum 50 psi
Uniform Load		Maximum 30 psf
Nail Pull Resistance	ASTM C473	Minimum 90 lbs
Water Absorption	ASTM C473	Maximum 15% by weight in 24 Hours
Freeze/Thaw Resistance	ASTM C666 Procedure B	No deterioration after 100 cycles
Mold Resistance	ASTM G21	No growth
Non-Combustibility	ASTM E136	Pass

Flame Spread	ASTM E84	0 maximum
Smoke Developed	ASTM E84	0 maximum

2.2 ACCESSORIES

- A. Water Resistive Barrier: ASTM D226, Type I; 15 pound asphalt saturated roofing felt; unperforated.
- B. Fasteners: Bugle head screws recommended by cementitious backer board manufacturer; stainless steel or corrosion resistant finish; length sufficient to penetrate through metal framing minimum 1/4 inch.
- C. Reinforcing Tape: Coated fiberglass mesh type recommended by cementitious backer board manufacturer.
- D. Cement Mortar: ANSI A118.4; factory preblended polymer fortified dry set mortar same as that specified in Section 09300 – Tile; gray color.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that site conditions are ready to receive work and opening dimensions are as instructed by manufacturer.
- B. Verify that framing is installed and is properly secured, spaced and aligned so that specified tolerances can be achieved.
- C. Verify that blocking, backing and bracing for fixtures, equipment, accessories, hardware and other items secured to walls are installed and are properly secured and aligned so that specified tolerances can be achieved.
- D. Verify that steel door frames have been properly set for thickness of board to be used and opening dimensions are as instructed by manufacturer.
- E. Verify that mechanical, plumbing, electrical and other items to be enclosed in walls and partitions are installed, inspected and approved.
- F. Verify that surfaces to receive cementitious backer boards are free from protruding fastener heads and other protrusions which deflect backer units.
- G. Do not begin installation until unsatisfactory conditions have been corrected.

3.4 WATER RESISTIVE BARRIER INSTALLATION

- A. Install water resistive barrier over wall framing to receive cementitious backer board in weatherboard fashion.
- B. Lap membrane over waterproof membrane at floor minimum 3 inches.
- C. Lap membrane edges minimum 2 inches and ends minimum 6 inches.
- D. Continue membrane minimum 6 inches around corners.

3.5 CEMENTITIOUS BACKER BOARD INSTALLATION

- A. Install cementitious backer units in accordance with ANSI A108.11 and manufacturer's installation instructions.
- B. Install backer units with ends and edges occurring over framing or solid blocking. Stagger end joints in successive courses.
- C. Install backer units with ends and edges closely abutted but not forced together.
- D. Secure to framing with fasteners at 6 to 8 inches oc with perimeter fasteners between 3/8 inch and 5/8 inch from ends and edges. Drive screws so bottoms of heads are flush with unit surface; do not over drive.
- E. Under ceramic tile, fill spaces at backer unit joints and between bottom of backer units and concrete slabs and curbs with latex-Portland cement mortar. Tape joints, including corner joints, with fiberglass mesh tape embedded in latex-Portland cement mortar.
- F. Coordinate installation of tile finish over interior cementitious backer board.

3.6 TOLERANCES

- A. Maximum Variation from True Flatness: 1/4 inch in 10 feet and 1/16 inch in 1'-0" regardless of direction.

3.7 ADJUSTING

- A. Repair evidence of popping or ridging fasteners.

END OF SECTION

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SECTION 09253

GYP SUM SHEATHING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Glass mat faced gypsum sheathing board.
- B. Accessories.

1.2 RELATED SECTIONS

- A. Section 05400 - Cold Formed Metal Framing: Exterior metal framing.
- B. Section 06100 - Rough Carpentry: Wood nailers and miscellaneous blocking.
- C. Section 07540 - Thermoplastic Membrane Roofing: Gypsum roof board.
- D. Section 07900 - Joint Sealers.
- E. Section 09250 - Gypsum Board.

1.3 REFERENCES

- A. ASTM C355 - Test Methods for Test for Water Vapor Transmission of Thick Materials.
- B. ASTM C473 - Methods for Physical Testing of Gypsum Board Products and gypsum Lath.
- C. ASTM C475 - Specification for Joint Compound and Joint Tape for Finishing Gypsum Board.
- D. ASTM C518 - Test method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Heat Flow Meter.
- E. ASTM C954 - Specification for Steel Drive Screws for the Application of Gypsum Board or Metal Plaster Bases to Studs from 0.33 in. to 0.112 in. Thickness.
- F. ASTM C1002 - Specification for Steel Drill Screws for the Application of Gypsum Board.
- G. ASTM C1177 - Specification for Glass Mat Gypsum Substrate for Use as Sheathing.
- H. ASTM D3273 - Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber.

- I. ASTM E72 - Method for Conducting Strength Tests of Panels for Building Construction.
- J. GA 253 - Application of Gypsum Sheathing.

1.4 DESIGN REQUIREMENTS

- A. Sustainable Design Requirements: Products used in work of this section is intended to contribute to meeting requirements for recycled content outlined in LEED™-NC 2009 Credit MR4.

1.5 SUBMITTALS

- A. Product Data: Provide product data on gypsum sheathing indicating material composition, thickness, sizes and fire resistance and on fasteners.
- B. LEED Documentation:
 - 1. Submit letter or product data from manufacturer indicating recycled contents. Designate percentage of post-consumer and post-industrial recycled content.
 - 2. Submit hard copies of completed Online Documentation required for LEED™ MR Credit 4.

1.6 QUALITY ASSURANCE

- A. Perform gypsum sheathing work in accordance with recommendations of GA 253 unless otherwise specified in this section.

1.7 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturer of gypsum sheathing with minimum 10 years documented experience.
- B. Applicator: Company specializing in application of commercial gypsum sheathing work with minimum 5 years documented experience.

1.8 DELIVERY, STORAGE AND HANDLING

- A. Deliver products to site, store, handle and protect in accordance with manufacturer's instruction and recommendations.
- B. Deliver materials to site in original unopened containers or bundles clearly marked with manufacturer's name, brand name, size, grade, testing agency listing if applicable and other pertinent data.
- C. Store materials in original packaging with seal unbroken and labels intact until time of use.

- D. Store materials protected against damage from contact with damp or wet surfaces, exposure to weather, direct sunlight, surface contamination, corrosion, construction traffic or other causes.
- E. Stack gypsum sheathing neatly, flat on leveled supports off ground. Provide air circulation under coverings and around stacks.
- F. Handle with care to avoid damage to edges, ends and surfaces.

1.9 COORDINATION

- A. Coordinate installation of gypsum sheathing with installation of framing and with installation of electrical and mechanical work.
- B. Schedule application so that sheathing is not left exposed to weather for more than 180 days.

PART 2 PRODUCTS

2.1 GYPSUM SHEATHING

- 1. Manufacturer:
 - 1. G-P Gypsum: DensGlass Gold® Exterior Sheathing.
 - 2. Manufacturers Offering Acceptable Equivalent Products: United States Gypsum Company.
 - 3. Substitutions: Under provisions of Division 1.
- 2. Glass Mat Gypsum Sheathing Board: ASTM C1177; moisture resistant treated core with glass mats both sides and long edges; rated Type X fire resistant as defined by ASTM C36; 5/8 inch thick; maximum available size in place; ends square cut; square edges; 5/8 Inch DensGlass Gold® Fireguard® Type X.

Property	Test Method	Result
Ultimate Racking Strength	ASTM E72	>654 lbs/ft dry
Flexural Strength	ASTM C473	100 lbs parallel
Humidified Deflection	ASTM C473	1/4 inch
Permeance	ASTM C355	12 perms
R Value	ASTM C518	0.67

2.2 ACCESSORIES

- A. Fasteners: Steel drill screws with organic-polymer or other corrosion-protective coating having salt-spray resistance of more than 800 hours according to ASTM B117.
 - 1. For Cold Formed Light Gauge Steel Framing up to 20 Gauge: ASTM C1002; length sufficient to penetrate through second surface minimum 1/4 inch.
 - 2. For Cold Formed Light Gauge Steel Framing Over 20 Gauge: ASTM C954; length sufficient to penetrate through second surface minimum 1/4 inch.
- B. Reinforcing Tape: 10 x 10 fiber glass mesh tape; 2 inches wide.
- C. Joint Compound: ASTM C475; setting type recommended by sheathing manufacturer for embedding reinforcing tape and skim coating sheathing at soffits and other areas to receive paint finish in lieu of weather resistive barrier and cladding; powder form for field mixing formulated to harden while drying; low shrinkage; free from asbestos; 90 minute set time.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine substrate conditions to determine acceptability for installation. Verify that substrates are acceptable for product installation in accordance with manufacturer's instructions and recommendations.
- B. Verify that site conditions are ready to receive work and opening dimensions are as instructed by manufacturer.
- C. Verify that metal framing and furring are installed and are properly secured, spaced, aligned and within tolerances required by sheathing manufacturer.
- D. Verify that blocking, backing and bracing for fixtures, equipment, accessories, hardware and other items secured to walls are installed and are properly secured and aligned.
- E. Do not begin installation until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install gypsum sheathing in accordance with GA 253 and manufacturer's instructions and recommendations.
- B. Cut boards at penetrations, edges, and other obstructions of work.

1. Fit tightly against abutting construction unless otherwise indicated.
 2. Cut openings for penetrations through gypsum sheathing to regular shapes; do not fracture core.
 3. Install boards with 3/8-inch setback where non-load-bearing construction abuts structural elements.
 4. Install boards with 1/4-inch setback where they abut masonry or similar materials that might retain moisture to prevent wicking.
- C. Coordinate sheathing installation with flashing and joint-sealant installation so these materials are installed in sequence and manner that prevent exterior moisture from passing through completed exterior wall assembly.
- D. Apply fasteners so screw heads bear tightly against face of sheathing boards but do not cut into facing.
- E. Do not bridge building expansion joints with sheathing; cut and space edges to match spacing of structural support elements.
- F. Install sheathing with long dimension perpendicular to framing with vertical ends centered over flanges of steel studs.
1. Use maximum lengths possible to minimize joints.
 2. Offset end joints between adjacent boards.
 3. Abut ends and edges of each board with those of adjacent boards.
- G. Screw-attach boards at perimeter and within field of board to each steel stud.
1. In rated assemblies, space fasteners in accordance with listed designs.
 2. In non-rated assemblies, space fasteners approximately 8 inches oc and set back minimum of 3/8 inch from edges and ends of boards.
- H. Within 18 inches of recessed window openings and projecting Portland cement plaster sills and ledges, treat panel joints with setting compound and bedded joint tape to form smooth uniform substrate for fluid-applied air barrier system and subsequent self-adhering membrane and flexible membrane flashing.
1. Fill gaps greater than 1/8 inch wide and minor voids and holes with setting compound.
 2. Tape and fill joints. Embed tape in setting compound; remove excessive joint compound; tool marks and ridges are acceptable.
- I. Coordinate installation of air barrier; ensure gypsum sheathing is covered within 180

days of installation.

3.3 ADJUSTING

- A. Repair evidence of popping or ridging fasteners.

END OF SECTION

SECTION 09300

TILE

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Interior floor tile installed over waterproofing/crack-isolation/anti-fracture membrane using thinset method with epoxy grouted joints.
- B. Interior wall and base tile installed using thinset method with cementitious grouted joints.

1.2 RELATED SECTIONS

- A. Section 09110 – Non-Load Bearing Metal Framing: Metal stud framing and backing.
- B. Section 09250 - Gypsum Board: Gypsum board to receive thinset wall tile.

1.3 REFERENCES

- A. American National Standards Institute:
 - 1. ANSI A108.5 - Ceramic Tile Installed with Dry-Set Portland Cement Mortar or Latex-Portland Cement Mortar.
 - 2. ANSI A108.6 - Ceramic Tile Installed with Chemical Resistant, Water Cleanable Tile Setting and Grouting Epoxy.
 - 3. ANSI A118.3 - Chemical-Resistant, Water Cleanable, Tile Setting and Grouting Epoxy and Water Cleanable Tile Setting Adhesive.
 - 4. ANSI A118.4 - Latex-Portland Cement Mortar.
 - 5. ANSI A118.7 – Polymer Modified Tile Grouts for Tile Installation.
 - 6. ANSI A118.10 – Load Bearing, Bonded Waterproof Membranes for Thin-Set Ceramic Tile and Dimension Stone Installation.
 - 7. ANSI A118.12 – Crack Isolation Membranes for Thin-Set Ceramic Tile and Dimension Stone Installation.
- B. ASTM International:
 - 1. ASTM C373 - Test Method for Water Absorption, Bulk Density, Apparent

Porosity, and Apparent Specific Gravity of Fired Whiteware Products.

2. ASTM C482 - Test Method for Bond Strength of Ceramic Tile to Portland Cement.
3. ASTM C627 - Test Method for Evaluating Ceramic Floor Tile Systems Using the Robinson-Type Floor Tester.
4. ASTM C648 - Test Method for Breaking Strength of Ceramic Tile.
5. ASTM C650 - Test method for Resistance of Ceramic Tile to Chemical Substances.
6. ASTM C920 - Specification for Elastomeric Joint Sealants.
7. ASTM C1028 - Test Method for Static Coefficient of Friction of Ceramic Tile and Other Like Surfaces by the Horizontal Dynameter Pull-Meter Method.
8. 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.

D. TCNA (Tile Council of North America) - Handbook for Ceramic Tile Installation.

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

- A. Installation and Setting Materials: Conform to TCNA Handbook for Ceramic Tile Installation.
- 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. Deliver products and store products in their original unbroken cartons.
- C. Store tile in dry covered area.

1.9 WARRANTY

- A. Manufacturer's Warranty: Provide manufacturer's limited 25 year system warranty for tile installation materials including tile bond coat, grout, waterproofing/anti-fracture membrane and related sealant.

1.10 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. Ceramic Tile:

1. CT-1: Unglazed porcelain floor tile; coefficient of friction not less than 0.60 when tested in accordance with ASTM C1028; Royal Mosa, Mosa Global Collection.
 - a. Size: 6 x 6 inch.
 - b. Color: #75210.
2. CT-2: Unglazed porcelain wall tile; Royal Mosa, Mosa Global Collection.
 - a. Size: 6 x 6 inch.
 - b. Color: #15210.

B. Natural Stone Tile:

1. ST-1: Marble threshold; beveled profile as indicated on Drawings; ASN Natural Stone, Inc., Hampshire Cream.
 - a. Size: 3/8 inch thick; length and width as indicated on Drawings.
 - b. Finish: Honed.

2.2 SETTING AND GROUTING MATERIALS

A. 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 preblended 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.

Property	Test Method	Result
28 Day Cure Shear Strength	ANSI A118.4 5.2.4	395 to 432 psi
Shear Bond Water Immersion	ANSI A118.4 5.2.3	150 to 300 psi

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:

Property	Test Method	Result
Shrinkage	ANSI A118.3 E5.3	<0.25%
Vertical Joint Sag	ANSI A118.3 E5.4	Passes
Bond Strength	ANSI A118.3 E5.5	1,000 psi
Compressive Strength	ANSI A118.3 E5.6	3,500 psi
Tensile Strength	ANSI A118.3 E5.7	1,100 psi
Thermal Shock	ANSI A118.3 E5.8	510 psi
Water Absorption	ANSI A118.3	<0.50%

b. Colors: To be determined.

2. Cementitious Grout: ANSI A118.7; polymer modified cement dry grout recommended by manufacturer for heavy duty use in exterior environments; sanded; Laticrete International, Inc. Laticrete® 1500 Sanded Grout fortified with Laticrete® 1776 Grout Enhancer or equal product substituted under provisions of Division 1.

a Properties:

Property	Test Method	Result
Linear Shrinkage	ANSI A118.7	<0.2%

Compressive Strength	ANSI A118.7	3,000 psi
Water Absorption	ANSI A118.7	7%
TCNA Service Rating	ASTM C627	Extra heavy

b. Colors: To be determined.

2.3 ACCESSORIES

- A. 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 anti-microbial 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:

Property	Test Method	Result
7-Day Hydrostatic Test	ANSI A118.10	Passes
7-Day Tensile Strength	ANSI A118.10	265 to 300 psi
7-Day Water Immersion	ANSI A118.10	95 to 120 psi
7-Day Shear Bond	ANSI A118.10	200 to 275 psi
28-Day Shear Strength	ANSI A118.10	214 to 243 psi
System Crack Resistance Test	ANSI A118.12 5.4	Passes

2. Accessory Materials:

- a. Reinforcing Fabric: Laticrete International, Inc. Laticrete® Waterproofing Membrane Reinforcing Fabric.
- b. Sealant: ASTM C920, Type S, Grade NS, Uses M and G; single component silicone; non-sag formula; neutral cure; Laticrete International, Inc. Laticrete® Latasil™.

B. 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; two part polyurethane; Shore A hardness of 35; color to match grout.

C. 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.

D. 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.

E. Grout Cleaner: Type recommended by grout manufacturer to remove grout haze from face of tile; Laticrete International, Inc. Laticrete® Cleaning Additive.

F. Grout Sealer: Water-based silicone or polymer formulation; water repellent; stain resistant; non-flammable; low odor; formulated for application as soon as 48 hours after grouting; Miracle Sealants Company MiraSeal 511 H₂O, TEC Specialty Products, Inc. #TA-256 Penetrating Silicone Grout Sealer or equal product substituted under provisions of Division 1.

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.

- B. Verify that surfaces to receive tile and waterproofing/crack isolation/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 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 joints in gypsum 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.
- E. Verify that concrete slabs to receive waterproofing/crack isolation/anti-fracture membranes 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.
- F. Verify that concrete slabs to receive waterproofing/crack/isolation/anti-fracture membranes slope to drains.
- G. Verify that deflection of concrete slabs to receive waterproofing/crack isolation/anti-fracture membranes and thinset tile under live, dead and impact loads does not exceed L/360.
- H. Ensure surfaces are clean and well cured.
- I. Verify that moisture vapor emission rate of concrete subfloors to receive waterproofing/crack-isolation/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.
- J. Do not begin installing tile until deficiencies are corrected.

3.2 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 pretreated 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.
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.

3.3 INSTALLATION - TILE

A. Floor 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 with latex Portland cement bond coat in accordance with TCNA F122 and ANSI A108.5
- 2. Interior Floor Tile Over Elevator Cab Shell: Install interior floor tile over metal elevator cab floors with epoxy cement bond coat in accordance with TCNA F116 and ANSI A108.4.

B. Wall and Base Tile: Install interior wall tile over gypsum cementitious backer board on metal studs with latex-Portland cement mortar bond coat in accordance with TCNA W245C and ANSI A108.5.

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 plan tile layouts, ensure pattern is uninterrupted from one surface to next and through door ways.

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 and form 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 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 contaminants 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 interior wall tile in accordance with ANSI A108.10 and manufacturer's instructions.
 1. Force maximum grout into joint.
 2. Before grout sets, tool joints to depth of bevel.
 3. Fill joints smooth without voids, pinholes or low spots.
 4. Upon completion of grouting, sponge and wash tile thoroughly, diagonally across joints. Remove excess grout.
 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.

3.6 SEALING

- A. Apply grout sealer to cementitious grouted joints in accordance with manufacturer's instructions and recommendations.
- B. Mask glass, concrete and other surfaces not specified to receive grout sealer.
- C. Ensure that surfaces to be sealed are clean and dry and that grout has cured minimum 48 hours prior to application.
- D. Apply grout sealer at full strength to grout lines with grout sealer applicator; wipe excess from tile immediately with soft dry cloth without disturbing sealer at grout line. Remove spattered and splashed sealer from glass surfaces by immediately flushing with water before sealer dries.
- E. Remove excess film from tile and surrounding surfaces with nylon scrubbing pad and mild abrasive cleaner.

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

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SECTION 09511

ACOUSTICAL PANEL CEILINGS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Suspended metal grid ceiling systems.
- B. High density fiberglass acoustic panels.
- C. Perimeter trim and accessories.

1.2 RELATED SECTIONS

- A. Section 03300 – Cast-In-Place Concrete: Concrete floor and roof decks supporting suspended ceilings.
- B. Section 09120 - Ceiling Suspension Framing: Suspended metal grid system for cement plaster soffits.
- C. Division 15 - Mechanical: Fire protection devices and air diffusion devices in ceiling system.
- D. Division 16 - Electrical: Light fixtures and fire alarm smoke detectors in ceiling system.

1.3 REFERENCES

- A. ASHRAE Standard 62 – Ventilation for Acceptable Indoor Air Quality.
- B. ASTM A568 - General Requirements for Steel, Carbon and High-Strength Low-Alloy Hot-Rolled and Cold-Rolled Sheet.
- C. ASTM A641 - Specification for Zinc Coated Galvanized Steel Wire.
- D. ASTM C635 - Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings.
- E. ASTM E84 - Surface Burning Characteristics of Building Materials.
- F. ASTM E580 - Practice for Application of Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels in Areas Requiring Seismic Restraint.
- G. ASTM E1264 - Classification of Acoustical Ceiling Products.
- H. CBC - California Building Code, 2010 edition.
- I. DSA IR 25-1 - Division of State Architect Interpretation of Regulations Document "Maximum Allowable Load for 10 Gage and 12 Gauge Wires."

- J. DSA IR 25-5 - Division of State Architect Interpretation of Regulations Document "Metal Suspension Systems for Lay In Panel Ceilings."

1.4 SYSTEM DESCRIPTION

- A. Suspended High Density Fiberglass Panel Ceilings: Kerfed-and-cut-back-edged membrane-faced acoustic wall panels set into semi-concealed exposed suspended grid with 15/16 inch grid face.

1.5 DESIGN REQUIREMENTS

- A. Locations of elements in suspended ceilings shall conform to locations shown on Architectural Reflected Ceiling Plans. Architectural Reflected Ceiling Plans govern over Mechanical Drawings and Electrical Drawings.
- B. Sustainable Design Requirements:
 - 1. Metal grid systems used in work of this section are intended to contribute to meeting requirements for recycled content outlined in LEED™-NC 2009 Credit MR4.
 - 2. Acoustic panels used in work of this section is intended to: Contribute to meeting requirements for recycled content outlined in LEED™-NC 2009 Credit MR4.

1.6 SUBMITTALS

- A. Shop Drawings:
 - 1. Indicate complete reflected ceiling layout at 1/4 inch = 1'-0" scale with every element penetrating or contacting ceiling including, but not limited to, lighting fixtures, mechanical diffusers and registers, speakers, smoke detectors and ceiling mounted equipment and supports.
 - 2. Indicate general and atypical conditions and details.
 - 3. Include calculations where required, details of bracing, special featured and joints, perimeters, relationship to adjacent construction, anchorage and connections.
- B. Product Data: Provide manufacturer's data on metal grid system components and acoustic panels.
- C. Samples:
 - 1. Panels: Submit samples, minimum 4 x 6 inches in size, illustrating material, edge condition, and finish of each type panel.
 - 2. Suspension Systems: Submit samples, minimum 12 inches long, of suspension system main runner, cross runner, wall angle perimeter trim and channels perimeter trim illustrating materials, profiles and colors.

- D. **Manufacturer's Instructions:** Submit preparation instructions and recommendations, storage and handling requirements and recommendations and installation instructions for fabric-faced composite core acoustic panels.
- E. **LEED Documentation:**
 - 1. **Metal Grid Systems:** Submit letter or product data from manufacturer indicating recycled contents. Designate percentage of post-consumer and post-industrial recycled content.
 - 2. **Acoustic Panels: Recycled Content:** Submit letter or product data from manufacturer indicating recycled contents. Designate percentage of post-consumer and post-industrial recycled content.
 - 3. Submit hard copies of completed Online Documentation required for LEED™ MR Credit 4.
- 1.7 **OPERATION AND MAINTENANCE DATA**
 - A. **Maintenance Data:** Include maintenance procedures and recommended maintenance materials for panel finishes.
- 1.8 **QUALIFICATIONS**
 - A. **Manufacturers:**
 - 1. **Ceiling Suspension Systems:** Company specializing in manufacture of ceiling suspension systems with minimum 5 years documented experience.
 - 2. **Panels:** Companies specializing in manufacture of ceiling panels of types specified with minimum 5 years documented experience.
 - B. **Installer:** Company specializing in installation of commercial suspended ceilings with minimum 3 years documented experience and approved by manufacturers.
- 1.9 **REGULATORY REQUIREMENTS**
 - A. Conform to CBC Section 803 for combustibility requirements for finish materials.
 - B. Conform to CBC Section 2506.2.1, DSA IR 25-1 and DSA IR 25-5 for suspension of ceiling grid.
- 1.10 **DELIVERY, STORAGE AND HANDLING**
 - A. Deliver products to site, store, handle and protect in accordance with manufacturer's instructions and recommendations.
 - B. Deliver panels only after glazing has been completed, exterior openings are closed in and wet work is completed and dried.

- C. Deliver and store products in original packaging and containers with seals unbroken and labels intact until time of use.
- D. Store products inside enclosed storage facilities or closed buildings and supported above grade and slabs-on-grade. Protect from exposure to sunlight, moisture and mechanical damage.
- E. Maintain storage spaces and products in dry condition and within temperature range recommended by manufacturer.
- F. Handle acoustic panels to avoid soiling exposed surfaces and damaging surfaces and edges.

1.11 ENVIRONMENTAL REQUIREMENTS

- A. Do not install suspended acoustical panel ceilings until building is enclosed with temperature and humidity closely approximating conditions that will exist during occupancy for not less than 10 days.
- B. Store acoustical panels within spaces in which they will be installed for at least 3 days prior to installation with cartons opened and stripped sufficiently to permit panels to stabilize to ambient conditions.

1.12 COORDINATION

- A. Coordinate work of this section with installation of mechanical, electrical and other equipment, materials or work which could conflict with installation of suspended acoustical ceilings.
- B. Do not install acoustical ceilings until wet work and dust generating activities have terminated, and overhead work is completed, tested and approved.
- C. Schedule installation of acoustic panels after interior wet work is dry.

1.13 EXTRA STOCK

- A. Deliver 1 carton of each type and size of panel used to Owner; obtain receipt.
- B. Wrap and label with name of material, project and areas installed.

PART 2 PRODUCTS

2.1 SUSPENSION SYSTEMS

- A. Manufacturers:
 - 1. Armstrong World Industries, Inc.: Prelude® XL 15/16 Inch Exposed Tee with Seismic Rx® Solution.

2. Manufacturers Offering Acceptable Equivalent Products:
 - a. Chicago Metallic Corporation.
 - b. USG Interiors, Inc.
 3. Substitutions: Under provisions of Section Division 1.
- B. Grids: ASTM C635, heavy duty; double web; exposed tee; components die cut and interlocking; main tees with non-directional bayonet couplings; cross tees with stab-in end tabs; commercial quality cold rolled galvanized steel; minimum 25 percent recycled content; "white" baked enamel finish.
1. Main Tees: 15/16 inch grid face; 1-11/16 inches high; 12 foot length; #7301.
 2. Cross Tees: 15/16 inch grid face.
 - a. 4-Foot Length: 1-1/2 inches high; #XL7342.
 - b. 2-Foot Length: 1-3/8 inches high; #XL7238.
- C. Accessories: Stabilizer bars, clips, splices and perimeter trims required for suspended grid systems.
1. Perimeter Trim: Commercial quality cold rolled galvanized steel; enamel finish to match grid color where exposed to view.
 - a. Angle Perimeter Trim: Hemmed angle molding with 7/8 inch horizontal and vertical flanges; Armstrong #7800.
 - b. Shadow Molding Trim: "W" profile molding with 1/4 x 1/4 inch reveal; 15/16 inch exposed horizontal flange; 15/16 inch vertical flange; Armstrong #7877.
 2. Runner Splice: Commercial quality cold rolled galvanized steel; hemmed angle molding with 7/8 inch horizontal and vertical flanges; Armstrong #7800.
 3. Seismic Retaining Clips: Configured to join main tees and cross tees to perimeter trim with utilizing specified angle perimeter trim with no visible pop rivets; fitted with slotted holes for unattached wall connections and round holes for attached wall connections; Armstrong #BERC2 2 Inch Beam End Retaining Clips.
 4. Seismic Joint Clips: Configured to join main tees and cross tees to provide seismic separation joints with no visible disruption of grid from room side.
 - a. Main Tee Clip: 2-piece assembly consisting of web-mounted clip and face mounted expansion sleeve.

- 1) Clip: Flat plate fitted with round holes on 1 end for attaching to web of first main beam and with slotted holes for attaching to web of adjacent main beam; Armstrong #SJMR Seismic Joint Clip – MB.
 - 2) Sleeve: 4 inch long sleeve configured to clip over 1/16 inch grid to cover expansion joint gaps; Armstrong #ES4 Expansion Sleeve.
- b. Cross Tee Clip: Configured to clip over cross tees at intersection with main tee; fitted with slotted holes for attachment to cross tees; Armstrong #SJC Seismic Joint CT.
- C. Support Channels and Hangers: Galvanized steel; size and type to suit application, to rigidly secure acoustic ceiling system including integral mechanical and electrical components with maximum deflection of 1/360.
1. Trapeze Framing: 12 gauge framing channel; 1-5/8 x 1-5/8 inch size; galvanized finish; P1000 as manufactured by Unistrut Corporation, or equal product substituted under provisions of Section Division 1.
 2. Fasteners:
 - a. Screws: Self-drilling and self-tapping sheet metal screws; zinc plated steel; pan head or hex head with washer; point as required to drill 12 gauge stock; #8 x by length sufficient to penetrate through second surface minimum 1/4 inch unless otherwise indicated or specified.
 - b. Expansion Anchors: FF S-325, Group II, Type 4, Class 1; stud type expansion anchor with single-piece three-section wedge; zinc plated steel; 3/8 inch diameter; length sufficient for minimum 1-5/8 inch embedment into concrete; Hilti Corporation "Kwik Bolt TZ" Expansion Anchor, ITW Ramset/Redhead "Trubolt+" Seismic Wedge Anchors or equal product substituted under provisions of Division 1.
 - c. Powder-Actuated Fasteners:
 - 1) Sheet Steel to Concrete: Zinc plated steel; 0.145 shank diameter; 1 inch length; plastic guide washer to accurately control penetration to minimum 3/4 inch; Hilti Corporation #DNI27P8 or equal product substituted under provisions of Division 1.
 - 2) Sheet Steel to Structural Steel Shapes: Zinc plated steel; 0.145 diameter knurled shank; 7/8 inch length; plastic guide washer to accurately control penetration to minimum 3/4 inch; Hilti Corporation #ED-NI22P8 or equal product substituted under provisions of Division 1.

- d. Machine Screws with Nuts:
 - 1) Machine Screws: Hex head; fully threaded; 1/4 inch diameter size or as indicated on Drawings; length sufficient to penetrate through framing member minimum 1/2 inch.
 - 2) Nuts: Hex; thread to match machine screws.
- e. Rivets: Blind pop rivets; steel body; steel mandrel; 1/8 inch diameter rivet; 1/4 inch head diameter domed head; 0.063 to 0.125 inch grip range.
- 3. Hanger and Bracing Wire: ASTM A641, Class 1 coating; mild steel; soft temper; galvanized coating; minimum 12 gauge.
- 4. Hanger Wire Anchors:
 - a. Clips: Bent steel plates; 13 gauge; right angle; minimum 3/4 inch wide; 5/16 inch diameter eye in vertical leg for hanger wire; hole in horizontal leg for shot in anchor with centerline not more than 5/8 inch from vertical leg; Hilti Corporation CC27 Ceiling Clips or equal product substituted under provisions of Division 1.
 - b. Fasteners: Powder-actuated fasteners; type appropriate for fastening sheet metal to concrete decks and steel beams as applicable.
- 5. Bracing Wire Anchors:
 - a. Clips: Custom bent steel angle plates with profile as required to set bracing wires at required angle; 12 gauge; minimum 1 inch wide; 5/16 inch diameter eye in splayed leg for bracing wire; hole in horizontal leg for expansion anchor with centerline not more than 5/8 inch from angle break.
 - b. Fasteners:
 - 1) For Concrete Decks: Expansion anchors as specified above.
 - 2) For Steel Beams: Powder-actuated fasteners; type appropriate for fastening sheet metal to steel.
- D. Compression Strut Assembly:
 - 1. Vertical Members: Compression Struts: Hot or cold rolled metal studs; formed from steel complying with ASTM A653 with minimum 33,000 psi yield point; G40 galvanized finish; 1/r ratio of 200 maximum
 - 2. Clips: Custom bent steel angle bracket with right angle break; 12 gauge; dimensions as indicated on Drawings.

2.2 ACOUSTIC PANELS

- A. Ultima Item 1912, High Density Fiberglass Panels For Installation Prelude 15/16" exposed Tee grid system (AC-1): ASTM E1264, Type IV, Form 2, Pattern E
 - 1. Sizes: 24 x 24 inches; item.
 - 2. Thickness: 3/4 inch.
 - 3. Composition: Wet-formed mineral fiber with DuraBrite acoustically transparent membrane
 - 4. Light Reflectance: 0.89.
 - 5. NRC: 0.70.
 - 7. Edge: Beveled Tegal
 - 8. Surface Color: White.
 - 9. Surface Pattern: Smooth.
 - 10. Flame Spread Classification: Class A per ASTM E84.
 - 11. Recycled Content: Minimum 70 percent combined pre/post consumer content.

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 manufacturer's instructions and recommendations.
- B. Verify that installation of building components above ceiling is complete, inspected and approved.
- C. Verify that layout of hangers will not interfere with other work.
- D. Do not begin installation until unsatisfactory conditions have been corrected.

3.2 INSTALLATION - SUSPENSION SYSTEM

- A. Install suspension in accordance with ASTM E580, CBC Section 2506.2.1, DSA IR 25-5 and with manufacturer's instructions, recommendations and ICC-ES Evaluation for alternate seismic solution with perimeter clips.
- B. Install system according to Architectural Reflected Ceiling Plan and final reviewed shop drawings after major above ceiling work is complete.

- C. Coordinate location of hanger and bracing wires with other work. Separate hanger and bracing wires minimum 6 inches from unbraced ducts, pipes and conduits.
- D. Install system capable of supporting imposed loads to deflection of 1/360 maximum.
 - 1. Provide hanger wires at ends of main and cross runners within 8 inches from support or within 1/4 of length of end tee, whichever is least, for perimeter of ceiling area.
 - 2. Provide sets of 4 splayed bracing wires oriented 90 degrees to each other at spacing not more than 12 feet by 12 feet on center in field and not more than 6 feet by 6 feet from each perimeter wall and at edge of vertical ceiling offsets.
 - 3. Provide minimum 4 hanger wires at each light fixture and air terminal. Attach hanger wire terminal and to fixture above to support terminal independently from ceiling grid.
- E. Install hanger and bracing wires taut without causing ceiling to lift.
 - 1. Install hanger and bracing wires so that direction of wire aligns as closely as possible with direction of forces acting on wire.
 - a. Install hanger wires plumb; provide counter sloping wires at hanger wires that are more than 1 in 6 out of plumb.
 - b. Install bracing wires within 45 degrees of plane of ceiling.
 - 2. Secure hanger wires to structure and to suspension system.
 - a. Secure hanger wires to concrete decks and steel beams with clips; secure clips to bottom of deck with powder-actuated fasteners. Thread hanger wire through eyes in clips; secure with 3 tight turns in 1-1/2 inches.
 - b. Secure hanger wires to suspension system by threading through eyes in runners and fastening with 3 tight turns in 1-1/2 inches.
 - 3. Secure bracing wires to structure and to suspension system.
 - a. Secure bracing wires to concrete decks and steel beams with clips; secure clips to bottom of deck with expansion anchors. Thread bracing wires through eyes in clips; secure with 4 tight turns in 1-1/2 inches.
 - b. Secure bracing wires to suspension system by threading through eyes in runners and fastening with 4 tight turns in 1-1/2 inches.
 - 4. Do not splice hanger or bracing wires.
- F. Provide compression struts at each set of bracing wires to resist vertical component induced by bracing wires.

1. Fasten clips to decks with powder actuated fasteners; provide minimum 2 fasteners per clip.
 2. Fasten struts to clips with machine bolts and nuts; provide minimum 2 bolts per strut.
 3. Fasten struts to main runners with machine bolts and nuts; provide minimum 2 bolts per strut.
- G. Hang system independent of walls, columns, ducts, pipes and conduit.
1. Do not attach ceiling grid members to more than 2 adjacent walls. Separate ceiling grid members from other walls by 3/4 inch.
 2. Provide seismic end clip connections between main and cross runners and perimeter trim.
 - a. At perimeter of ceiling area where main or cross runners are not connected to adjacent walls, provide 3/4 inch spaces between ends of runners and vertical legs of perimeter trim and secure clips to runners with loose screw connections through slotted openings in clips to webs of runners.
 - b. At perimeter of ceiling area where main or cross runners are connected to adjacent walls, butt between ends of runners and vertical legs of perimeter trim and secure clips to runners with tight screw connections through round openings in clip to webs of runners.
 - c. Visible pop rivet connections thorough horizontal flanges of perimeter trims are not permitted.
- H. Install seismic separation joints in ceiling areas exceeding 2500 square feet and slip joints in ceiling intersections of corridors and corridors with lobbies. Use seismic clips and expansion sleeves so that joints in grid are not discernable from room side.
- I. Use carrying members using longest practical lengths; do not use scraps and short cut members. Where carrying members are spliced, avoid visible displacement of face panel of adjacent members.
- J. Where ducts or other equipment prevent regular spacing of hangers, provide trapeze framing or other supplementary support members. Provide additional hanger struts or braces as required at ceiling breaks, soffits, or discontinuous areas.
- K. Do not support components on main runners or cross runners if weight causes total dead load to exceed deflection capability. Support fixture loads by supplementary hangers located within 6 inches of each corner, or support components independently.
- L. Do not eccentrically load system or produce rotation of runners.
- M. Install wall molding at intersection of ceiling and vertical surfaces and junctions with other

penetrations. Install angle moldings at ceilings with exposed grids; install shadow moldings at ceilings with semi-concealed grids.

1. Using longest practical lengths; pieces shorter than 48 inches will not be permitted.
2. Miter corners.
3. Where round obstructions occur, provide preformed closers to match edge molding.

- N. Level suspension system in each area after installation of mechanical and electrical equipment.

3.3 INSTALLATION - PANELS

- A. Install acoustic ceiling panels in accordance with respective manufacturer's instructions.
- B. Fit panels in place, free from damaged edges or other defects detrimental to appearance and function.
- C. Install panels level, in uniform plane, and free from twist, warp and dents.
- D. Install panels in suspension system with factory cut edges resting on flanges of main tees and cross tees.
- E. Scribe and cut panels to fit irregular grid, perimeter trim and around penetrations.
1. Single cut edges of panels square. Rest field cut edges of panels installed with semi-concealed grid on shadow molding; rest field cut edges of panels installed with exposed grid on wall angles.
 2. Provide hold down clips for field cut panels.

3.4 ERECTION TOLERANCES

- A. Maximum Variation from Flat and Level Surface: 1:360.

3.5 FIELD QUALITY CONTROL

- A. Field testing will be performed by Owner's Testing Laboratory.
- B. Owner's Testing Laboratory will test powder-actuated fasteners and expansion anchors for tension.
1. When used for hanger wires; 10 percent of anchors will be tested for minimum 200 pound.
 2. When used for bracing wires; 50 percent of anchors will be tested for 440 pounds.

3.6 ADJUSTING

- A. Remove damaged or soiled components and replace with new components prior to final acceptance of project.

3.7 PROTECTION OF INSTALLED WORK

- A. Protect installed system from damage until final acceptance of project.

END OF SECTION

09513
EXTERIOR PLANK CEILING

PART 1 GENERAL

1.1 SECTION INCLUDES

This specification includes the Exterior Plank ceiling system including suspension systems and components.

1.2. SUBMITTALS

A. Submittals should include the following items:

1. Product information: submit manufacturer's product data for each type of product specified.
2. Shop drawings: submit shop drawings for reflected ceiling plans and coordinating penetrations and ceiling mounted items. Show the following details:
 - a. Details and reflected ceiling plans for the Exterior Plank Series
 - b. Clearly illustrate all components of the Exterior Plank suspension and components.
 - c. System assembly details and connections to building components.
 - d. Location and direction of light fixtures, diffusers, speakers and other finish items.
 - e. Framing and support details for work supported by acoustical ceiling suspension system.
 - f. List of materials, dimensions, hanger fastenings, and any special details.

B. Samples:

1. Submit the following:
 - a. Exterior Plank panel minimum 18 inch (450 mm) piece of each type and finish c/w acoustical core medium used.
 - b. 18 inch (450 mm) long sample of each of the extruded aluminum suspension system mm) long sample of exposed peripheral moldings and trims in the required finish.

C. Qualification data:

1. For firms and persons specified in the "Quality Assurance" section to demonstrate their capabilities and experience, submit lists of completed projects with project names and addresses, and other requested information.

D. Control documentation:

- a. Manufacturer's specification including reports and other pertinent data as required testifying compliance with the project specification.
- b. Manufacturer's storage, installation, cleaning, maintenance instructions and recommendations.
- c. Manufacturer's guarantee on material and factory workmanship.

1.3 QUALITY ASSURANCE

A. Manufacturer and Installer Qualifications

1. Provide exterior plank metal ceiling components produced by a single manufacturer with resources adequate to deliver a product of consistent quality in terms of appearance and physical properties for all project scopes and scales without risk of delay or interruption.
2. Provide suspension system components produced by a single manufacturer to provide compatible of similar size, requirements and complexity.

B. Regulatory Requirements

1. Compliance with specific standards to be verified with applicable governing agencies for the following:
 - a. The system to be installed should be rated Class A for fire performance with a flame spread index of 25 or less and a smoke developed rating of 50 or less when tested according to ASTM method E 84.
 - b. The system to be installed should be certified to comply with structural, wind uplift and seismic requirements of governing codes currently in effect and with these specifications requirements.

C. Mock-up

1. Prior to beginning installation, erect a mock-up section in a pre-determined location using all system components. Mock-up should be installed in an area where it can become part of the final installation, if accepted.

1.4. DELIVERY, STORAGE AND HANDLING

- A. Deliver system components in manufacturer's original unopened packages clearly labeled with the following information: project number, item number and quantity, manufacturer's name and address, client name and address and site address.
- B. Store components in a fully enclosed dry space where they will be protected against damage from moisture, direct sunlight, surface contamination and other construction activities.
- C. Respect prescribed stacking instructions to prevent damage to the components.

- D. Handle components in a manner to prevent damage to the surfaces and edges and prevent distortion and other physical damage.
- E. Panels shall be protected with peelable PVC protector. Protector to be removed after complete installation is done to prevent damage to the panel during installation.

1.5 PROJECT SITE CONDITIONS

- A. Begin system installation only after spaces are enclosed and weather-tight, and after all wet work and overhead work has been completed.
- B. Prior to starting installation, allow materials to reach ambient room temperature and humidity intended to be maintained for normal occupancy. Coordinate with other work supported by or penetrating through the ceiling.

1.6 EXTRA MAINTENANCE MATERIAL

- A. Provide extra material, matching installed material, in manufacturer's original packages and clearly labeled as attic stock as specified in DELIVERY, STORAGE AND HANDLING section.
- B. Deliver extra stock and access tools to owner's representative.

PART 2 PRODUCTS

2.1 MANUFACTURER

- A. Basis of Design
 - 1. Provide an Exterior Plank system manufactured by:
 - a. Simplex Ceilings, a division of Intalite Inc.
255 Montpelier, St-Laurent, Quebec,
Canada, H4N 2G3
Tel: 514-744-3323
Fax: 514-744-2716
- B. Alternate products may be substituted only if accepted by the Architect and Owner.

2.2 MATERIALS SPECIFICATION

- A. Sheet metal characteristics:
 - 1. Form metal panel to fit specified grid module from sheet metals selected for their surface flatness, smoothness, and freedom from surface blemishes where exposed to view in finished unit. Do not use materials whose exposed surfaces exhibit pitting, seam marks, variations in flatness exceeding those permitted by referenced standards for stretched-leveled metal sheet, stains, discolorations, or other imperfections.
- B. Aluminum sheet: Complying with ASTM B 209, alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with not less than the strength and durability properties of the alloy and temper designated below:

1. Alloy and Temper for Color-Coated Finish: 3003-H14 or as standard with manufacturer.
2. Exterior Plank: Brake formed from aluminum complying with ASTM B 209 in adequate thickness.
- C. Fire Rating: All metal pans and associated suspension systems are made entirely of noncombustible materials and meet all known building code requirements.
- D. Material: Aluminum type 3003-H14
- E. Panels: The ceiling panels are to be brake formed. Panel to have integral stiffener flange on two opposite sides for added strength. Additional midpoint snap bars could be used with additional aluminum plank clips in order to support stronger wind loads.
- D. Accessibility: System shall be supplied with an access door for access to the plenum, where necessary, to service equipment.
- E. Thickness: Minimum 0.040" thick.
- F. Size: Standard sizes are 6" x 96", 8" x 96", 12" x 96", 24" x 96"
- G. Edge details: Butt (closed) joint as indicated on drawings.
- I. Color: Select from Simplex standard color palette.
- J. Finish: Baked enamel finish complying with coating manufacturer's written instruction for pretreatment, application, baking and minimum poly film thickness.

2.3 SUSPENSION SYSTEM

- A. Primary suspension: Provide a black iron steel "C" channel. Sizing and spacing between "C" channels to be determined by a recognized professional engineer.
- B. Secondary suspension: Provide secondary suspension members consisting of galvanized snap tee bar that will meet structural requirements as defined in ASTM 635 and ASTM636 for direct hung ceilings.
 1. Indirect secondary suspension:
 - a. Snap bar 10 ft. (3m) made from 0.051" (1.3mm) thick aluminum attached perpendicular to 1-1/2" (38mm) black iron channels (by other trade) with an aluminum Flanged contour clip. Snap bars should be in parallel rows with panel length as on center distances and level to within 1/4" (6mm) in 10 ft (3m). Snap panels into snap bar by use of aluminum exterior plank clip.
 2. Direct secondary suspension:
 - a. Simplex aluminum Utility Channel hangers attached directly to construction above. Fasten Simplex Snap bar angle hanger to utility channel hangers. Install Simplex 0.051" (1.3mm) aluminum snap bar into snap bar into snap bar angle hanger in parallel rows at panel length on centers and level within 1/4" (6mm) in

10 ft (3m). Panels are then snapped into snap bar by use of aluminum exterior plank clip.

2.4 ACCESSORIES

- A. Custom panels, trim pieces, moldings and other design particularities are to be manufactured to match the ceiling panels with respect to material, finish and texture.
- B. Exposed edge moldings and trims: Provide exposed members as indicated or required for the edge of the ceiling, fixture trim, beams, fascias of metal and finish matching acoustical exterior plank ceiling units.
- C. Formed trim: Install factory curved and assembled mold and trim with a finish to match panel unless otherwise specified.
- D. Sound insulation: Perforated panels should have a 0.2 mm (0.008") thick Simplex "T" non-woven black acoustical textile laminated on the back of panel. Also available, 1-1/2" thick x 3/4 pound density glass wool fiber completely sealed in an incombustible bag and installed with accordion pad spacers placed between the panel back and acoustical pad.
- E. Exterior plank clip: Provide 0.040" aluminum exterior plank clip with seared open buttons to connect exterior planks to snap bars.
- F. Plank splice: Provide Exterior plank series plank splice to connect planks to each other and maintain linearity.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Carefully inspect the area where the ceiling system is to be installed for conditions that may affect the work.
- B. Installer must examine the conditions under which acoustical ceiling work is to be performed, and notify the contractor in writing of any unsatisfactory conditions before proceeding.
- C. All work above the ceiling system is to be satisfactorily completed prior to start of ceiling installation.
- D. All unsatisfactory conditions potentially affecting the ceiling system are to be corrected prior to the start of installation.

3.2 PREPARATION

- A. Verify and confirm ceiling layouts by actual field measurements to balance borders and minimize out-of square conditions. Coordinate all work that penetrates the ceiling.

- B. Ceiling systems shall be properly centered per the manufacturer's installation manual or as shown on the approved shop drawings.
- C. Cutouts for lights, speakers, sprinklers or other items can be factory cut providing the opening size is Simplex. If the information is not available, cutouts can be done on site.

3.3 INSTALLATION

- A. Install the suspended ceiling system in accordance with the manufacturer's printed installation instructions, applicable industry standards and local regulations and requirements in effect.

3.4 ADJUSTMENT AND CLEANING

- A. Adjust ceiling components to provide a consistent finish and appearance in conformity with pre-established clearances and requirements. All panels showing signs of damage, either in finish or in form are to be replaced. All exposed surfaces are to be cleaned of any dirt, grease, fingerprints and marks and other imperfections with cleaning materials recommended by the manufacturer

END OF SECTION

09543
WOOD CEILING SYSTEM

PART 1 GENERAL

- 1.1 Description of Work:
 - A. Work Included: Provide wood ceiling system where shown on architectural drawings, and as specified in this specification.
- 1.2 Quality Assurance:
 - A. Maintain the quality as instituted by the architect or A.W.I.
 - B. Design Criteria: System shall be installed true and plumb to within manufacturing tolerance of 1/8" within 8' of length.
 - C. Product Construction: Wood shall be kiln dried to 10%. Cracking, checking and warpage of members will not be acceptable.
- 1.3 Submittals:
 - A. Technical Data: Submit manufacturer's data and installation instructions.
 - B. Shop Drawings: Submit 4 copies of shop drawings showing all areas involved, attachment conditions and perimeter circumstances.
 - C. Submittal Sample: Submit 3 product samples for approval by architect.
- 1.4 Delivery, Storage and Handling
 - A. Material must be stored and installed only in secured ambient environment (humidity min. 25% - max. 55%, temperature not to exceed 86 degrees).
 - B. Windows, doors and all wet-work must be completed before unpacking and installation. Handle carefully to avoid damage.
- 1.4 Product Warranty
 - A. Manufacturer shall warranty the Linear Wood Ceiling System against manufacturer's defects up to one year. Changes in finish or dimensions due to ultra violet light, excessive temperature or humidity conditions and/or abuse of any kind shall void any warranties from ACGI.
 - B. Install conditions for the area should remain for the proper occupied conditions of humidity and temperature (humidity min. 25% - max. 55%, temperature not to exceed 86 degrees).
 - C. The contractor shall warranty for one year all work from final acceptance of completed work.

PART 2 — PRODUCTS

- 2.1 Manufacturer:
 - A. ARCHITECTURAL COMPONENTS GROUP, INC.
521 George Street, Marshfield, MO 65706
Phone (417) 869-6777
Fax (417) 869-7888
 - B. Alternate products may be substituted only if accepted by the both the Architect and Owner.

2.2 Product Type

A. Basis of Design Product Configuration: Linear Open Wood Ceiling System

1. Product LO2-375-C. Nomenclature for product # LO2-375-C: LO2 = Linear Open Series 2, 375 = 3-3/4" wide, and C = 3/4" thick plank.
 2. Wood planks shall be provided in a size of: 11.25" wide x 3/4" thick and custom widths x 3/4" thick in order to make the design continuous on warped planes.
 3. Wood veneer plank length shall be 8' and installed with staggered butt-joints. Refer to sheet A2.12 for design basis of plank layout.
 4. Planks shall be installed with a 3/4" reveal between planks. Linear wood members shall be 12" module size (with the module size equal to wood plank width plus 3/4" reveal); e.g., product # LO2-375-C has a 11.25" wide plank plus a 3/4" reveal that equals a 12" module.
 5. Black non-woven felt shall be factory attached to one long edge of each plank, interior; and Black ABS plastic shall be factory attached to one long edge of each plank, exterior;
- B. Wood Specie: System shall consist of desired solid wood or veneer; wood specie. If veneer, it shall have matching veneer edge banding on both long sides.
- C. Finish: Wood finish shall utilize ACGI clear finish with satin sheen or specify custom stain to match architect sample. Back of planks shall be factory sealed.
- D. Certification: Wood veneer, wood veneer shall be FSC certified, and the core material shall FSC certified. If FSC, Chain of Custody shall be provided.
- E. NAUF: If veneer, substrate material shall be manufactured with no added urea formaldehyde.
- F. Fire Rating: Panels shall achieve a Class I(A) Fire Rating.
- G. Normal installation is with a factory-attached, black, non-woven felt reveal between planks. If acoustical absorption is required, a contractor-supplied acoustical insulation shall be installed above the planks.
- H. Attachment System: Linear Wood Ceiling System shall be suspended according to manufacturer's suggested method of suspension as per the design details provided in the plans.

PART 3 — EXECUTION

3.1 Installation

- A. Linear Wood Ceiling System shall be handled and installed with care in order to prevent surface and structure damage. Field cutting shall be kept to a minimum and performed as recommended by manufacturer.
- B. The contractor shall suspend planks in accordance with manufacturer's recommended installation guides and shop drawings. "Unistrut" supporting members are a contractor supplied item and shall be suspended according to architect's drawings and manufacturers' shop drawings.
- C. The ceiling system shall be suspended by 15/16" black Heavy Duty T-Rail with main runners on 2' centers and cross T's every 4'.

- D. Planks shall be installed by screwing LSC-101 and LSC-105 clips into the T-Grid and attaching the wood members in accordance to the manufactures' installation instructions. LSC-106 alignment clips shall be used at plank end-joints.
- E. Contractor shall clean all panels prior to installation according to manufacturer's recommended maintenance procedures. Upon completion of installation, panels shall be inspected and cleaned as needed.

END OF SECTION

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SECTION 09650
RESILIENT TILE FLOORING

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. Solid vinyl floor tile.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For each type of floor tile. Include floor tile layouts, edges, columns, doorways, enclosing partitions, built-in furniture, cabinets, and cutouts.
 - 1. Show details of special patterns.
- C. Samples for Initial Selection: For each type of floor tile indicated.
- D. Samples for Verification: Full-size units of each color and pattern of floor tile required.
- E. Seam Samples: For seamless-installation technique indicated and for each flooring product, color, and pattern required; with seam running lengthwise and in center of 6-by-9-inch (150-by-230-mm) Sample applied to a rigid backing and prepared by Installer for this Project.
- F. Product Schedule: For floor tile. Use same designations indicated on Drawings.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.

1.5 SUSTAINABLE SUBMITTALS

- A. Product data for Credit MR 4.1 and Credit MR 4.2 for products having recycled content, including documentation indicating percentages by weight of post-consumer and pre-consumer recycled content.
 - 1. Include statement indicating costs for each product having recycled content.

- B. Product data for Credit MR6 for products having rapidly renewable content, including documentation indicating percentages by weight of rapidly renewable content as required by Division 01.
 - 1. Include statement indicating costs for each product having Rapidly Renewable content.
- C. Product data for Credit EQ 4.1 for adhesives and sealants, including printed statement of VOC content as required by Division 01.
- D. Confirm that each product complies with the testing and product requirements of the California Department of Health Services Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small Scale Environmental Chambers, including 2004 Addenda. If a product specified has not been tested as noted, provide a substitution to the Architect for review and approval of an equal product meeting noted California Department of Health standard.
- E. Product data and certification of SMART sustainable product certification pursuant to LEED innovation credit.

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For each type of floor tile to include in maintenance manuals.

1.7 MATERIALS MAINTENANCE SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Floor Tile: Furnish 1 box for every 40 boxes or fraction thereof, of each type, color, and pattern of floor tile installed.

1.8 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who employs workers for this Project who are competent in techniques required by manufacturer for floor tile installation and seaming method indicated.
 - 1. Engage an installer who employs workers for this Project who are trained or certified by manufacturer for installation techniques required.
- B. Fire-Test-Response Characteristics: As determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.
 - 1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.
- C. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 - 1. Build mockups for floor tile including accessories.

- a. Size: Minimum 100 sq. ft. (9.3 sq. m) for each type, color, and pattern in locations directed by Architect.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Store floor tile and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F (10 deg C) or more than 90 deg F (32 deg C). Store floor tiles on flat surfaces.

1.10 PROJECT CONDITIONS

- A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F (21 deg C) or more than 95 deg F (35 deg C), in spaces to receive floor tile during the following time periods:
 - 1. 48 hours before installation.
 - 2. During installation.
 - 3. 48 hours after installation.
- B. Until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F (13 deg C) or more than 95 deg F (35 deg C).
- C. Close spaces to traffic during floor tile installation.
- D. Close spaces to traffic for 48 hours after floor tile installation.
- E. Install floor tile after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. FloorScore Compliance: Resilient tile flooring shall comply with requirements of FloorScore Standard.
- B. Low-Emitting Materials: Flooring system shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.2 SOLID VINYL SHEET FLOORING

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

VCT Flooring: Marmoleum by Forbo M0412 Claudy Jongstra "Twin Materials" (RF-1)

B. Tile Standard: ASTM F 1700.

1. Class: Class II, surface-decorated vinyl tile.
2. Type: Type A, smooth surface.

C. Thickness: 0.125 inch (3.2 mm).

D. Size: 12 by 12 inches (305 by 305 mm).

E. Seaming Method: Chemically bonded.

F. Colors and Patterns: As selected by Architect from full range of industry colors. Refer to finish materials list in drawings.

G. **SLIP RESISTANCE: MEET OR EXCEED 0.6 FOR FLAT SURFACES**
2.4 **INSTALLATION MATERIALS WHEN TESTED IN ACCORDANCE WITH ASTM D 2047.**

A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by manufacturer for applications indicated.

B. Adhesives: Water-resistant type recommended by manufacturer to suit floor tile and substrate conditions indicated.

1. Adhesives shall comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):

- a. VCT and Asphalt Tile Adhesives: Not more than 50 g/L.
- b. Rubber Floor Adhesives: Not more than 60 g/L.
- c. Terrazzo Floor Tile Adhesives: Not more than 65 g/L.

2. Adhesives shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

D. Floor Polish: Provide protective liquid floor polish products as recommended by manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

- B. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of floor tile.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.
- B. Concrete Substrates: Prepare according to ASTM F 710.
 - 1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
 - 2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
 - 3. Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer. Proceed with installation only after substrates pass testing.
 - 4. Moisture Testing: Perform tests recommended by manufacturer and as follows. Proceed with installation only after substrates pass testing.
 - a. Perform anhydrous calcium chloride test, ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m) in 24 hours.
 - b. Perform relative humidity test using in situ probes, ASTM F 2170. Proceed with installation only after substrates have a maximum 75% relative humidity level measurement.
- C. Access Flooring Panels: Remove protective film of oil or other coating using method recommended by access flooring manufacturer.
- D. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound and remove bumps and ridges to produce a uniform and smooth substrate.
- E. Do not install floor tiles until they are same temperature as space where they are to be installed.
 - 1. Move resilient products and installation materials into spaces where they will be installed at least 48 hours in advance of installation.
- F. Sweep and vacuum clean substrates to be covered by resilient products immediately before installation.

3.3 SHEET FLOORING INSTALLATION

- A. Comply with manufacturer's written instructions for product installation.

- B. Adhesive Flooring Installation: Cut required length of linoleum flooring from roll, allowing enough material to extend up the wall 4 to 6 inches at either end. Layout and position sheet flooring so that any seams will fall at least 6 inches from underlayment joints or saw cuts in concrete substrate. Scribe and cut flooring material to shape of vertical surfaces, including walls and partitions. Apply adhesive and lay sheet flooring into wet adhesive and roll with a 100 pound roller. Install sheet flooring square with room axis.
1. Adhesive, Seamless Flooring Installation: Rout out seams and heat weld together with complementary colored heat welding rod of complimentary composition in accordance with resilient flooring manufacturer's recommendations.
 2. Adhesive Flooring and Flash Coved Base Installation: Extend flooring up the wall in a flash-coved method to a height of 4 inches as indicated.
- C. Adhesive Material Installation: Use trowel as recommended by flooring manufacturer for specific adhesive. Spread at a rate of approximately 150 ft²/gallon, as recommended by flooring manufacturer.
1. Installation Techniques:
 2. Where demountable partitions and other items are indicated for installation on top of finished flooring, install flooring before these items are installed.
 3. Scribe, cut, fit flooring to butt tightly to vertical surfaces, permanent fixtures and built-in furniture, including pipes, outlets, edgings, thresholds, nosings, and cabinets.
 4. Extend flooring into toe spaces, door reveals, closets, and similar openings.
 5. Install flooring on covers for telephone and electrical ducts, and similar items occurring within finish floor areas. Maintain overall continuity of color and pattern with pieces of flooring installed on these covers.
- D. Do not install resilient flooring over expansion joints. Use expansion joint covers manufactured for use with resilient flooring. Refer to other specification sections for expansion joint covers.
- E. Adhere resilient flooring to substrate without producing open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, or other surface imperfections in completed installation.
- F. Use adhesive applied to substrate in compliance with flooring manufacturer's recommendations, including those for trowel notching, adhesive mixing, and adhesive open and working times.
- G. Roll resilient flooring as required by resilient flooring manufacturer.

3.4 CLEANING AND PROTECTION

A. CLEANING

1. Remove temporary coverings and protection of adjacent work areas. Repair or replace damaged installed products. Clean installed products in accordance with manufacturer's instructions prior to owner's acceptance. Remove construction debris from project site and legally dispose of debris.
2. Remove visible adhesive and other surface blemishes using cleaning methods recommended by floor manufacturer.
3. Sweep and vacuum floor after installation.
4. Do not wash floor until after time period recommended by flooring manufacturer.
5. Damp mop flooring to remove black marks and soil.

B. PROTECTION

1. Protect installed product and finish surfaces from damage during construction. Remove and legally dispose of protective covering at time of Substantial Completion.

C. INITIAL MAINTENANCE PROCEDURES

1. General: Include in Contract Sum Amount cost for initial maintenance procedures, and execute procedures after flooring installation as recommended by flooring manufacturer.
2. Initial maintenance "Starter Kit" supplied by manufacturer. Initial maintenance to be conducted by flooring contractor.
3. Drying Room Yellowing: Expose installed linoleum to either natural or artificial light to allow "drying room yellowing" (the film is a natural occurrence of the oxidation of the linseed oil in linoleum products) on installed linoleum flooring to disappear prior to initiating temporary protection procedures.

END OF SECTION 09650

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SECTION 09651

RESILIENT BASE

PART 1 GENERAL

1.1 SECTIONS INCLUDES

- A. Resilient base.
- B. Accessories.

1.2 RELATED SECTIONS

- A. Section 09250 - Gypsum Board: Wall materials to receive base.
- B. Section 09683 - Carpet Tile: Termination edging of carpet.

1.3 REFERENCES

- A. ASTM F1861 - Specification for Resilient Wall Base.
- B. CBC - California Building Code, 2010 edition.

1.4 DESIGN REQUIREMENTS

- A. Sustainable Design Requirements:
 - 1. Resilient base products used in work of this section are intended to contribute to meeting requirements for recycled content outlined in LEED™-NC 2009 Credit MR4.
 - 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™-NC 2009 Credit IEQ4.1.

1.5 SUBMITTALS

- A. Product Data: Provide data on each type of base and adhesive used describing physical characteristics.
- B. Samples: Submit samples, minimum 3 inches long, of each type of resilient base illustrating profiles and colors specified.

C. LEED Documentation:

1. Resilient Base: Submit letter or product data from manufacturer indicating recycled contents. Designate percentage of post-consumer and post-industrial recycled content.
2. 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.
3. Submit hard copies of completed Online Documentation required for LEED™ MR Credit 4 and IEQ Credit 4.1.

1.6 OPERATION AND MAINTENANCE DATA

- A. Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning, stripping and re-waxing.
- B. Include precautions against cleaning materials and methods detrimental to finishes and performance.

1.7 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacture of commercial resilient base of type specified with minimum 10 years documented experience.
- B. Installer: Company specializing in installation of commercial resilient base of type specified with minimum 5 years documented experience and certified by manufacturer.

1.8 REGULATORY REQUIREMENTS

- A. Conform to CBC Chapter 8 for flame/fuel/smoke rating requirements in accordance with ASTM E84.

1.9 PREINSTALLATION CONFERENCE

- A. Convene preinstallation conference minimum 1 week prior to beginning work of this section.
- B. Attendance: Contractor, installer, Construction Manager, Project Inspector and Architect.
- C. Agenda: Review Construction Documents, schedule of work, existing conditions, details of work, installation procedures and coordination with related work. Conduct walkover inspection of substrates.

1.10 DELIVERY, STORAGE AND HANDLING

- A. Deliver products to site, store, handle and protect in accordance with manufacturer's instructions and recommendations.
- B. Deliver materials in their original packages with seals unbroken and with manufacturer's name and product identification clearly visible.
- C. Deliver materials sufficiently in advance of installation to condition materials to room temperature prior to installation.
- D. Store packaged materials in original packaging with seals unbroken and labels intact until time of installation.
- E. Store materials in protected area. Keep materials dry. Maintain temperature between 40 degrees F and 100 degrees F.

1.11 ENVIRONMENTAL REQUIREMENTS

- A. Areas to receive base shall be clean, fully enclosed, weathertight with temperature maintained between 65°F and 85°F.
- B. Store materials for minimum 72 hours prior to installation in area of installation to achieve temperature stability.
- C. Maintain ambient temperature required by base and adhesive manufacturer 48 hours prior to installation, during installation, and thereafter.

1.12 FIELD MEASUREMENTS

- A. Verify actual dimensions and opening locations by field measurements.

1.13 SEQUENCING AND SCHEDULING

- A. Do not install resilient base until finishing operations including painting and ceiling installation are complete.

1.14 EXTRA MATERIALS

- A. Provide additional maintenance materials from same production runs as products installed.
- B. Resilient Base: Furnish quantity equivalent to 5 percent of amount installed for each type and color of resilient base used. Furnish in maximum contiguous length units.
- C. Wrap and clearly identify each box or roll. Deliver to Owner; obtain receipt.

PART 2 PRODUCTS

2.2 RESILIENT BASE

- A. Manufacturer:
 - 1. Roppe Corporation: Pinnacle Rubber Base.
 - 2. Substitutions: Under provisions of Division 1.
- B. Resilient Wall Base (WB-1): ASTM F1861, Type TS, Group 1, Styles A and B; extruded thermoset rubber; 1/8 inch thick; 4 inches high; 120 foot seamless coils; matte finish.
 - 1. Profiles:
 - a. Wall Base at Carpeting: Style A; straight toeless profile.
 - b. Wall Base at Other Flooring: Style B; coved toe profile.
 - 2. Color: #P193 "Black-Brown."

2.3 ACCESSORIES

- A. Adhesive: Water-resistant type recommended by base manufacturer for commercial installations for specific base type and substrate material; VOC content not to exceed limits established by SCAQMD Rule #1168.

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 manufacturer's instructions and recommendations.
- B. Verify that substrate surfaces are porous and free from non-porous paint, wallcovering, adhesive and other extraneous coatings and materials that could prevent successful adhesive bond. Do not proceed with installation until existing bond breaking compounds have been removed.
- C. Verify that substrate surfaces are structurally sound, clean, dry, smooth and flat with maximum variation of 1/8 inch in 10 feet non-cumulative and free of depressions, raised areas and other defects which could telegraph through installed base materials.
- D. Verify that adhesives are compatible with substrates by conducting adhesive bond tests minimum 72 hours prior to scheduled installation.

1. Perform adhesive bond tests for each resilient base adhesive in each major area prior to installation.
 2. Adhere minimum 12 inch length of base in place; examine after 72 hours to determine whether bond is solid and no moisture is present.
 3. Do not proceed with installation until results of bond tests are acceptable.
- E. Verify that temperatures of products and substrates are within manufacturer's recommended tolerances.
- F. Do not begin installation until unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean substrates of dust, dirt, solvents, oil, grease, loose paint, loose plaster and other substances detrimental to proper performance of adhesive and resilient base. Allow floors to dry thoroughly.
- B. Vacuum clean substrate.
- C. Allow coiled wall base to lay flat for minimum 24 hours prior to installation.

3.3 INSTALLATION

- A. Install resilient wall base materials in accordance with manufacturers' instructions and recommendations.
- B. Fit joints tight and vertical. Use maximum lengths possible; maintain minimum measurement of 24 inches between joints.
- C. Scribe and fit to door frames and other interruptions.
- D. Install base on solid backing. Bond tight to wall surfaces.
1. Apply adhesive to wall base in accordance with manufacturer's instructions. Leave 1/4 inch uncovered space at top of wall base.
 2. Position base on wall surface and roll with hand roller to ensure adhesive transfer and good fit. Roll back to starting point to prevent stretching of base.
- E. Field cut outside corners on wall base.
1. Stop application of adhesive approximately 24 inches from outside corner of wall.
 2. Position base on corner and mark location on back of base where bend should occur.

3. Lay base on floor with back up; make vertical notch approximately 1/4 thickness of base with gouge tool along mark on back of base. Make diagonal stress relief notches approximately 1 inch long each side of vertical notch beginning approximately 1 inch above bottom of vertical notch.

4. Reposition base on wall and check fit; apply adhesive and install.

F. Miter inside corners of wall base.

1. Install wall base terminating in corner.
2. Position meeting piece of wall base on opposing wall without adhesive; scribe to adhered piece.
3. Cut meeting piece to pattern, apply adhesive and install.

3.5 ADJUSTING

- A. Prior to final acceptance, remove and replace scratched or damaged base.

3.6 CLEANING

- A. Remove excess adhesive from base and adjacent floor and wall surfaces without damage.

END OF SECTION

SECTION 09683

CARPET TILE

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Carpet tile, fully adhered.
- B. Accessories.

1.2 RELATED SECTIONS

- A. Section 09651 - Resilient Base: Resilient base for carpeted areas.

1.3 REFERENCES

- A. ASTM E648 - Test Method for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source.
- B. ASTM E662 - Test Method for Specific Optical Density of Smoke Generated by Solid Materials.
- C. ASTM F1869 - Test Method for Measuring Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride.
- D. CRI 104 - Carpet and Rug Institute "Standard for Installation of Textile Floor Covering Materials."
- E. DOC-FF-1-70 - Standard for the Surface Flammability of Carpets and Rugs.
- F. NFPA 258 - Determining Smoke Generation of Solid Materials.

1.4 DESIGN REQUIREMENTS

- A. Sustainable Design Requirements:
 - 1. Carpet products used in work of this section are intended to:
 - a. Contribute to meeting requirements for recycled content outlined in LEED™-NC 2009 Credit MR4.
 - b. Reduce quantity of indoor air contaminants that are harmful to comfort and well-being of installers and occupants and are to be manufactured to be within VOC content limits outlined in LEED™-NC 2009 Credit IEQ4.3.

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™-NC 2009 Credit IEQ4.

1.5 SUBMITTALS

- A. Shop Drawings: Indicate layout of joints, color layout; direction of pile and transition details to other flooring materials. Identify subfloor type, carpet tile types, colors and dye lots, type of installation and type, color and location of edge moldings.
- B. Product Data: Submit data on specified products describing physical characteristics, sizes, patterns and method of installation.
- C. Samples:
 1. Carpet Tiles: Submit full sized samples illustrating each style and color of carpet tile used. Label each sample with manufacturer's name, material description, color, pattern and designation indicated on Drawings.
 2. Edge Strips: Submit samples, minimum 6 inches long, illustrating each specified color and profile of edge strip.
- D. Certifications:
 1. Manufacturer's Certifications:
 - a. Compliance: Submit certification from manufacturer of each material supplied under this section that each product supplied complies with specified requirements.
 - b. Compatibility: Submit certification from manufacturer of each material supplied under this section that material supplied is compatible with every other material installed under work of this section.
 - c. Installer's Qualifications: Submit certification from manufacturer of carpet that carpet tile installer is licensed or approved applicator.
 2. Installer's Certification: Certify that carpet tile is installed in accordance with manufacturer's installation requirements.
- E. Manufacturer's Installation Instructions: Submit special procedures and perimeter conditions requiring special attention.

F. LEED Documentation:

1. Carpet:

- a. Recycled Content: Submit letter or product data from manufacturer indicating recycled contents. Designate percentage of post-consumer and post-industrial recycled content.
 - b. VOC Content: Submit letter or product data from manufacturer stating that materials used in work of this section do not exceed VOC content limits established in Carpet and Rug Institute Green Label Plus Program.
2. 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.
3. Submit hard copies of completed Online Documentation required for LEED™ MR Credit 4, IEQ Credit 4.1 and IEQ Credit 4.3.

1.6 OPERATION AND MAINTENANCE DATA

- A. Maintenance Data: Submit maintenance procedures, recommended maintenance materials and suggested schedule for cleaning.

1.7 QUALITY ASSURANCE

- A. Work of this section shall be installed by single entity with unity responsibility for submittals, field measurements, installation and warranty.
- B. Installation: Complying with requirements of CRI 104 and manufacturer's installation instructions except as otherwise specified. In case of conflict, comply with more stringent requirement.
- C. Final Cleaning: Complying with requirements of Carpet and Rug Institute "Commercial Carpet Maintenance Manual."

1.8 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacture of commercial tufted carpet tile with minimum 10 years documented experience.
- B. Installer: Company specializing in installation of commercial tufted carpet tile with minimum 3 years documented experience.

1.9 DELIVERY, STORAGE AND HANDLING

- A. Deliver products to site, store, handle and protect in accordance with manufacturer's instructions and recommendations.

- B. Arrange deliveries of products in accordance with construction schedules. Coordinate to avoid conflict with sequence of construction and conditions at site.
- C. Deliver products in undamaged condition, in manufacturer's original containers and packaging with identifying labels intact and legible. Labeling to contain manufacturer's name, product name and identification number and other related information.
- D. Inspect shipments immediately upon delivery to assure compliance with specified requirements and final reviewed submittals and to assure products are undamaged and properly protected. Notify Architect of discrepancies with Contract Documents and final reviewed submittals.
- E. Provide equipment and personnel to handle products by methods to prevent soiling and damage to products and packaging.
- F. Store products in accordance with CRI 104 with seals and labels intact.
 - 1. Store materials subject to damage by elements in weathertight enclosures.
 - 2. Maintain temperature and humidity within ranges required by CRI 104.

1.10 ENVIRONMENTAL REQUIREMENTS

- A. Remove carpet tile from cartons and store for minimum 48 consecutive hours prior to installation in area of installation to achieve temperature stability.
- B. Maintain temperature between 60 degrees F and 85 degrees F minimum 48 hours prior to, during and minimum 48 hours after installation of materials.
- C. Maintain fresh air ventilation during normal working hours during and 72 hours after installation of materials.
 - 1. Open windows and doors in area in installation; augment with exhaust fans.
 - 2. Operate ventilation systems at full capacity.
- D. Provide sufficient lighting during installation.

1.11 FIELD MEASUREMENTS

- A. Field verify dimensions and other conditions affecting layout and installation of carpet tile.
- B. Verify that field measurements are as indicated on shop drawings.

1.12 SEQUENCING AND SCHEDULING

- A. Do not begin carpet tile installation until painting and finish work is complete and ceiling and other overhead work has been installed.

1.13 WARRANTY

A. Installer's Warranty:

1. Warranty work provided against defects in material and workmanship for period of 2 years from date of Substantial Completion.
2. Warranty compatibility of materials installed.

B. Manufacturer's Warranty:

1. Provide manufacturer's standard non-prorated lifetime of carpet product warranty for wear, static, edge ravel, delamination, tuft bind, adhesive bind and stain resistance.
 - a. Wear: Not more than 10 percent face yarn loss by weight in normal use for as long as carpet is on floor.
 - b. Static: No greater than 3 kv for as long as carpet is on floor.
 - c. Edge Ravel: No edge ravel in normal use without use of seam sealers for as long as carpet is on floor.
 - d. Delamination: No delamination in normal use without use of chair pads for as long as carpet is on floor.
 - e. Tuft Bind: No zippering wet or dry for as long as carpet is on floor.
 - f. Adhesive Bond: Carpet will remain bonded to properly prepared substrate with carpet manufacturer's adhesives for as long as carpet is on floor.
 - g. Stain Resistance: Stain resistant for as long as carpet is on floor.
2. Provide manufacturer's standard 10 year lightfastness and atmospheric containment warranty.

1.14 EXTRA MATERIALS

- A. Provide 5 percent of installed area of each style and color carpet tile in full-sized units from same dye lots as installed tile.
- B. Deliver carpet tile to Owner in cartons labeled to identify style, color and location installed; obtain receipt.

PART 2 PRODUCTS

2.1 CARPET TILE

A. Carpet Tiles (CP-1): Interface; Palindrome & Alleteration; style #: To be determined

1. Color: To be Determined
2. Construction:
 - a. Gauge: 1/10 in.
 - b. Stitches per Inch: 13.0
 - c. Pile Height Average: 0.15 inch
 - d. Fiber System: Post-Consumer Content Type 6 Nylon
 - e. Dye Method: 100% solution
 - f. Soil/Stain protection: Protekt²®
 - g. Pattern Repeat: N/A
3. Secondary Backing: GlasBac® RE Tile
 - a. Primary Backing: Non-woven
 - b. Secondary Backing Density: 125.0 oz/yd² ± 4.0 oz/yd²
 - c. Secondary Backing Thickness: 0.09 inch ± 0.010"
4. Product Size: 19.69 x 19.69
5. Performance Specifications

Indoor Air Quality:	Green Label Plus Certified <u>#GLP0820</u>
Sustainable Carpet Assessment Standard:	NSF-140 Gold
Radiant Panel:	(ASTM E-648) Class 1
Smoke Density:	(ASTM E - 662)
Lightfastness:	(AATCC 16 - E)
Static:	(AATCC - 134) < 3.0 KV
Standard Backing:	GlasBac® Tile
Backing Options:	GlasBac® RE Tile

2.2 ACCESSORY MATERIALS

- A. Subfloor Filler: Cementitious type containing not more than 7 percent gypsum recommended by carpet tile manufacturer.
- B. Adhesive: Releasable contact type recommended by carpet tile manufacturer.
- C. Edge Strips:
 - 1. Manufacturer:
 - a. Johnsonite.
 - b. Manufacturer Offering Acceptable Equivalent Product: Burke-Mercer Flooring Products.
 - c. Substitutions: Under provisions of Division 1.
 - 2. Edge Strips: Homogeneous composition of polyvinyl static coefficient of friction not less than 0.6; Critical chloride, additives and colorants; minimum 85 shore A hardness; Radiant Flux of 0.45 watts/sq cm or greater per ASTM E648; smoke developed of 450 or less per ASTM E662; colors to be determined.
 - a. Carpet Tile to Resilient Flooring: 1-piece carpet adaptor under cut 5/16 inch for carpet tile and 1/8 inch for resilient flooring; 1-5/8 inch wide exposed surface; Johnsonite #CTA-XX-D.
 - b. Carpet Tile to Subflooring: 1-piece edge guard undercut 5/15 inch for carpet tile; 1-9/32 inch wide exposed face; Johnsonite #EG-XX-G.

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 manufacturer's instructions and recommendations.
- B. Verify that no curing, hardening or bond breaking compounds have been applied to substrate. Do not proceed with installation until existing compounds have been removed.
- C. Verify that surfaces are smooth and flat with maximum variation of 1/8 inch in 10 feet non-cumulative and are ready to receive work.
- D. Verify that concrete slabs are fully cured. Ensure concrete is cured minimum 90 days prior to carpet tile installation.

E. Concrete Slabs:

1. Verify concrete subfloors are free from scaling and irregularities.
2. Verify that alkalinity level of concrete slabs is between 7.0 and 9.0 by conducting alkalinity tests.
 - a. Perform minimum 1 alkalinity test for every 1,000 sq ft using alkalinity test kit capable of measuring pH range of 1 through 14.
 - b. Conduct tests in accordance with kit manufacturer's instruction in weather-tight conditioned spaces.
 - c. Ensure adhesives, coatings, finishes, dirt, curing compounds, sealant and other substances that can affect test results are removed from test site minimum 48 hours prior to testing.
 - d. Maintain temperature between 65 and 85 degrees F and relative humidity between 40 and 60 percent in area of test for minimum 48 hours prior to and during testing.
3. Verify that concrete slabs are dry by conducting calcium chloride tests in accordance with ASTM F1869 and test manufacturer's instructions.
 - a. 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.
 - b. Prepare diagram of area or room showing location and results of each test.
 - c. If test results indicate moisture emission exceeds 3.0 pounds per 1,000 sq ft in 24 hrs, do not proceed with flooring installation until corrective action has been completed.

F. Verify that adhesives are compatible with substrates by conducting adhesive bond tests.

1. Perform adhesive bond tests for each carpet tile backing type and adhesive in each major area prior to installation.
2. Adhere carpet tile in place; examine after 72 hours to determine whether bond is solid and no moisture is present.
3. Do not proceed with installation until results of bond tests are acceptable.

G. Do not begin installation until unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean subfloors of dust, dirt, solvents, oil, grease, paint, plaster and other substances detrimental to proper performance of adhesive and carpet. Allow floors to dry thoroughly.
- B. Remove subfloor ridges and bumps. Fill low spots, cracks, joints, holes, and other defects with subfloor filler.
- C. Apply, trowel, and float filler to leave smooth, flat, hard surface. Allow to dry; sand smooth.
- D. Prohibit traffic until filler is cured.
- E. Clean floor to remove dust; ensure no cleaner residue remains after cleaning.

3.3 INSTALLATION

- A. Apply carpet tile in accordance with CRI 104, manufacturer's instructions and final reviewed shop drawings.
- B. Do not mix carpet tile from different cartons unless from same dye lot. Do not mix dye lots in same area of installation.
- C. Measure to determine center point of each area of installation. Establish and mark longitudinal and transverse centerlines; ensure centerlines are at 90 degree angles.
- D. Dry fit row of carpet tiles along entire length of longitudinal and transverse centerlines to determine if center lines must be offset; ensure perimeter tiles will be cut no less than half size.
- E. Lay field and accent carpet tiles in random pattern indicated on Drawings. Install carpet tile monolithically with corners aligned and with pile direction parallel.
- F. Fully adhere carpet tile to substrate. Apply adhesive by full-spread method using roller or sprayer; if using sprayer, protect adjoining surfaces with plastic or other material before spraying.
- G. Lay carpet tiles closely following centerlines. Snugly join tiles with no visible gaps, peaks or overlaps. Continually check installation to verify tiles are being joined with correct firmness.
- H. Tip carpet tiles into place; do not slide across adhesive. Ensure pile yarn is not caught in joints.
- I. Trim carpet tiles neatly at walls and around interruptions. Cut carpet tile clean; fit tight to intersection with vertical surfaces without gaps.
- J. Complete installation of edge strips concealing exposed edges.

1. Use full length pieces only.
2. Butt tight to vertical surfaces.
3. Where splicing cannot be avoided, butt ends tight and flush.

K. Cut and fit carpet tile evenly into edge strips.

3.4 CLEANING

- A. Remove excess adhesive from floor, base, and wall surfaces without damage.
- B. Clean and thoroughly vacuum carpet surfaces with upright beater-bar type vacuum cleaner.

3.5 PROTECTION

- A. Prohibit traffic from carpet areas for minimum of 24 hours after installation or until adhesive is set.
- B. Provide substantial coverings to protect installed carpet from damage from traffic and subsequent construction operations. Remove when no longer needed.

END OF SECTION

SECTION 09721 CORK WALL COVERINGS

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes: Cork Wall Coverings
 - 1. Bulletin Board, adhesive installation.

1.2 RELATED SECTIONS

- A. 10100 – Visual Displays
- B. 09650 - Resilient Sheet Flooring

1.3 REFERENCES

- A. American Society for Testing and Materials (ASTM):
 - 1. ASTM F 2034 Standard Specification for Linoleum Sheet Floor Covering.
 - 2. ASTM F 1861 Standard Specification for Resilient Wall Base.
 - 3. ASTM E 84 Standard Test Method for Surface Burning Characteristics of Building Materials.
- B. National Fire Protection Association (NFPA):
 - 1. NFPA 255 Test Method for Surface Burning Characteristics of Building Materials.
- C. International Standards and Training Alliance (INSTALL):
 - 1. INSTALL Resilient Certification.

1.4 SYSTEM DESCRIPTION

- A. Performance Requirements: Provide material which has been manufactured, fabricated and installed to performance criteria certified by manufacturer without defects, damage, or failure.

1.5 SUBMITTALS

- A. General: Submit listed submittals in accordance with "Conditions of the Contract" and Division 1 Submittal Procedures Section.
- B. Product Data: Submit product data, including manufacturer's SPEC-DATA product sheet, for specified products.
- C. Shop Drawings: Submit shop drawings showing layout, profiles, and product components, including anchorage, accessories, finish colors, patterns and textures.
- D. Samples: Submit selection and verification samples for finishes, colors, and textures.
- E. Quality Assurance Submittals: Submit the following:
 - 1. Certification of compliance: Letter of compliance signed by manufacturer certifying materials comply with specified performance characteristics and criteria, and physical requirements.
 - 2. Manufacturer's Instructions: Manufacturer's installation instructions.
 - 3. Manufacturer's Field Reports: Manufacturer's field reports specified herein.

F. Sustainable Submittals

1. Product data for Credit MR 4.1 and Credit MR 4.2 for products having recycled content, including documentation indicating percentages by weight of post-consumer and pre-consumer recycled content.
 - a. Include statement indicating costs for each product having recycled content.
2. Product data for Credit MR6 for products having rapidly renewable content, including documentation indicating percentages by weight of rapidly renewable content as required by Division 01.
 - a. Include statement indicating costs for each product having Rapidly Renewable content.
3. Product data for Credit EQ 4.1 for adhesives and sealants, including printed statement of VOC content as required by Division 01.
4. Confirm that each product complies with the testing and product requirements of the California Department of Health Services Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small Scale Environmental Chambers, including 2004 Addenda. If a product specified has not been tested as noted, provide a substitution to the Architect for review and approval of an equal product meeting noted California Department of Health standard.
5. Product data and certification of SMART sustainable product certification pursuant to LEED innovation credit.

G. Closeout Submittals: Submit the following:

1. Operation and Maintenance Data: Operation and maintenance data for installed products in accordance with Division 1 Closeout Submittals (Maintenance Data and Operation Data) Section. Include methods for maintaining installed products, and precautions against cleaning materials and methods detrimental to finishes and performance.
2. Warranty: Warranty documents specified herein.

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.

1. Engage installer certified as a Forbo "Associate Mechanic" Certificate: Submit certificate indicating installer qualification.

B. Regulatory Requirements:

1. Fire Performance Characteristics: Provide material with the following fire performance characteristics as determined by testing products in accordance with ASTM method indicated below by a certified testing laboratory or another testing and inspecting agency acceptable to authorities having jurisdiction:
 - a. Tunnel Furnace Test Method: Class B Rating (ASTM E 84/NFPA 255)

C. Mock-Ups: Install at project site a job mock-up using acceptable products and manufacturer approved installation methods. Obtain Owner's and Architect's acceptance of finish color, texture and pattern, and workmanship standard. Comply with Division 1 Quality Control Mock-Up Requirements Section.

1. Mock-Up Size: 24" x 24"
2. Maintenance: Maintain mock-up during construction for workmanship comparison; remove and legally dispose of mock-up when no longer required.
3. Incorporation: Mock-up may be incorporated into final construction upon Owner's approval.

- D. Pre-Installation Meetings: Conduct pre-installation meeting to verify project requirements, substrate conditions, manufacturer's installation instructions, and manufacturer's warranty requirements. Comply with Division 1 Project Management and Coordination Project Meetings Section.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. General: Comply with Division 1 Product Requirements Sections.
- B. Ordering: Comply with manufacturer's ordering instructions and lead time requirements to avoid construction delays.
- C. Delivery: Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.
- D. Storage and Protection: Store materials protected from exposure to harmful weather conditions and at temperature and humidity conditions recommended by manufacturer.
 1. Material should be stored in areas that are fully enclosed and weathertight. The permanent HVAC should be fully operational, controlled and set at a minimum of 68° F (20° C) for at least 48 hours prior to the installation.

1.8 PROJECT CONDITIONS

- A. Environmental Requirements/Conditions: In accordance with manufacturer's recommendations, areas to receive material should be clean, fully enclosed and weathertight. The permanent HVAC must be fully operational, controlled and set at a minimum of 68° F (20° C) for a minimum of seven days prior to, during, and seven days after the installation. The material should be conditioned in the same manner for at least 48 hours prior to the installation. Areas to receive material shall be adequately lighted to allow for proper inspection of the substrate, installation and seaming, and for final inspection.
- B. Temperature Requirements: Maintain air temperature in spaces where products will be installed for time period before, during, and after installation as recommended by manufacturer.
 1. Temperature Conditions: 68° F (20° C) for a minimum of seven days prior to, during, and seven days after the installation.
- C. Field Measurements: Verify actual measurements/openings by field measurements before fabrication; show recorded measurements on shop drawings. Coordinate field measurements and fabrication schedule with construction progress to avoid construction delays.

1.9 SEQUENCING AND SCHEDULING

- A. Finishing Operations: Install material after finishing operations, including painting and ceiling operations, have been completed.
- B. Concrete Curing: Do not install over concrete substrates until substrates have cured and are dry to bond with adhesive as determined by manufacturer's recommended bond test.

1.10 WARRANTY

- A. Project Warranty: Refer to "Conditions of the Contract" for project warranty provisions.
- B. Manufacturer's Warranty: Submit, for Owner's acceptance, manufacturer's standard warranty document executed by authorized company official. Manufacturer's warranty is in addition to, and not a limitation of, other rights Owner may have under Contract Documents.
 - 1. Warranty Period: Five (5) year limited warranty commencing on Date of Substantial Completion.

1.11 MAINTENANCE

- A. Extra Materials: Deliver to Owner extra materials from same production run as products installed. Package products with protective covering and identify with descriptive labels. Comply with Division 1 Closeout Submittals (Maintenance Materials) Section.
 - 1. Quantity: Furnish quantity of material units equal to 5% of amount installed.
 - 2. Delivery, Storage and Protection: Comply with Owner's requirements for delivery, storage and protection of extra materials.

PART 2 PRODUCTS

2.1 CORK WALL COVERINGS

- A. Basis of Design Manufacturer: Forbo Flooring, Inc.
- B. Alternate products per Architect's approval
 - 1. Contact: 8 Maplewood Dr., Humboldt Industrial Park, P.O. Box 667, Hazleton, PA 18202; Telephone +800 842 7839 or +570 459 0771; Fax + 570 450 0258
- C. Proprietary Product(s): Bulletin Board Sheet and Adhesive.
 - 1. Description: Homogeneous tackable surface material made of primary natural materials consisting of linseed oil, cork, rosin binders and dry pigments mixed and calendared onto a natural jute backing. The uni-color extends throughout the thickness of the material.
 - 2. Width: 48" x 72"
 - 3. Length: 90 Linear Feet
 - 4. Gauge: 1/4"
 - 5. Backing: Jute
 - 6. Pattern and Color: Bulletin Board - Item 2182
 - 7. Adhesive: Forbo Flooring, Inc., L 910W Adhesive

2.2 PRODUCT SUBSTITUTIONS

- A. Substitutions: Substitutions permitted, only if approved by Architect and Owner.

2.3 SOURCE QUALITY

- A. Source Quality: Obtain product materials from a single manufacturer.

PART 3 EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

- A. Compliance: Comply with manufacturer's product data, including product technical bulletins, product catalog installation instructions, and product carton instructions for installation.

3.2 EXAMINATION

- A. Site Verification of Conditions: Verify substrate conditions (which have been previously installed under other sections) are acceptable for product installation in accordance with manufacturer's instructions (i.e. bond test, etc.).
- B. Material Inspection: In accordance with manufacturer's installation requirements, visually inspect materials prior to installation. Material with visual defects shall not be installed and shall not be considered as a legitimate claim.

3.3 PREPARATION

- A. Adjacent Surfaces Protection: Protect adjacent work areas and finish surfaces from damage during product installation.
- B. Surface Preparation:
 - 1. General: Prepare substrate in accordance with manufacturer's instructions.
 - 2. Substrate: Substrate shall be sound, smooth, flat, permanently dry, clean, and free of all foreign materials including, but not limited to, dust, paint, grease, oils, solvents, curing and hardening compounds, sealers, asphalt and old adhesive residue.

3.4 INSTALLATION

- A. Adhesive Installation: Cut required length from roll, allowing 2-3 inches overlap. Lay sheets flat to acclimate, preferably 24 hours prior to installation. Back roll sheets once in reverse direction to release roll stretch. Remove the factory edge from both sides of the material. Apply adhesive and place sheet into wet adhesive and roll with a 100 pound roller.
 - 1. Adhesive Material Installation: Use trowel as recommended by manufacturer for specific adhesive. Spread at a rate of approximately 150 ft²/gallon, as recommended by manufacturer.
- B. Installation Techniques:
 - 1. Adhere material to substrate without producing open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, or other surface imperfections in completed installation.
 - a. Use adhesive applied to substrate in compliance with manufacturer's recommendations, including those for trowel notching, adhesive mixing, and adhesive open and working times.
 - 2. Roll material as required by manufacturer.

3.5 CLEANING

- A. Cleaning: Remove temporary coverings and protection of adjacent work areas. Repair or replace damaged installed products. Clean installed products in accordance with manufacturer's instructions prior to owner's acceptance. Remove construction debris from project site and legally dispose of debris.

1. Remove visible adhesive and other surface blemishes using cleaning methods recommended by manufacturer.
2. Dust or wipe with a damp cloth.

3.6 PROTECTION

- A. Protection: Protect installed product and finish surfaces from damage during construction. Remove and legally dispose of protective covering at time of Substantial Completion.

3.7 INITIAL MAINTENANCE PROCEDURES

- A. General: Include in Contract Sum Amount cost for initial maintenance procedures, and execute procedures after installation as recommended by manufacturer.
- B. Initial maintenance to be conducted by contractor.
- C. Drying Room Yellowing: Expose installed linoleum to either natural or artificial light to allow "drying room yellowing" (the film is a natural occurrence of the oxidation of the linseed oil in linoleum products) on installed linoleum to disappear prior to initiating temporary protection procedures.

END OF SECTION

SECTION 09820

ACOUSTICAL INSULATION AND SEALANTS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Acoustical batt insulation.
- B. Acoustical sealant and accessories.

1.2 PRODUCTS SUPPLIED BUT NOT INSTALLED UNDER THIS SECTION

- A. Supply acoustical batt insulation to Section 09110 – Non-Load Bearing Metal Framing for installation in boxed jamb, header and sill construction.

1.3 RELATED SECTIONS

- A. Section 07213 – Thermal Batt Insulation: Thermal batt insulation installed in exterior wall, floor and roof framing.
- B. Section 07840 - Firestopping: Firestop caulk and sealant; mineral wool batt insulation used in firestopping assemblies.
- C. Section 07900 - Joint Sealers.
- D. Section 09110 - Non-Load Bearing Metal Framing: Steel stud framing.
- E. Section 09250 - Gypsum Board: Gypsum board finish at sound-rated partition and ceiling construction.
- F. Division 15 - Mechanical: Pipe and duct insulation.

1.4 REFERENCES

- A. ASTM C165 - Test Method for Measuring Compressive Properties of Thermal Insulation.
- B. ASTM C303 - Test Method for Dimensions and Density of Preformed Block and Broad-Type Thermal Insulation.
- C. ASTM C423 - Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.
- D. ASTM C665 - Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing.
- E. ASTM D1056 - Flexible Cellular Materials - Sponge of Expanded Rubber.

- F. ASTM E612 - Test Method for Mineral Fiber Block and Board Insulation.
- G. ASTM E84 - Test Method Surface Burning Characteristics of Building Materials.
- H. CBC - California Building Code, 2010 edition.

1.5 DESIGN REQUIREMENTS

A. Sustainable Design Requirements:

1. Acoustical batt insulation used in work of this section are intended to contribute to meeting requirements for recycled content outlined in LEED™-NC 2009 Credit MR4.
2. Sealants 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™-NC 2009 Credit IEQ4.1.

1.6 SUBMITTALS

- A. Product Data: Provide data on acoustical insulation batts, sealant and accessories.
- B. Manufacturer's Installation Instructions: Submit special preparation criteria and sequence of installation for acoustical sealant.
- C. Manufacturer's Certificates: Certify that products comply with specified requirements.
- D. LEED Documentation:
 1. Acoustical Batt Insulation: Submit letter or product data from manufacturer indicating recycled contents. Designate percentage of post-consumer and post-industrial recycled content.
 2. Sealants: Submit letter or product data from manufacturer stating that sealants used in work of this section do not exceed VOC content limits established in South Coast Air Quality Management District Rule #1168.
 3. Submit hard copies of completed Online Documentation required for LEED™ Credit MR 4 and IEQ4.1.

1.7 QUALITY ASSURANCE

- A. Insulation to meet Greenguard™ Environmental Institute "Certification Standards for Indoor Air Quality."

1.8 QUALIFICATIONS

A. Manufacturers:

1. Insulation Manufacturers: Companies specializing in manufacture of acoustical insulation of types specified with minimum 3 years documented experience.
2. Sealant Manufacturer: Company specializing in manufacture of acoustical insulation with minimum 3 years documented experience.

B. Installer: Company specializing in installation of commercial acoustical insulation and sealants with minimum 3 years documented experience and approved by the insulation manufacturers.

1.9 REGULATORY REQUIREMENTS

A. Comply with requirements of CBC Section 719.2.

1.10 DELIVERY, STORAGE AND HANDLING

- A. Deliver products to site, store, handle and protect in accordance with manufacturer's instructions and recommendations.
- B. Protect products from moisture in shipment, storage and handling.
- C. Do not deliver products until building is enclosed and "wet" work such as plaster and concrete is complete and cured to condition of equilibrium.

1.11 COORDINATION

- A. Coordinate installation of acoustical batt insulation with installation of metal framing specified under Section 09110 - Non-Load Bearing Metal Framing and Section 09265 - Shaft Wall Assemblies and with installation of gypsum board specified under Section 09250 - Gypsum Board.
- B. Coordinate installation of acoustical batt insulation with installation of piping, ductwork and conduit specified under Divisions 15 – Mechanical and Division 16 – Electrical. Ensure that insulation required to be installed above extensive or densely packed utilities is installed prior to installation of utilities.
- C. Coordinate application of acoustical sealants with installation of gypsum board specified under Section 09250 - Gypsum Board.

PART 2 PRODUCTS

2.1 ACOUSTICAL BATT INSULATION

A. Manufacturers:

1. Johns Manville International, Inc.: JM Formaldehyde-Free™ Sound Control Fiber Glass Batts.
2. Manufacturer Offering Acceptable Equivalent Product: Knauf Insulation.
3. Substitutions: Under provisions of Division 1.

- B. Batts: ASTM C665, Type I, unfaced preformed glass fiber batts manufactured of long resilient glass fibers bonded with acrylic thermosetting binder; formaldehyde free; minimum 25 percent recycled glass content; flame spread of 25 or less per ASTM E84; smoke developed of 50 or less per ASTM E84; 3-5/8 inch and 6-1/2 inch thicknesses; width compatible with stud spacing.

2.2 ACOUSTICAL SEALANTS AND ACCESSORIES

A. Flexible Acoustical Sealant:

1. Manufacturers:
 - a. Pecora Corporation: BA-89 Acoustical Sealant.
 - b. Tremco, Inc.: Tremco Acoustical Sealant.
 - c. United States Gypsum Company: Sheetrock Brand Acoustical Sealant.
 - d. Substitutions: Under provisions of Division 1.
2. Sealant Properties: Non-hardening non-skinning flexible type recommended for use in conjunction with gypsum board; capable of spanning 1/2 inch wide x 3/8 inch deep gaps; VOC content not to exceed limits established in South Coast Air Quality Management District Rule #1168.

B. Expanding Foam Acoustical Sealant:

1. Manufacturers:
 - a. Macklanburg-Duncan Co.: Polycel Expanding Insulating Foam Sealant.
 - b. Manufacturers Offering Acceptable Equal Products:
 - 1) Dow Corning Corporation.
 - 2) Hilti, Inc.
 - 3) Substitutions: Under provisions of Division 1.

2. Sealant Properties: Single-component expanding urethane foam formulated to fill gaps and holes too large for conventional sealants; fire retardant; UL Classified; HCFC 22 blowing agent; VOC content limits established in South Coast Air Quality Management District Rule #1168.
- C. Acoustical Sheet Caulking: Self-adhering polybutene-butyl pads configured for sealing back side of electrical boxes, telephone outlet boxes and television jack boxes; 1/8 x 6 x 8 inches; Lowry's Outlet Box Pads, Kinetics IsoBacker Acoustical Fire Rated Outlet Backer Pad or equal product substituted under provisions of Division 1.
- D. Backing Rod: ASTM D1056; round closed cell neoprene or polyethylene foam rod; oversized 30 to 50 percent; compatible with sealant.
- E. Sleeves: Galvanized sheet metal; cylindrical; gauge, seal lap and length as required to repair openings in gypsum board.

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 building is enclosed and weathertight and that roofing is complete.
- C. Do not begin installation until unsatisfactory conditions have been corrected.

3.2 INSTALLATION - ACOUSTICAL INSULATION

- A. Install acoustical fiberglass batt insulation in sound-rated partitions and where indicated on Drawings. Install in accordance with manufacturer's instructions and recommendations.
- B. Install acoustical batt insulation in framed partitions and framed floor/ceiling assemblies to fill framing cavities.
- C. Pack acoustical batt insulation behind and around perimeter of piping and electrical boxes in sound-rated partition and ceiling cavities.

3.3 APPLICATION - ACOUSTICAL SEALANTS AND ACCESSORIES

- A. Seal perimeters and penetrations of sound-rated gypsum board partitions and ceilings airtight with acoustical sealant. Place sealant in partitions in accordance with manufacturer's instructions.

B. Sleeves and Backer Rods:

1. Where perimeter clearance at penetration exceeds 3/4 inch, install sheet metal sleeve within partition packed with safin insulation.
2. Where perimeter clearance or gap exceeds 3/8 inch, install backer rod.

C. Acoustical Sheet Caulking:

1. Apply acoustical sheet caulking to backs and sides of electrical boxes and other rough in boxes occurring in sound insulated walls and floor/ceiling assemblies in accordance with manufacturer's instructions and recommendations.
2. Verify wiring is complete prior to installation.
3. Clean receiving surfaces free of dirt, grease, oil, rust, release agents, water repellents and other substances that may affect proper adhesion.
4. Peel release paper from 1 side acoustical sheet caulking; position acoustical sheet caulking on back side of electrical box.
5. Peel release paper from other side of acoustical sheet caulking; wrap entire back and side of electrical box with acoustical sheet caulking. Do not cover front of box.
6. Use additional sheets as required to ensure entire box is covered.
7. Ensure sheet caulking closes firmly against stud and back of gypsum board or is positioned to be incorporated in sealant applied to annular space between electrical boxes and gypsum board.
 - a. Provide minimum 1/4 inch bead of flexible acoustical sealant.
 - b. In multiple layer assemblies of gypsum board, plywood sheathing or combination of gypsum board and plywood sheathing, apply sealant to first layer.

D. Flexible Acoustical Sealant:

1. Apply continuous bead of flexible acoustical sealant gypsum board face layer at head and sill conditions of sound-rated partitions and around perimeter of sound-rated ceilings.
2. In addition, apply sealant behind control joints and in door frame immediately prior to inserting gypsum board.
3. Seal penetrations airtight. Seal through penetrations on both sides of partitions; seal membrane penetrations including those for conduit, piping, electrical boxes, panels boards and equipment around perimeter at face.

- E. Expanding Foam Acoustical Sealant: Apply expanding foam sealant at multiple pipe and conduit penetrations of sound-rated partitions and ceilings and where indicated on Drawings.

END OF SECTION

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SECTION 09900

PAINTS AND COATINGS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Field application of paints and coatings to newly installed surfaces.
- B. Backpriming.

1.2 RELATED SECTIONS

- A. Section 09910 – Parking Area Striping and Markings: Painting of concrete surfaces other than specified in this section.
- B. Section 09960 – Graffiti-Resistant Coatings: Field applied coatings for concrete surfaces not designated to receive paint.
- C. Shop primed products specified in other sections.

1.3 REFERENCES

- A. ASTM D16 - Definitions of Terms Relating to Paint, Varnish, Lacquer, and Related Products.
- B. ASTM D2016 - Test Method for Moisture Content of Wood.
- C. CBC - California Building Code, 2010 edition.

1.4 DEFINITIONS

- A. Conform to ASTM D16 for interpretation of terms used in this section.

1.5 DESIGN REQUIREMENTS

- A. Sustainable Design Requirements: Interior paints and coatings 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™-NC 2009 Credit IEQ4.2.

1.6 SUBMITTALS

- A. Product Data: Submit complete list of materials in form of paint systems scheduled listing specific product intended for each coat. In addition, submit:

1. Manufacturer's data for each product to be used identified by manufacturer's name and product label or stock number. Include material composition and analysis data.
 2. Material Safety Data Sheets for purposes of Owner's information and records only. Material Safety Data Sheets will not be reviewed by Architect and will not be returned with balance of submittals.
- B. Samples: Submit samples, minimum 8-1/2 x 11 inches in size, illustrating colors and sheens to be used. Identify each sample with manufacturer name, product names, color name, color number, sheen name, and color formula.
1. For paint finishes to be applied to gypsum board surfaces, apply full paint system including primers and intermediate coats to drywall boards having surface finish levels and textures specified for gypsum board to receive that paint finish.
 2. For transparent or stained finishes, apply full finish system to material identical to that which it will be applied on job.
- C. Manufacturer's Application Instructions: Indicate preparation and application requirements and procedures.
- D. LEED Documentation:
1. Submit letter or product data from manufacturer stating that interior paints and coatings used in work of this section do not exceed VOC content limits established in following standards:
 - a. Architectural Paints, Coatings and Primers: Green Seal Standard GS-11 – Paints, Second Edition.
 - b. Anti-Corrosive and Anti-Rust Paints: Green Seal Standard GS-03 – Anti-Corrosive Paints, Second Edition.
 - c. Clear Wood Finishes, Floor Coating, Stains, Sealers and Shellacs: South Coast Air Quality Management District Rule #1113.
 2. Submit hard copies of completed Online Documentation required for LEED™ IEQ Credit 4.2.

1.7 QUALIFICATIONS

- A. Product Manufacturer: Company specializing in manufacturing quality paint and finish products with minimum 5 years documented experience.
- B. Applicator: Company specializing in commercial painting and finishing with minimum 5 years documented experience and approved by product manufacturer.

1.8 REGULATORY REQUIREMENTS

- A. Conform to regulations of South Coast Air Quality Management District and California Air Resources Board regarding use of architectural coatings (paint).

1.9 MOCK-UPS

- A. Construct mock-ups of interior paint systems using materials and methods specified herein demonstration aesthetic effects and qualities of materials and execution for review by Architect.
- B. Construct 4 foot x 4 foot mock-up of each color used in each paint system used for that color applied to each surface indicated to receive that color and paint system.
 - 1. Include prime coats and intermediate coats tinted to slight color variation from each other and from final coat.
 - 2. Maintain record of locations of mock-ups with manufacturer name, primer and paint product names, color name, color number, sheen name, and color formula
- C. Locate mock-ups where directed by Architect.
- D. Rework mock-up panels not meeting specified requirements as directed by Architect.
- E. Color and sheen of accepted mock-ups will establish minimum standard of quality and workmanship of painting plaster work.
- F. Retain accepted mock-ups in undisturbed condition until work of this section is complete.
- G. Accepted mock-ups may remain as part of work.

1.10 DELIVERY, STORAGE AND HANDLING

- A. Deliver products to site, store, handle and protect in accordance with manufacturer's instructions and recommendations.
- B. Deliver products to site in sealed and labeled containers; inspect to verify acceptance.
- C. Container labeling to include manufacturer's name, type of paint, brand name, brand code, coverage, surface preparation, drying time, cleanup, color designation, and instructions for mixing and reducing.
- D. Store paint materials at minimum ambient temperature of 45 degrees F and maximum of 90 degrees F in well ventilated area, unless required otherwise by manufacturer's instructions.
- E. Take precautionary measures to prevent fire hazards and spontaneous combustion. Do not store thinners and other flammable materials in buildings.

1.11 ENVIRONMENTAL REQUIREMENTS

- A. Provide continuous ventilation and heating facilities to maintain surface and ambient temperatures above 45 degrees F for 24 hours before, during, and 48 hours after application of finishes, unless required otherwise by manufacturer's instructions.
- B. Do not apply exterior coatings during rain or snow, or when relative humidity is above 50 percent, unless required otherwise by manufacturer's instructions.
- C. Minimum Application Temperatures for Latex Paints: 45 degrees F for interiors; 50 degrees F for exterior; unless required otherwise by manufacturer's instructions.
- D. Provide lighting level of 80 ft candles measured mid-height at substrate surface.

1.12 COORDINATION

- A. Coordinate backpriming with installation of uncoated millwork, trim, and plywood.
- B. Coordinate application of paints and coatings specified under this section with application of graffiti-resistant coating specified under Section 09960 – Graffiti-Resistant Coatings. Ensure that:
 - 1. Surfaces designated to receive paint do not receive graffiti-resistant coating and surfaces to receive graffiti-resistant coating are not painted.
 - 2. Exposed vertical interior concrete surfaces are either painted or coated with graffiti-resistant coating.
 - 3. Exposed vertical exterior concrete surfaces and precast concrete surfaces are coated with graffiti-resistant coating and are not painted.

1.13 EXTRA MATERIALS

- A. Provide minimum 2 gallons of each color of paint used in each sheen of that color used to Owner for use as maintenance stock.
 - 1. At completion of work and prior to delivering maintenance paint materials to Owner, test color and sheen match of extra materials paint with applied paint.
 - 2. Using paint from maintenance stock containers, paint 12 inch diameter patch on surface having applied paint of same color and sheen in presence of Architect.
 - 3. If colors and sheens match and are accepted by Architect, label and deliver maintenance paints to Owner. If colors and sheens do not match, correct maintenance stock and retest until color and sheen match is attained.
- B. Label each container with color, finish, and room locations, in addition to manufacturer's label.
- C. Deliver containers to owner; obtain receipt.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. The Sherwin Williams Company.
- B. Manufacturers Offering Acceptable Equivalent Products:
 - 1. Acrylic Finishes and Primers:
 - a. Dunn-Edwards Corporation.
 - b. Frazee Industries, Incorporated.
 - c. Glidden Professional.
 - 2. Urethane and Epoxy Primers and Finishes:
 - a. Ameron International.
 - b. Devoe Coatings.
 - c. Tnemec Company.
- C. Substitutions: Under provisions of Division 1.

2.2 MATERIALS

- A. Paints:
 - 1. Ready mixed.
 - 2. Process pigments to soft paste consistency, capable of being readily and uniformly dispersed to homogeneous coating.
 - 3. Good flow and brushing properties; capable of drying or curing free of streaks or sags.
 - 4. Free of asbestos and lead products.
 - 5. Additional Requirements by Sheen:
 - a. Exterior 100 Percent Acrylic Enamel – Semi-Gloss Sheen:
 - 1) Pigment and Vehicle: 100 percent of direct composition method.
 - a) Pigment: Not less than 23 percent; titanium dioxide not less than 24 percent of pigment by weight.
 - b) Vehicle: Not less than 75 percent; acrylic resin not less than

20 percent of vehicle by weight.

2) Minimum Thickness: 1.5 dry mils.

b. Interior Acrylic Enamel – Low Sheen:

1) Pigment and Vehicle: 100 percent of direct composition method.

a) Pigment: Not less than 35 percent; titanium dioxide not less than 20 percent of pigment by weight.

b) Vehicle: Not less than 78 percent; vinyl resin not less than 24 percent of vehicle by weight.

2) Gloss Level: Not less than 5 percent or more than 9 percent using Garder Gloss Meter after paint is air dry for 7 days.

3) Minimum Thickness: 1.5 dry mils.

c. Interior Acrylic Enamel – Semi-Gloss Sheen:

1) Pigment and Vehicle: 100 percent of direct composition method.

a) Pigment: Not less than 43 percent; titanium dioxide not less than 22 percent of pigment by weight.

b) Vehicle: Not less than 78 percent; vinyl resin not less than 26 percent of vehicle by weight.

2) Gloss Level: Not less than 50 percent or more than 60 percent using Garder Gloss Meter after paint is air dry for 7 days.

3) Minimum Thickness: 1.5 dry mils.

B. Accessory Materials: Linseed oil, turpentine, paint thinners, shellacs and other materials not specifically indicated but required to achieve finishes specified, of commercial quality.

2.3 FINISHES

A. Refer to schedule at end of section for surface finish schedule.

B. Colors to be per Architect's finish material board.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine surfaces scheduled to be finished prior to commencement of work. Report conditions that may potentially affect proper application.
- B. Verify that surfaces are ready to receive work as instructed by product manufacturer.
- C. Measure moisture content of surfaces using electronic moisture meter. Do not apply finishes unless moisture content of surface is below following maximums:
 - 1. Gypsum Wallboard: 12 percent.
 - 2. Concrete: 12 percent.
 - 3. Wood: 15 percent, measured in accordance with ASTM D2016.
- D. Do not begin installation until unsatisfactory conditions have been corrected. Application of prime coat will be considered acceptance of receiving surface.

3.2 PREPARATION

- A. Prepare surfaces in accordance with paint manufacturer's instructions and recommendations.
- B. Remove electrical raceways and plates, hardware, light fixture trim, and fittings prior to preparing surfaces or finishing.
- C. Correct minor defects and clean surfaces which affect work of this section.
- D. Seal marks which may bleed through surface finishes.
- E. Factory and Shop Primed Surfaces: Prepare as specified below. Apply test panels of specified primer to verify compatibility and adhesion with factory and shop primers.
 - 1. Provide 1 test panel, minimum 24 x 24 inches in size, for each type of previously primed surface.
 - 2. Apply specified primer to prepared substrate and allow to dry in accordance with manufacturer's application instructions.
 - 3. Cut "X" minimum 12 x 12 inches through primer; cover with 2 inch wide thoroughly adhered masking tape.
 - 4. After minimum 48 hours, remove tape. If primer remains totally adhered, proceed with specified system. If primer fails, notify Architect.
- F. Impervious Surfaces: Remove mildew by scrubbing with solution of trisodium phosphate and bleach. Rinse with clean water and allow surface to dry.

- G. Insulated Coverings: Remove dirt, grease, and oil from canvas and cotton.
- H. Gypsum Board Surfaces: Latex fill minor defects; texture or sand to match adjacent surface. Sweep surface clean with broom and wipe with damp rag; remove excess powder from sanding.
- I. Concrete Surfaces: Remove dirt, loose matter, scale, salt and alkali powder and other foreign matter. Remove oil and grease with solution of trisodium phosphate; rinse well and allow to dry. Remove stains caused by weathering of corroding metals with solution of sodium metasilicate after thoroughly wetting with water; allow to dry.
- J. Uncoated Steel and Iron Surfaces: Remove grease, scale, dirt and rust. Where heavy coatings of scale are evident, remove by wire brushing or with solvent. Apply treatment of phosphoric acid solution, ensuring weld joints, bolts, and nuts are similarly cleaned. Spot prime paint after repairs.
- K. Shop Primed Steel Surfaces: Sand and scrape to remove loose primer and rust. Feather edges to make touch-up patches inconspicuous. Clean surfaces with solvent. Test to verify compatibility of specified primer with shop primer. Prime bare steel surfaces. Prime metal items including shop primed items.
- L. Galvanized Surfaces: Remove surface contamination and oils and wash with solvent. Etch, rinse and allow to dry.
- M. Prefinished Steel Surfaces: Remove oil, grease, dirt and other contaminants. Etch, rinse and allow to dry.
- N. Aluminum Surfaces Scheduled for Paint Finish: Remove surface contamination by steam or high pressure water. Remove oxidation with acid etch and solvent washing. Apply etching primer immediately following cleaning.
- O. Shop Primed Aluminum Surfaces: Sand and scrape to remove loose primer and oxidation. Feather edges to make touch up patches inconspicuous. Test to verify compatibility of specified primer with shop primer. Prime bare aluminum surfaces. Prime metal items including shop primed items.
- P. Interior Wood Items Scheduled to Receive Paint Finish: Wipe off dust and grit prior to priming. Seal knots, pitch streaks, and sappy sections with sealer. Fill nail holes and cracks after primer has dried; sand between coats.
- Q. Shop Primed Interior Wood Items Scheduled to Receive Paint Finish: Sand and scrape to remove loose primer. Feather edges to make touch up patches inconspicuous. Wipe off dust and grit. Test to verify compatibility of specified primer with shop primer. Prime bare wood surfaces. Prime wood items including shop primed items.
- R. Wood and Metal Doors to Receive Paint Finish: Seal top and bottom edges with primer.

3.3 PROTECTION

- A. Protect elements surrounding work of this section from damage or disfiguration.
- B. Repair damage to other surfaces caused by work of this section.
- C. Furnish drop cloths, shields, and protective methods to prevent spray or droppings from disfiguring other surfaces.
- D. Remove empty paint containers from site.

3.4 APPLICATION

- A. Apply products in accordance with manufacturer's instructions and recommendations.
- B. Paint every exposed exterior and interior surface, except as specified or noted otherwise, whether or not paint is scheduled and colors are designated. Exposed surfaces include areas visible when permanent or built-in fixtures, grilles and similar components are in place.
 - 1. Do not paint plated or prefinished surfaces unless painting is specified, scheduled or noted.
 - a. Paint hot dipped galvanized and electrolytic zinc coated surfaces except as specifically specified or noted.
 - b. Do not paint galvanized steel site fabrications.
 - c. Include metal counterflashings exposed to weather, vent flashings and risers on roof.
 - 2. Paint factory and shop primed surfaces.
 - 3. Paint interior concrete ceilings and columns only. Do not paint interior concrete walls and slabs. Do not paint exterior concrete surfaces and exterior precast concrete surfaces unless painting is specified, scheduled or noted.
 - 4. Do not paint integrally colored cement plaster surfaces.
 - 5. Do not paint surfaces indicated to receive field applied finishes under other sections.
 - 6. Do not paint stainless steel surfaces and fittings.
- C. Spray apply paint to metal doors, access doors, access panels, louvers, grilles and registers.
- D. Apply material evenly, free from sags, runs, crawls, holidays, brush marks, lap marks, defects and blemishes. Cut sharply to lines.

- E. Do not apply finishes to surfaces that are not dry.
- F. Apply each coat of paint to:
 - 1. Uniform finish and to thickness recommended by manufacturer but never less than 1.5 dry mils.
 - 2. Slightly darker than preceding coat unless otherwise authorized.
- G. Allow applied coat to dry before next coat is applied.
- H. Sand lightly between coats to achieve required finish.
- I. Where clear finishes are required, tint fillers to match wood. Work fillers into grain before set. Wipe excess from surface.
- J. Prime back surfaces, edges, and ends of woodwork and plywood with primer paint.
- K. Finish top, bottoms and edges of doors same as door surfaces with same number of coats.
- L. Paint edges and adjacent sides of wood framing in contact with soffit vents with 1 coat of flat black paint.

3.5 FINISHING MECHANICAL AND ELECTRICAL EQUIPMENT

- A. Remove unfinished and designated prefinished louvers, grilles, covers, and access panels on mechanical and electrical components and paint separately.
- B. Prime and paint interior and exterior insulated and exposed pipes, conduit, boxes, insulated and exposed ducts, hangers, brackets, and collars and supports. Do not paint prefinished surfaces unless painting is specified, scheduled, or noted.
 - 1. Paint prefinished roof top mechanical units.
 - 2. Paint galvanized and electrolytic zinc coated items.
 - 3. Paint shop primed equipment.
 - 4. Paint prefinished equipment occurring within finished areas.
- C. Paint interior surfaces of air ducts that are visible through grilles and louvers with 1 coat black paint. Paint dampers exposed behind grilles and louvers to match face panels.
- D. Replace identification markings on mechanical or electrical equipment when painted accidentally.
- E. Paint exposed conduit and electrical equipment occurring in finished areas.

- F. Paint both sides and edges of plywood backboards for electrical and telephone equipment before installing equipment. Prime and paint with 1 coat flat enamel in color to match adjacent wall.
- G. Reinstall electrical plates and raceways, hardware, light fixture trim, and fittings removed prior to finishing.

3.6 CLEANING

- A. As work proceeds, promptly remove paint where spilled, splashed, spattered or oversprayed.
- B. Repair surfaces damaged by spilled, splashed, spattered or oversprayed paint. Replace surfaces which cannot be repaired to satisfaction of Architect.
- C. During progress of work maintain premises free of unnecessary accumulation of tools, equipment, surplus materials, and debris.
- D. Collect cotton waste, cloths, and material which may constitute a fire hazard, place in closed metal containers and remove daily from site.

3.7 PAINTING AND FINISHING SCHEDULE - EXTERIOR SURFACES

A. Uncoated Ferrous Metals:

1. Semi-Gloss Acrylic Enamel Finish with Acrylic Primer

1st coat	B66W310 Pro-Cryl Universal WB Primer
2nd coat	B42-100 Metalatex Semi-Gloss Coating
3rd coat	B42-100 Metalatex Semi-Gloss Coating

2. Gloss Urethane Enamel with Epoxy Primer

1st coat	Zinc Clad VI Epoxy Primer
2nd coat	Centurion WB Urethane
3rd coat	Centurion WB Urethane

B. Shop Primed Ferrous Metals:

1. Semi-Gloss Acrylic Enamel Finish with Acrylic Primer

Touch-up	B66W310 Pro-Cryl Universal WB Primer
1st coat	B66W310 Pro-Cryl Universal WB Primer
2nd coat	B42-100 Metalatex Semi-Gloss Coating
3rd coat	B42-100 Metalatex Semi-Gloss Coating

2. Gloss Urethane Enamel with Epoxy Primer

Touch-up	Zinc Clad VI Epoxy Primer
1st coat	Zinc Clad VI Epoxy Primer

2nd coat	Centurion WB Urethane
3rd coat	Centurion WB Urethane

C. Galvanized Metals:

1. Semi-Gloss Acrylic Enamel Finish with Acrylic Primer

Pretreatment	Acid etch
Rinse	Clear water
1st coat	B66W310 Pro-Cryl Universal WB Primer
2nd coat	B42-100 Metalatex Semi-Gloss Coating
3rd coat	B42-100 Metalatex Semi-Gloss Coating

2. Gloss Urethane Enamel with Water Based Wash Primer

Pretreatment	Acid etch
Rinse	Clear water
1st coat	DTM Wash Primer
2nd coat	Centurion WB Urethane
3rd coat	Centurion WB Urethane

D. Shop Primed Galvanized Metals:

1. Semi-Gloss Acrylic Enamel Finish with Acrylic Primer

Touch-up	B66W310 Pro-Cryl Universal WB Primer
1st coat	B66W310 Pro-Cryl Universal WB Primer
2nd coat	B42-100 Metalatex Semi-Gloss Coating
3rd coat	B42-100 Metalatex Semi-Gloss Coating

2. Gloss Urethane Enamel with Water Base Wash Primer

Touch-up	DTM Wash Primer
1st coat	DTM Wash Primer
2nd coat	Centurion WB Urethane
3rd coat	Centurion WB Urethane

E. Phosphate Treated Galvanized Metals:

1. Semi-Gloss Acrylic Enamel Finish with Acrylic Primer

1st coat	B66W310 Pro-Cryl Universal WB Primer
2nd coat	B42-100 Metalatex Semi-Gloss Coating
3rd coat	B42-100 Metalatex Semi-Gloss Coating

2. Gloss Urethane Enamel with Water Based Wash Primer

1st coat	DTM Wash Primer
2nd coat	Centurion WB Urethane

3rd coat Centurion WB Urethane

F. Aluminum:

1. Semi-Gloss Acrylic Enamel Finish with Acrylic Primer

Pretreatment	Acid Etch
Rinse	Clear Water
1st coat	B66W310 Pro-Cryl Universal WB Primer
2nd coat	B42-100 Metalatex Semi-Gloss Coating
3rd coat	B42-100 Metalatex Semi-Gloss Coating

2. Gloss Urethane Enamel with Water Based Wash Primer

1st coat	DTM Wash Primer
2nd coat	Centurion WB Urethane
3rd coat	Centurion WB Urethane

G. Shop Primed Aluminum:

1. Semi-Gloss Acrylic Enamel Finish with Acrylic Primer

Touch-up	B66W310 Pro-Cryl Universal WB Primer
1st coat	B66W310 Pro-Cryl Universal WB Primer
2nd coat	B42-100 Metalatex Semi-Gloss Coating
3rd coat	B42-100 Metalatex Semi-Gloss Coating

2. Gloss Urethane Enamel with Water Based Wash Primer

Touch-up	DTM Wash Primer
1st coat	DTM Wash Primer
2nd coat	Centurion WB Urethane
3rd coat	Centurion WB Urethane

H. Prefinished Metal: Semi-Gloss Acrylic Enamel Finish; Acrylic Primer

Pretreatment	Detergent Wash
Rinse	Clear Water
1st coat	B66A50 DTM Bonding Primer
2nd coat	B71W200 Bond-Plex WB Coating
3rd coat	B71W200 Bond-Plex WB Coating

3.8 PAINTING AND FINISHING SCHEDULE - INTERIOR SURFACES

A. Gypsum Board:

1. Eggshell Latex Finish with Latex Primer

1st coat	B28W600 ProGreen 200 Latex Primer
2nd coat	B20W651 ProGreen 200 Latex Eg-Shel

3rd coat B20W651 ProGreen 200 Latex Eg-Shel

2. Semi-Gloss Latex Finish with Latex Primer

1st coat B28W600 ProGreen 200 Latex Primer
2nd coat B31W651 ProGreen 200 Latex Semi-Gloss
3rd coat B31W651 ProGreen 200 Latex Semi-Gloss

B. Concrete:

1. Eggshell Sheen: Eggshell Latex Finish; Acrylic Primer

1st coat B28W300 PrepRite Masonry Primer
2nd coat B20W651 ProGreen 200 Latex Eg-Shel
3rd coat B20W651 ProGreen 200 Latex Eg-Shel

3. Semi-Gloss Sheen: Semi-Gloss Latex Finish; Acrylic Primer

1st coat B28W300 PrepRite Masonry Primer
2nd coat B31W651 ProGreen 200 Latex Semi-Gloss
3rd coat B31W651 ProGreen 200 Latex Semi-Gloss

C. Uncoated Ferrous Metals:

1. Eggshell Latex Finish with Acrylic Primer

1st coat B66W310 Pro-Cryl Universal Primer
2nd coat B20W651 ProGreen 200 Latex Eg-Shel
3rd coat B20W651 ProGreen 200 Latex Eg-Shel

2. Semi-Gloss Latex Finish with Acrylic Primer

1st coat B66W310 Pro-Cryl Universal Primer
2nd coat B31W651 ProGreen 200 Latex Semi-Gloss
3rd coat B31W651 ProGreen 200 Latex Semi-Gloss

3. Gloss Urethane Enamel with Epoxy Primer

1st coat Zinc Clad VI Epoxy Primer
2nd coat Centurion WB Urethane
3rd coat Centurion WB Urethane

D. Shop Primed Ferrous Metals: Semi-Gloss Latex Enamel; Acrylic Primer

1. Eggshell Latex Finish with Acrylic Primer

Touch-up B66W310 Pro-Cryl Universal Primer
1st coat B66W310 Pro-Cryl Universal Primer
2nd coat B20W651 ProGreen 200 Latex Eg-Shel

3rd coat B20W651 ProGreen 200 Latex Eg-Shel

2. Semi-Gloss Latex Finish with Acrylic Primer

Touch-up B66W310 Pro-Cryl Universal Primer
1st coat B66W310 Pro-Cryl Universal Primer
2nd coat B31W651 ProGreen 200 Latex Semi-Gloss
3rd coat B31W651 ProGreen 200 Latex Semi-Gloss

3. Gloss Urethane Enamel with Epoxy Primer

Touch-up Zinc Clad VI Epoxy Primer
1st coat Zinc Clad VI Epoxy Primer
2nd coat Centurion WB Urethane
3rd coat Centurion WB Urethane

E. Galvanized Metals:

1. Flat Latex Finish for Galvanized Metal Ductwork Behind Registers: Flat Latex

1st coat B31W651 ProGreen 200 Latex Semi-Gloss

2. Eggshell Acrylic Finish with Acrylic Primer

1st coat B66W310 Pro-Cryl Universal Primer
2nd coat B20W51 ProClassic Waterborne Acrylic Satin
3rd coat B20W51 ProClassic Waterborne Acrylic Satin

3. Semi-Gloss Acrylic Finish with Acrylic Primer

1st coat B66W310 Pro-Cryl Universal Primer
2nd coat B31W51 ProClassic Waterborne Acrylic Semi-Gloss
3rd coat B31W51 ProClassic Waterborne Acrylic Semi-Gloss

4. Gloss Urethane Enamel with Water Based Wash Primer

Pretreatment Acid etch
Rinse Clear water
1st coat DTM Wash Primer
2nd coat Centurion WB Urethane
3rd coat Centurion WB Urethane

F. Shop Primed Galvanized Metals:

1. Eggshell Acrylic Finish with Acrylic Primer

Touch-up B66W310 Pro-Cryl Universal Primer
1st coat B66W310 Pro-Cryl Universal Primer
2nd coat B20W51 ProClassic Waterborne Acrylic Satin

3rd coat	B20W51 ProClassic Waterborne Acrylic Satin
2. Semi-Gloss Acrylic Finish with Acrylic Primer

Touch-up	B66W310 Pro-Cryl Universal Primer
1st coat	B66W310 Pro-Cryl Universal Primer
2nd coat	B31W51 ProClassic Waterborne Acrylic Semi-Gloss
3rd coat	B31W51 ProClassic Waterborne Acrylic Semi-Gloss
 3. Gloss Urethane Enamel with Water Base Wash Primer

Touch-up	DTM Wash Primer
1st coat	DTM Wash Primer
2nd coat	Centurion WB Urethane
3rd coat	Centurion WB Urethane

G. Aluminum:

1. Eggshell Latex Finish with Acrylic Primer

1st coat	B66W310 Pro-Cryl Universal Primer
2nd coat	B20W651 ProGreen 200 Latex Eg-Shel
3rd coat	B20W651 ProGreen 200 Latex Eg-Shel
2. Semi-Gloss Latex Finish with Acrylic Primer

1st coat	B66W310 Pro-Cryl Universal Primer
2nd coat	B31W651 ProGreen 200 Latex Semi-Gloss
3rd coat	B31W651 ProGreen 200 Latex Semi-Gloss
3. Gloss Urethane Enamel with Water Base Wash Primer

Touch-up	DTM Wash Primer
1st coat	DTM Wash Primer
2nd coat	Centurion WB Urethane
3rd coat	Centurion WB Urethane

H. Shop Primed Aluminum:

1. Eggshell Acrylic Finish with Acrylic Primer

Touch-up	B66W310 Pro-Cryl Universal Primer
1st coat	B66W310 Pro-Cryl Universal Primer
2nd coat	B20W51 ProClassic Waterborne Acrylic Satin
3rd coat	B20W51 ProClassic Waterborne Acrylic Satin

2. Semi-Gloss Acrylic Finish with Acrylic Primer

Touch-up	B66W310 Pro-Cryl Universal Primer
1st coat	B66W310 Pro-Cryl Universal Primer
2nd coat	B31W51 ProClassic Waterborne Acrylic Semi-Gloss
3rd coat	B31W51 ProClassic Waterborne Acrylic Semi-Gloss

3. Gloss Urethane Enamel with Water Based Wash Primer

Touch-up	DTM Wash Primer
1st coat	DTM Wash Primer
2nd coat	Centurion WB Urethane
3rd coat	Centurion WB Urethane

I. Prefinished Metals:

1. Eggshell Latex Finish with Acrylic Primer

Pretreatment	Paint etch
Rinse	Clear water
1st coat	B66W310 Pro-Cryl Universal Primer
2nd coat	B20W651 ProGreen 200 Latex Eg-Shel
3rd coat	B20W651 ProGreen 200 Latex Eg-Shel

2. Semi-Gloss Latex Finish with Acrylic Primer

Pretreatment	Paint etch
Rinse	Clear water
1st coat	B66W310 Pro-Cryl Universal Primer
2nd coat	B31W651 ProGreen 200 Latex Semi-Gloss
3rd coat	B31W651 ProGreen 200 Latex Semi-Gloss

J. Uncoated Wood and Plywood for Opaque Finish:

1. Eggshell Latex Finish with Latex Primer

1st coat	B51W20 PrepRite ProBlock Latex Primer Sealer
2nd coat	B9W951 Harmony Latex Eg-Shel
3rd coat	B9W951 Harmony Latex Eg-Shel

2. Semi-Gloss Latex Finish with Latex Primer

1st coat	B51W20 PrepRite ProBlock Latex Primer Sealer
2nd coat	B21W51 ProClassic Waterborne Acrylic Gloss
3rd coat	B21W51 ProClassic Waterborne Acrylic Gloss

K. Shop Primed Wood and Plywood for Opaque Finish:

1. Eggshell Latex Finish with Latex Primer

Touch-up	B51W20 PrepRite ProBlock Latex Primer Sealer
1st coat	B9W951 Harmony Latex Eg-Shel
2nd coat	B9W951 Harmony Latex Eg-Shel

2. Semi-Gloss Latex Finish with Latex Primer

Touch-up	B51W20 PrepRite ProBlock Latex Primer Sealer
1st coat	B21W51 ProClassic Waterborne Acrylic Gloss
2nd coat	B21W51 ProClassic Waterborne Acrylic Gloss

L. Uncoated Wood and Plywood for Transparent Finish: Stain with Water Reducible Satin Polyurethane Varnish

1st coat	Minwax 250 VOC Stain
2nd coat	A68 Series Gloss Wood Classics Waterborne Polyurethane Varnish
3rd coat	A68 Series Satin Wood Classics Waterborne Polyurethane Varnish

3.9 SCHEDULE OF SHEENS AND COLORS

A. Sheens:

1. Exterior Surfaces:

a. Metals:

- 1) Steel Stair Stringers, Railings and Other Stair Metal Components: Gloss urethane enamel.
- 2) Steel Pipe Bollards: Gloss urethane enamel.
- 3) Sign Posts: Gloss urethane enamel.
- 4) Steel Doors and Frames: Gloss urethane enamel.
- 5) Other Metal Surfaces: Semi-gloss acrylic enamel except where otherwise indicated on Drawings.

b. Other Surfaces: Sheens as scheduled except where indicated otherwise on Drawings.

2. Interior Surfaces:

a. Concrete and Gypsum Board:

- 1) Within Restrooms, Utility/Custodial Rooms and Storage Rooms:
Semi-gloss acrylic enamel.
- 2) Other Locations: Eggshell acrylic enamel except where indicated otherwise on Drawings.

b. Metals Within Parking Areas and in Surfaces Opening onto Parking Areas:
Gloss urethane enamel.

c. Other Metals:

- 1) Interior Ducts Behind Registers: Flat finish.
- 2) Within Eggshell Sheen Finished Walls and Ceilings:
 - a) Steel Doors and Door Frames: Semi-gloss sheen.
 - b) Other Surfaces: Eggshell sheen.
- 3) Other Locations: Semi-gloss except where indicated otherwise on Drawings.

d. Wood to Receive Opaque Finish:

- 1) Within Eggshell Sheen Finished Walls and Ceilings: Eggshell sheen.
- 2) Other Locations: Semi-gloss except where indicated otherwise on Drawings.

e. Other Materials: Sheens as scheduled except where indicated otherwise on Drawings.

B. Colors: Paint number designations on Drawings identify location of paint colors on project.

1. PT-1: Color to match Sherwin Williams color # "Swiss Coffee"
2. PT-2: Accent color to be determined
3. PT-3: Accent color to be determined

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SECTION 09960

GRAFFITI-RESISTANT COATINGS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Graffiti-resistant coating to protect exposed above-grade cast-in-place and precast concrete surfaces.

1.2 RELATED SECTIONS

- A. Section 09900 – Paints and Coatings: Field applied coatings for concrete surfaces other than specified in this section.

1.3 REFERENCES

- A. ASTM D5095 – Test Method for Determination of the Nonvolatile Content in Silanes, Siloxanes and Silane-Siloxane Blends Used in Masonry Water Repellent Treatments.

1.4 PERFORMANCE REQUIREMENTS

- A. Graffiti-resistant coating to allow complete removal of every type of paint and graffiti material without damaging uncoated surface to which coatings are applied.
- B. Graffiti-resistant coating and products recommended by coating manufacturer to remove graffiti to be non-toxic and comply with requirements of local air quality management district.
- C. Graffiti-resistant coating to be weather and rain resistant, abrasive resistant, peel resistant, ultra-violet resistant, non-yellowing and allow vapor transmission.
- D. Products recommended by coating manufacturer to remove graffiti from coated surface to permit removal of graffiti with little or not change in appearance of treated surface.

1.5 SUBMITTALS

- A. Product Data: Submit manufacturer's product data sheets for every product used. Include description for protection of surrounding areas and non-concrete and non-masonry surfaces; surface preparation, application and final cleaning.
- B. Certifications:

1. Applicator Qualifications: Certify that applicator is experienced in application of specified products. Include list of recently completed graffiti-resistant coatings projects listing project name, names of owner and architect, products used, substrates, applicable local environmental regulations, and application procedures.
2. VOC Regulations: Certify that graffiti-resistant coatings furnished comply with regulations controlling use of volatile organic compounds.

1.6 OPERATION AND MAINTENANCE DATA

- A. Submit manufacturer's recommendations for graffiti removal products and procedures. Include material specifications and instructions for application.

1.7 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacture of graffiti-resistant coatings with minimum 10 years documented experience.
- B. Applicator: Company specializing in application of graffiti-resistant coatings with minimum 5 years documented experience and employing persons experienced in application of specified products.

1.8 REGULATORY REQUIREMENTS

- A. Conform to regulations of South Coast Air Quality Management District and California Air Resources Board.

1.9 FIELD SAMPLES

- A. Before full-scale application, review manufacturer's product data sheets to determine suitability of each product for specific surfaces. Apply graffiti-resistant coating to test panels to determine number of applications, coverage rates, compatibility, effectiveness, surface preparation, application procedures and desired results.
- B. Apply graffiti-resistant coating to test panels in accordance with manufacturer's written instructions. Allow 48 hours or until test panels are thoroughly dry before evaluating final appearance and results.
- D. Do not begin full-scale application until test panels are reviewed and accepted by the Architect.
- E. Test Panel Requirements:
 1. Size: Minimum 4 x 4 feet.
 2. Location: As determined by the Architect.

3. Number: As required to completely test graffiti-resistant coating with each type of substrate to be protected.

- F. Retain and protect test panels accepted by the Architect in undisturbed condition during the work of this section. Accepted panels will be used to establish standard for work of this section.

1.10 PREINSTALLATION CONFERENCE

- A. Schedule preinstallation conference minimum 1 week prior to beginning work of this section.
- B. Attendance: Contractor, graffiti-resistant coating applicator, graffiti-resistant coating manufacturer's representative, Project Inspector and Architect.
- C. Agenda: Review environmental regulations, test panel procedures, protection of surrounding areas and non-concrete and non-masonry surfaces, surface preparation, application, field quality control, final cleaning and coordination with other work.

1.11 DELIVERY, STORAGE AND HANDLING

- A. Deliver products to site, store, handle and protect in accordance with manufacturer's instructions and recommendations.
- B. Deliver materials to site in manufacturer's original, unopened containers and packaging with labels clearly identifying product name and manufacturer.
- C. Store and handle materials in accordance with manufacturer's instructions.
 1. Store containers upright in cool, dry, well ventilated place out of sun. Maintain temperature between 45 degrees F and 100 degrees F.
 2. Store containers away from other chemicals and potential sources of contamination.
 3. Do not drop containers or slide across sharp objects.
 4. Do not double stack pallets.
 5. Keep containers tightly closed when not in use.

1.12 ENVIRONMENTAL REQUIREMENTS

- A. Do not apply graffiti-resistant coatings at surface and air temperatures below 40 degrees F or above 95 degrees F unless otherwise indicated by manufacturer's written instructions.

- B. Do not apply graffiti-resistant coatings when surface and air temperatures are not expected to remain above 40 degrees F and below 95 degrees F for minimum 8 hours after application unless otherwise indicated by manufacturer's written instructions.
- C. Do not apply graffiti-resistant coatings under windy conditions such that coating may be blown to surfaces not intended to be treated.
- D. Do not apply graffiti-resistant coatings to frozen substrate. Allow adequate time for substrate to thaw if freezing conditions exist before application.
- E. Do not apply graffiti-resistant coatings earlier than 24 hours after rain for if rain is predicted for a period of 6 hours after application unless otherwise indicated by manufacturer's written instructions.

1.13 COORDINATION

- A. Coordinate application of graffiti-resistant coating with installation of finish paving, planting and other site features specified under Division 2. Ensure graffiti-resistant coating is applied prior to installation of finish paving, planting and other site features.
- B. Coordinate application of graffiti-resistant coating with installation of aluminum curtain wall systems specified under Section 08911 – Glazed Aluminum Curtain Wall. Ensure graffiti-resistant coating is applied prior to installation of curtain wall systems.
- C. Coordinate application of graffiti-resistant coatings specified under this section with application of paints specified under Section 09900 – Paints and Coatings. Ensure that:
 - 1. Surfaces designated to receive paint do not receive graffiti-resistant coating and surfaces to receive graffiti-resistant coating are not painted.
 - 2. Exposed vertical interior concrete surfaces are either painted or coated with graffiti-resistant coating.
 - 3. Exposed vertical exterior concrete surfaces and precast concrete surfaces are coated with graffiti-resistant coating and are not painted.

PART 2 PRODUCTS

2.1 GRAFFITI-RESISTANT COATINGS

- A. Manufacturers:
 - 1. ProSoCo, Inc.: SureKlean® Weather Seal Blok-Guard® & Graffiti Control II.
 - 2. Substitutions: Under provisions of Division 1.

- B. Coating: Clear-drying water-based emulsion for weatherproofing and protecting concrete and masonry surfaces from graffiti attacks without altering natural appearance; non-sacrificial; UV stable; breathable.
1. Form: Milky white liquid.
 2. Specific Gravity: 1.00.
 3. Weight per Gallon: 8.32 lbs.
 4. Active Content: 6 percent.
 5. Total Solids: 6 percent in accordance with ASTM D5095.
 6. Flash Point: >212°F.
 7. Freeze Point: 32°F.
 8. VOC Content: 14 g/L.
 9. Shelf Life: 1 year in tightly sealed unopened containers.

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 manufacturer's instructions and recommendations.
1. Verify that surfaces are free from cracks, voids, defects and other damage.
 2. Verify that joints have been sealed and that sealant is completely cured.
 3. Verify that substrate surface has completely cured.
- B. Do not begin application until unsatisfactory conditions have been corrected.

3.2 PROTECTION

- A. Protect surrounding areas, landscaping, building occupants, pedestrians, vehicles and non-concrete and non-masonry surfaces not designated for protection during work from contact with product, splash, residue, fumes and wind drift in accordance with manufacture's written instructions.
- B. Mask windows, curtain wall, doors and door frames with polyethylene film or other proven protective material.

- C. Fill cracks and voids to prevent penetration of fumes into buildings.
- D. Divert and protect pedestrian and auto traffic.

3.3 PREPARATION

- A. Clean dirt, dust, oil, grease and other contaminants that interfere with penetration or performance of graffiti-resistant coatings from surfaces to be treated.
- B. Use appropriate cleaners approved by coating manufacturer where necessary.
- C. Rinse thoroughly using pressure water spray to remove cleaner residues. Allow surfaces to dry completely before application of graffiti-resistant coating.

3.4 APPLICATION

- A. Apply graffiti-resistant coating to substrates in accordance with manufacturer's written instructions, environmental regulations and application procedures determined from field samples.
- B. Apply as packaged; do not dilute or alter.
- C. Apply to clean, dry, cured and properly prepared surfaces using equipment and precautions stipulated in manufacturer's written instructions. Apply 'wet-to-wet' to visibly dry and absorbent surface.

1. Spray Application:

- a. Saturate form bottom up. Let first application penetrate for 2 to 3 minutes; resaturate.
- b. Spray fluted concrete surfaces in overlapping "X" pattern to ensure complete coverage of recessed surfaces.

2. Brush or Roller Application:

- a. Saturate uniformly. Let first application penetrate for 2 to 3 minutes; resaturate.
- b. Brush out heavy runs and drips that do not penetrate substrate.

- D. Apply in manner to prevent overspray, wind drift and splash.

3.5 FIELD QUALITY CONTROL

- A. Inspect graffiti-resistant completed coating work with Project Inspector, Architect, applicator and manufacturer's representative; compare with accepted field samples to determine if substrates are suitably protected by graffiti-resistant coating.
- B. Correct deficiencies in coatings as directed by Architect and in accordance with recommendations of manufacturer's representative.

3.6 CLEANING

- A. Remove overspray from adjacent surfaces not designated to receive graffiti-resistant coating using materials and methods recommended by coating manufacturer and acceptable to manufacturer and fabricator of adjacent surface.
- B. Repair, restore or replace, to satisfaction of Architect, materials and landscaping that cannot be successfully cleaned and are damaged by exposure to graffiti-resistant coatings.
- C. Clean site of unused graffiti-resistant coatings, residues, rinse water, wastes and effluents in accordance with environmental regulations. Remove and dispose of materials used to protect surrounding areas and non-masonry surfaces.

3.7 SCHEDULE

- A. Site Concrete: Apply graffiti-resistant coating to exposed surfaces of exterior architectural cast-in-place site concrete and architectural precast site concrete other than paving surfaces.
- B. Building Concrete: Apply graffiti-resistant coating to exposed interior and exterior cast-in-place and architectural precast concrete other than paving surfaces and surfaces designated to receive paint finish.

END OF SECTION

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SECTION 10100
VISUAL DISPLAY BOARDS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Surface mounted markerboards.
- B. Trim and accessories.

1.2 RELATED SECTIONS

- A. Section 09110 - Non-Load Bearing Metal Framing: Framing and backing for support of wall mounted boards.
- B. Section 09250 - Gypsum Board: Wall sheathing at walls scheduled to receive wall mounted boards.

1.3 REFERENCES

- A. ASTM A424 - Steel Sheets for Porcelain Enameling.
- B. ASTM B209 - Aluminum and Aluminum-Alloy Sheet and Plate.
- C. ASTM B221 - Aluminum-Alloy Extruded Bars, Rods, Wire Shapes and Tubes.
- D. NPA A208.1 - Mat Formed Wood Particle Board.
- E. Porcelain Enamel Institute - Performance Specifications for Porcelain Enamel Chalkboards.

1.4 SYSTEM DESCRIPTION

- A. Surface Mounted Markerboards: Factory-built metal marker boards with extruded aluminum frames configured for hanging on wall from continuous hanger bar and equipped with display rails, chalk rails and paper holders.

1.5 DESIGN REQUIREMENTS

- A. Sustainable Design Requirements:
 - 1. Composite wood panels, aluminum and steel used in work of this section are intended to contribute to meeting requirements for recycled content outlined in LEED™-NC 2009 Credit MR4.

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™-NC 2009 Credit IEQ4.1.
3. Composite wood panels 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 not to contain urea-formaldehyde resins outlined in LEED™-NC 2009 Credit IEQ4.4.
4. Steel and aluminum used in work of this section is intended to contribute to meeting requirements for recycled content outlined in LEED™-NC 2009 for Credit MR4.

1.6 SUBMITTALS

- A. Shop Drawings: Indicate wall elevations, dimensions, track configurations, and special anchor details.
- B. Product Data: Provide data on markerboards, trim and accessories. Include copy of manufacturer's warranty.
- C. Samples:
 1. Writing Surfaces: Submit samples, minimum 4 x 6 inches in size, of writing surface illustrating color, texture and sheen of specified finish.
 2. Framing:
 - a. Submit samples, minimum 12 x 12 inches in size, of corner of each frame type illustrating extrusion profiles, corner assemblies with reinforcement and finish.
 - b. Submit samples, minimum 12 inches long, of display rails and chalk rails illustrating profiles and finishes.
 3. Accessories: Submit samples of paper holders.
- D. Manufacturer's Certificates: Certify that gauge of sheet steel provided is as specified.
- E. LEED Documentation:
 1. Wood Composite Panels:
 - a. Recycled Content: Submit letter or product data from manufacturer indicating recycled contents. Designate percentage of post-consumer and post-industrial recycled content.

- b. Urea-Formaldehyde Resin Content: Submit letter or product data from manufacturer stating that materials used in this project contain no added formaldehyde.
 - 2. Aluminum: Submit letter or product data from manufacturer indicating recycled content. Designate percentage of post-consumer and post-industrial recycled content.
 - 3. Steel: Submit letter or product data from manufacturer indicating recycled content. Designate percentage of post-consumer and post-industrial recycled content.
 - 4. Adhesives: Submit letter or product data from manufacturer stating that adhesives used in work of this section do not exceed VOC 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, IEQ Credit 4.1 and IEQ Credit 4.4.
- 1.7 OPERATION AND MAINTENANCE DATA
- A. Maintenance Data: Include data on regular cleaning and stain removal.
- 1.8 QUALIFICATIONS
- A. Manufacturers: Companies specializing in manufacturing visual display boards with minimum 10 years documented experience.
 - B. Installer: Company specializing in installing visual display boards with minimum 3 years documented experience.
- 1.9 FIELD MEASUREMENTS
- A. Verify that field measurements are as indicated on shop drawings.
- 1.10 WARRANTY
- A. Manufacturer's Warranty: Warrant that porcelain enamel under normal classroom usage shall not exhibit excessive fading or coloring, crazing, cracking or flaking for lifetime of original installation and agree to either supply without charge new products for defective goods or refund purchase price with due allowance for service rendered by products.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Claridge Products and Equipment, Inc.: Series 1 LCS-II Markerboard.

1. Sizes as shown in plans
 - B. Manufacturer Offering Acceptable Equivalent Product: ABC School Equipment, Inc.
 - C. Substitutions: Under provisions of Division 1.
- 2.2 MATERIALS
- A. Sheet Steel: ASTM A424, Type I, commercial quality.
 - B. Particle Board: NPA A208.1; wood shavings set in waterproof resin binder; manufactured from 100 percent post industrial recycled or reclaimed materials with no added urea-formaldehyde; sanded faces.
 - C. Aluminum Sheet: ASTM B209, 6063 alloy, T52 temper.
 - D. Aluminum Extrusions: ASTM B221, 6063 alloy, T5 temper.
- 2.3 ACCESSORIES
- A. Adhesives: Types recommended by manufacturer.
 - B. Paper Holders: Formed aluminum or plastic clips with map hook; sliding type to fit map rail integral with markerboard frame; provide 2 for each 3 linear feet of map rail.
 - C. Temporary Protective Cover: Sheet polyethylene, 8 mils thick.
- 2.4 FABRICATED COMPONENTS
- A. Markerboard Panel Construction:
 1. Outer Face Sheet: Sheet steel, 24 gauge.
 2. Core: Particleboard, 3/8 inch thick.
 3. Backing Surface: Aluminum sheet, 0.015 inch thick.
 4. Splice Joint:
 - a. Boards Up to 16 Feet Long: None permitted.
 - b. Boards Over 16 Feet Long: Concealed spline of sheet steel; butted face sheets with fired edges.
 - B. Frames: Extruded aluminum; concealed fasteners.
 1. Head Trim: 1-1/2 inch face dimension with integral 1 inch map rail having cork insert and end caps.
 2. Jamb Trim: 1-1/2 inch face dimension.

3. Chalk Rail: Continuous hollow aluminum end tray with cast aluminum end closures; 2-3/16 inches high x 3-11/16 inches deep.

C. Mounting Hardware:

1. Top: Aluminum hanger clips at 16 inches oc.
2. Bottom: Aluminum angle clips at 16 inches oc.

D. Fasteners:

1. Angle Clips to Wall Framing: #8 pan or oval head sheet metal screws; length sufficient to penetrate through framing minimum 1/4 inch; stainless steel.
2. Angle Clips to Unit Frame: #6 x 3/8 inch pan head self tapping screw; stainless steel.
3. Hardware and Accessories to Unit Frame or Body: Manufacturer's standard.

2.5 FABRICATION

- A. Fabricate markerboard units to dimensions indicated on Drawings; fabricate completely assembled in 1 piece without joints except where manufacturer's maximum dimensions are exceeded.
- B. Where manufacturer's maximum dimensions are exceeded, fabricate in units with minimum number of pieces and joints and with equal sized pieces balanced around center of unit.
 1. Factory pre-assemble and pre-fit components; disassemble for delivery ready for re-assembly at site.
 2. Provide with spline-connected butt joints to produce non-lipped joint between adjoining writing surfaces.
- C. Fabricate panels by pressure laminating face sheet and backing surface to core.
- D. Provide frame trim at heads and jambs of units; provide chalk rail at sills of markerboard units.
 1. Fabricate frame trim with mitered corners.
 2. Extend frame trim full heights and widths of units in single pieces except that map rail to extend to within 6 inches of ends of units and butt to mitered and returned jamb trim.
 3. Extend chalk rail full width of unit.

2.6 FINISHES

- A. Markerboard Surfaces and Edges: Porcelain Enamel Institute Type A; fused-on porcelain enamel coating; medium gloss finish; 1.5 to 2.2 mil ceramic bottom ground coat

and mill ceramic top ground coat fused to both faces and edges; 3.0 to 4.0 mil ceramic top coat fused to writing surface; color to match Claridge #92 LCS-II "White."
- B. Frames and Trim: Clear anodized aluminum.

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 framing and backing have been installed and properly located and secured.
- C. Do not begin installation until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install markerboards in accordance with final reviewed shop drawings and manufacturer's instructions and recommendations.
- B. Install markerboards plumb, level, square and free from warp and twist while maintaining dimensional tolerances and alignment with surrounding construction.
- C. Secure surface mounted units with concealed fasteners.
 - 1. Install metal clips at 16 inches oc at heads and sills of markerboards.
 - 2. Secure markerboards to clips.
- D. Re-assemble and install multiple piece markerboards with writing surface and trim joints flush, tight and hairline.

3.3 CLEANING

- A. Clean writing surfaces and trim in accordance with manufacturer's instructions. Do not use materials or methods that may damage markerboard finishes.
- B. Cover markerboards with protective covers, taped to frames.
- C. Remove protective cover at Date of Substantial Completion.

END OF SECTION

SECTION 10140

SIGNAGE

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Metal plate signs.
- B. Decals.
- C. Plastic plaques.
- D. Dimensional letter signs.
- E. Mounting accessories, fittings and fastenings.

1.2 RELATED SECTIONS

- A. Section 03300 - Cast-In-Place Concrete: Surface to receive signage.
- B. Section 08110 – Hollow Metal Doors and Frames: Surface to receive signage.
- C. Section 08410 - Aluminum Framed Entrances and Storefronts: Glass surfaces to receive decals.
- D. Section 08911 - Glazed Aluminum Curtain Wall: Glass surfaces to receive decals.
- E. Section 09250 - Gypsum Board: Surface to receive signage.
- F. Division 26 - Electrical: Illuminated exit signs.

1.4 REFERENCES

- A. ASTM A53 – Specification for pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
- B. ASTM C94 – Specification for Ready-Mixed Concrete.
- C. CBC - California Building Code, 2010 edition.

1.5 DEFINITIONS

- A. Grade 2 Braille: Contracted Grade 2 Braille with dots 1/10 inch oc in each cell with 2/10 inch space between cells; dots raised minimum 1/40 inch above background.

1.6 DESIGN REQUIREMENTS

- A. Materials, shapes, colors and graphics of plastic plaques provided under this section to match materials, shapes, colors and graphics of like plastic plaques installed at existing buildings on campus.

- B. Sustainable Design Requirements:

- 1. Steel and aluminum used in work of this section is intended to contribute to meeting requirements for recycled content outlined in LEED™-NC 2009 for Credit MR4.
 - 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™-NC 2009 Credit EQ4.1.

1.7 SUBMITTALS

- A. Shop Drawings: Indicate sign styles, lettering, styles, text, pictographs, locations, overall dimensions, and mounting.

- B. Samples:

- 1. Plates, Decal and Plaques:
 - a. Submit samples illustrating manufacturer's full range of colors and lettering styles available for Architect's selection.
 - b. Submit samples of plastic plaques and decals illustrating materials and construction.
 - 2. Dimensional Letters: Submit samples of letters illustrating material, finish, mounting, letter font styles and sizes. Submit letters that may be incorporated into signs. Samples will be returned to Contractor.

- C. 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. Adhesives: Submit letter or product data from manufacturer stating that adhesives used in work of this section meet testing and product requirements of South Coast Air Quality Management District Rule #1168.

4. Submit hard copies of completed Online Documentation required for LEED™ MR Credit 4 and EQ Credit 4.1.

1.8 QUALITY ASSURANCE

- A. Source Limitation: For each type of material required for work of this section, provide primary materials which are product of single manufacturer. Provide secondary and accessory materials which are acceptable to manufacturers of primary materials.

1.9 QUALIFICATIONS

- A. Manufacturer: Company specializing in fabrication of signs of types required for period of not less than 3 years documented experience with plant, facilities and experienced personnel to produce signs as specified in conformance with industry standards and practices.
- B. Installer: Company specializing in installation of signs of types required for period of not less than 3 years and approved by the manufacturer.

1.10 REGULATORY REQUIREMENTS

- A. Parking Reserved for Persons with Disabilities Signage: Comply with requirements of CBC Section 1129B.4.
- B. Accessible Entrance Directional Signs: Comply with CBC Sections 1117B.5.1, 1117B.5.8.1 and 1127B.3.
 1. Design of International Symbol of Accessibility: Comply with requirements of CBC Section 1117B.5.8.1.
 2. Color of International Symbol of Accessibility: Comply with requirements of CBC Section 1117B.5.8.1.1.
 3. Minimum Pictograph Height: Comply to requirements of CBC Section 1117B.5.5.
- C. Building Accessible Entrance Signage: Comply with requirements of CBC Section 1117B.5.
 1. Room Identification Signage: Comply with requirements of CBC Section 1117B.5.
 1. Braille: Comply with requirements of CBC Section 1117B.5.6.
 2. Proportions: Comply with requirements Of CBC Section 1117B.5.3.
 3. Contrast of Text and Pictographs: Comply with requirements of CBC Section 1117B.5.2.

- 4. Raised Text and Pictographs: Comply with requirements of CBC Section 1117B.5.5.
 - 5. Mounting Height and Location: Comply with requirements of CBC Section 1117B.5.7.
 - D. Tactile Exit Signage: Comply with requirements of CBC Section 1011.3.
 - E. Area of Refuge Identification Signage: Comply with requirements of CBC Sections 1007.6.5.
 - F. Toilet Door Signage for Visually Impaired: Comply with requirements of CBC Section 1115B.6.
 - G. Room Capacity Load Signage: Comply with CBC Section 1004.3.
 - H. Elevator Use Limits Signage: Comply with requirements of CBC Section 3003.2.1.1.
 - I. Assistive Listening Availability Signage: Comply with requirements of CBC Section 1104B.2.4.
- 1.11 DELIVERY, STORAGE AND HANDLING
- A. Deliver products to site, store, handle and protect in accordance with manufacturer's instructions and recommendations.
 - B. Do not deliver signs until areas are ready for installation.
 - C. Provide protective wrapping or packaging to protect fabricated signs from damage during handling and storage.
 - D. Deliver products unopened.
 - E. Store and handle in accordance with manufacturer's instructions and recommendations.
 - F. Store under cover in dry secure area off the ground to protect from moisture and abnormal and sudden temperature changes.
- 1.12 FIELD MEASUREMENTS
- A. Field verify dimensions of areas to receive project signage prior to fabrication.
- 1.13 COORDINATION
- A. Coordinate installation of signage with painting specified under Section 09900 – Paints and Coatings. Ensure painting is complete and thoroughly dry prior to installing signs.

PART 2 PRODUCTS

2.1 METAL PLATE SIGNS

- A. Parking Reserved for Persons with Disabilities Signs: 16 gauge galvanized steel or 0.080 inch aluminum; reflective finish; radiused corners; mounting for mechanical fasteners.

1. Standard Accessible Space:

- a. Size: As indicated on Drawings.
- b. Pictograph: International symbol of accessibility.
- b. Text: San serif letters; minimum 2 inches high located below pictograph and arranged in 2 lines reading "MINIMUM FINE \$250."
- c. Border: Inset.
- d. Colors:
 - 1) Background: Blue to match Federal Standard 595B color #15090.
 - 2) Border and Pictograph: White.
- e. Locations: As indicated on Drawings.
- f. Quantity: 1 required for each designated accessible parking space.

2. Additional Sign for Van Accessible Space:

- a. Size: As indicated on Drawings with width to match width of standard accessible space sign.
- b. Text: San serif letters; minimum 2 inches high arranged in 2 lines reading "VAN ACCESSIBLE."
- c. Border: Inset.
- d. Colors:
 - 1) Background: Blue to match Federal Standard 595B color #15090.
 - 2) Border and Pictograph: White.
- e. Locations: As indicated on Drawings.
- f. Quantity: 1 required for each designated van accessible parking space.

- B. Accessible Entrance Directional Signs: 16 gauge galvanized steel or 0.080 inch aluminum; radiused corners; non-reflective baked enamel finish mounting for mechanical fasteners.

1. Sizes: As indicated on Drawings.
2. Text: San serif letters; minimum 2 inches high; wording as indicated on Drawings.
3. Pictographs: International symbol for accessibility and directional arrows; field for international symbol minimum 6 inches high; use of symbols and arrows as indicated on Drawings.
4. Colors:
 - a. Background: Blue to match Federal Standard 595B color #15090.
 - b. Pictograph and Text: White.
5. Locations: As indicated on Drawings.
6. Quantity: As indicated on Drawings.

2.2 DECALS

- A. Exterior Building Accessible Entrance Signs: Pressure sensitive vinyl decal for application to inside face of glass; silk screened graphics; radiused corners.

1. Size: As indicated on Drawings.
2. Pictograph: International symbol for accessibility; minimum 6 inches high field.
3. Colors:
 - a. Background: Blue to match Federal Standard 595B color #15090.
 - b. Text and Pictograph: White.
4. Location: Mounted on glass adjacent to latch side centered 48 inches above floor.
5. Quantity: 1 required for each primary building entrance.

2.3 PLASTIC PLAQUES

- A. Plaques with Raised Tactile Characters:

1. Room Identification Signs: Unframed plaque with raised tactile pictographs and text and Grade 2 Braille; minimum 1/8 inch thick; flat planar face; square corners; square edges.

- a. Sizes: As indicated on Drawings.
 - b. Text: Sans serif letters and Grade 2 Braille; minimum 5/8 inch high to maximum 2 inch high letters; letter font to be determined; exact letter size, wording and arrangement as indicated on Drawings.
 - c. Pictographs: International symbols and combinations of symbols; minimum 6 inch high field; exact symbols, combinations, heights and arrangements as indicated on Drawings.
 - d. Colors:
 - 1) Text and Pictographs: Custom color to be determined.
 - 2) Background: Contrasting custom color to be determined.
 - e. Locations: On wall within 18 inches of latch side of doors centered 60 inches above floor unless otherwise indicated on Drawings.
 - f. Quantity: As indicated on Drawings.
2. Tactile Exit Signs: Unframed plaque with raised tactile text and Grade 2 Braille; minimum 1/8 inch thick; flat planar face; square corners; square edges.
- a. Sizes: As indicated on Drawings.
 - b. Text: Sans serif letters and Grade 2 Braille; minimum 5/8 inch high to maximum 2 inch high letters; letter font to be determined; exact letter size, wording and arrangements as indicated on Drawings.
 - c. Colors:
 - 1) Text: Custom color to be determined.
 - 2) Background: Contrasting custom color to be determined.
 - d. Locations: On wall within 18 inches of latch side of doors centered 60 inches above floor unless otherwise indicated on drawings.
 - e. Quantity: 1 required at each grade level exterior exit and at each exit above and below first floor into stair, exit enclosure, exit passageway, corridor or hall requiring visual exit signs and horizontal exits.
3. Area of Refuge Identification Signs: Unframed plaque with raised tactile pictograms and text and Grade 2 Braille; minimum 1/8 inch thick; flat planar face; square corners; square edges.
- a. Size: As indicated on Drawings.

- b. Text: Sans serif letters and Grade 2 Braille; minimum 5/8 inch high to 2 inch high letters; letter font to be determined; exact size, wording and arrangement as indicated on Drawings.
- c. Pictograms: International symbol of accessibility; minimum 6 inch high field; exact symbol height and arrangement as indicated on Drawings.
- d. Colors:
 - 1) Text and Pictogram: Custom color to be determined.
 - 2) Background: Contrasting custom color to be determined.
- e. Locations: As indicated on Drawings.
- f. Quantity: As indicated on Drawings.

B. Plaques with Subsurface Graphics

- 1. Toilet Door Signs for Visually Impaired: Unframed plaque with sub-surface graphics; 1/8 inch thick clear non-glare acrylic with sign color transferred to second surface laminated to 1/8 inch thick base plate; flat planar face; 1/8 inch diameter eased edges and corners.
 - a. Sizes and Shapes:
 - 1) Men's Toilets: 1/4 inch thick equilateral triangle with 12 inch sides; vertex of triangle pointing upward.
 - 2) Women's Toilets: 1/4 inch thick circle with 12 inch diameter.
 - b. Pictograph: International symbol for accessibility; minimum 6 inches high field; exact height as indicated on Drawings.
 - c. Colors:
 - 1) Pictograph: Custom color to be determined.
 - 2) Background: Contrasting custom color to be determined.
 - d. Locations: On door equidistant between jambs centered 60 inches above floor.
 - e. Quantity: 1 required for each public toilet.
- 2. Room Capacity Load Signs: Unframed plaque with subsurface graphics; minimum 1/8 inch thick; flat planar face; square corners; square edges.
 - a. Size: As indicated on Drawings.

- b. Text: Sans serif letters; minimum 5/8 inch high to maximum 2 inch high letters; letter font to be determined; exact letter size, wording and arrangement as indicated on Drawings. Exact number of occupants for each room to be provided by Architect.
 - c. Colors:
 - 1) Text: Custom color to be determined.
 - 2) Background: Contrasting custom color to be determined.
 - d. Locations: As directed by Architect.
 - e. Quantity: As indicated on Drawings.
3. Elevator Use Limits Signs: Unframed plaque with raised tactile text; minimum 1/8 inch thick; flat planar face; square corners; square edges.
- a. Size: As indicated on Drawings.
 - b. Text: Sans serif letters; minimum 5/8 inch high to maximum 2 inch high letters; letter font to be determined; exact letter size, wording and arrangement as indicated on Drawings.
 - c. Colors:
 - 1) Text and Pictographs: Custom colors to be determined.
 - 2) Background: Contrasting custom color to be determined.
 - d. Locations: Wall adjacent to elevator call buttons at landings above first floor.
 - e. Quantity: 1 for each elevator landing above first floor.
4. Assistive Listening Availability Signs: Unframed plaque with raised tactile text; minimum 1/8 inch thick; flat planar face; square corners; square edges.
- a. Size: As indicated on Drawings.
 - b. Pictograph: International Symbol of Access for Hearing Loss; minimum 6 inches high field, exact size as indicated on Drawings.
 - c. Text: Sans serif letters; minimum 5/8 inch high to maximum 2 inch high letters; letter font to be determined; exact letter size, wording and arrangement as indicated on Drawings.
 - c. Colors:

- 1) Text and Pictographs: Custom colors to be determined.
- 2) Background: Contrasting custom color to determined.
- d. Locations: As indicated on Drawings.
- e. Quantity: 1 required for each assembly area, conference room and meeting room.

2.4 DIMENSIONAL LETTER SIGNS

- A. Building Identification: Water jet cut stainless steel dimensional letters and numbers; flat face; projected mounting with threaded studs and pre-cut spacers; brushed finish.
 1. Letter Style: To be determined.
 2. Letter Size:
 - a. Height: 12 inches.
 - b. Depth: 1/2 inch.
 3. Text: Wording and arrangement indicated on Drawings.
 4. Locations: As indicated on Drawings.
 5. Quantities: To be determined.

2.5 ACCESSORIES

- A. Mounting Hardware:
 1. Pole Mounted Signs:
 - a. Saddles: High tensile aluminum alloy extrusions to fit specified pipe size; curved serrated face on pipe side; flat plate on sign side.
 - b. Bolts: Zinc plated steel carriage bolts with zinc die cast adapter rings, nylon washers, and zinc die cast vandal proof nuts.
 2. Wall and Door Mounted Plates and Plaques:
 - a. Mechanical Fasteners:
 - 1) To Framed Walls: Non-corrosive stainless steel or cadmium plated steel screws; torx or square drive pan heads; length sufficient to penetrate through first metal framing surface minimum 1/4 inch.

- 2) To Concrete and Masonry: Stainless steel sleeve type expansion anchors; bolt head; length sufficient for minimum 1 inch embedment into concrete and masonry.
 - 3) To Doors: Non-corrosive stainless steel or cadmium plated steel screws; torx or square drive pan heads; length sufficient to penetrate through first sheet steel surface minimum 1/4 inch.
 - b. Adhesives:
 - 1) Mounting Adhesive: High bond silicone type adhesive recommended by sign manufacturer for sign material and substrate; VOC content not to exceed limits established by South Coast Air Quality Management District Rule #1168.
 - 2) Foam Tape: Double-faced pressure sensitive vinyl foam tape; 1/32 inch thick.
- 2. Dimensional Letters:
 - a. Studs: Stainless steel all-thread bolts.
 - b. Spacers: Manufacturer's standard non-corrosive type.
 - c. Adhesive: Epoxy type formulated for bonding stainless steel to cementitious materials.
- B. Pipe: ASTM A53, Grade B, Schedule 40; galvanized steel; 2 inch inside diameter.
- C. Pipe Fittings: Aluminum press-on type; 0.040 inch thick to fit 2 inch inside diameter pipe; hemispherical top.
- D. Concrete: Mixed and proportioned in accordance with ASTM C94; maximum 3 inch slump; 4 to 6 percent air entrainment; minimum 2500 psi compressive strength at 28 days; refer to Section 03 30 00 for additional requirements.

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 grades in vicinity of pole mounted signs are correct and soil is properly compacted and ready for excavation.

- C. Verify that painting of surfaces to receive wall and door mounted signs is complete and surfaces are ready to receive work.
- D. Verify that surfaces are true and free from foreign matter and projections.
- E. Verify that receiving dimensions are correct.
- F. Do not proceed with work until unsatisfactory conditions are corrected.

3.2 PREPARATION

- A. Protect adjacent work from damage during installation of work of this section. Replace damaged areas or repair to equal their original conditions.
- B. Verify exact sign locations with Architect minimum 1 week prior to installation.

3.3 INSTALLATION

- A. Install signs in accordance with final reviewed shop drawings and with manufacturer's instructions and recommendations except where more restrictive requirements are specified in this section.
- B. Install signs plumb, level, in alignment and plane without warp and rack. Anchor securely in place.
- C. Pole Mounted Signs:
 - 1. Set posts plumb in minimum 12 inch diameter concrete footings with top of footing 6 inches below finish grade and bottom of footing minimum 40 inches below finished grade except where otherwise indicated on Drawings. Slope top of concrete for water runoff. Cap top of pipe.
 - 2. Secure signs to posts with saddles and vandal proof nuts. Provide back to back signs where indicated on Drawings.
 - 3. Install pole mounted parking control signs with bottom of sign minimum 80 inches above finished grade except where otherwise indicated on Drawings. Install lower sign in 2 sign assemblies with bottom 80 inches above grade and with bottom of upper sign within 1 inch of top of lower sign.
 - 4. Install pole mounted way finding signs with bottom of sign maximum 27 inches above finished grade except where other indicated on Drawings.
- D. Decals:
 - 1. Install door mounted decals after glass has been cleaned.
 - 2. Apply decals to inside face of glass.

E. Wall and Door Mounted Plates and Plaques:

1. Install wall and door mounted signs after substrate surfaces are painted and finished.
2. Secure signs to metal gates with mechanical fasteners.
3. Secure other signs with double faced tape adhesive; hold signs in place with foam tape until adhesive is fully cured.

F. Dimensional Letters:

1. Layout dimensional letter signs and drill holes for fasteners using full-size templates.
2. Secure in place with studs attached to backs of letters and set in drilled holes in walls with adhesive.

3.4 CLEANING

- A. Clean exposed surfaces using manufacturer's printed instructions recommending materials and methods to be used. Remove and replace work which cannot be successfully cleaned.
- B. Touch up damaged coatings and finishes. Eliminate visible evidence of repair.

3.5 PROTECTION

- A. Provide temporary protection during course of work and immediately after completion to ensure work is not damaged and deteriorated at time of final acceptance.
- B. Remove temporary protection and re-clean as necessary immediately prior to final inspection.

END OF SECTION

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SECTION 10441
FIRE EXTINGUISHER CABINETS

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. Fire protection cabinets for the following:
 - a. Portable fire extinguishers.
- B. Related Sections:
 - 1. Section 09900 "Paints and Coatings" for field painting fire protection cabinets.
 - 3. Section 10451 "Fire Extinguishers."

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for fire protection cabinets.
 - 1. Fire Protection Cabinets: Include roughing-in dimensions, details showing mounting methods, relationships of box and trim to surrounding construction, door hardware, cabinet type, trim style, and panel style.
 - 2. Show location of knockouts for hose valves.
- B. Shop Drawings: For fire protection cabinets. Include plans, elevations, sections, details, and attachments to other work.
- C. Samples for Initial Selection: For each type of fire protection cabinet indicated.
- D. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below:
 - 1. Size: 6 by 6 inches (150 by 150 mm) square.

- E. Product Schedule: For fire protection cabinets. Coordinate final fire protection cabinet schedule with fire extinguisher schedule to ensure proper fit and function. Use same designations indicated on Drawings.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For fire protection cabinets to include in maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Fire-Rated, Fire Protection Cabinets: Listed and labeled to comply with requirements in ASTM E 814 for fire-resistance rating of walls where they are installed.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Pre-installation Conference: Conduct conference at Project site.
 - 1. Review methods and procedures related to fire protection cabinets including, but not limited to, the following:
 - a. Schedules and coordination requirements.

1.6 COORDINATION

- A. Coordinate size of fire protection cabinets to ensure that type and capacity of fire extinguishers indicated are accommodated.
- B. Coordinate size of fire protection cabinets to ensure that type and capacity of fire hoses, hose valves, and hose racks indicated are accommodated.
- C. Coordinate sizes and locations of fire protection cabinets with wall depths.

1.7 SEQUENCING

- A. Apply decals on field-painted, fire protection cabinets after painting is complete.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B.

- B. Aluminum: Alloy and temper recommended by aluminum producer and manufacturer for type of use and finish indicated, and as follows:
 - 1. Sheet: ASTM B 209 (ASTM B 209M).
 - 2. Extruded Shapes: ASTM B 221 (ASTM B 221M).
- C. Stainless-Steel Sheet: ASTM A 666, Type 304.
- D. Copper-Alloy Brass Sheet: ASTM B 36/B 36M, alloy UNS No. C26000 (cartridge brass, 70 percent copper).
- E. Copper-Alloy Bronze Sheet: ASTM B 36/B 36M, alloy UNS No. C28000 (muntz metal, 60 percent copper).
- F. Clear Float Glass: ASTM C 1036, Type I, Class 1, Quality q3, 6 mm thick.
- G. Tempered Float Glass: ASTM C 1048, Kind FT, Condition A, Type I, Quality q3, 3 mm thick, Class 1 (clear).
- H. Break Glass: Clear annealed float glass, ASTM C 1036, Type I, Class 1, Quality q3, 1.5 mm thick, single strength.
- I. Tempered Break Glass: ASTM C 1048, Kind FT, Condition A, Type I, Quality q3, 1.5 mm thick.
- J. Wire Glass: ASTM C 1036, Type II, Class 1, Form 1, Quality q8, Mesh m1 (diamond), 6 mm thick.
- K. Transparent Acrylic Sheet: ASTM D 4802, Category A-1 (cell-cast sheet), 6 mm thick, with Finish 1 (smooth or polished).
- L. Acrylic Bubble: One piece.

2.2 FIRE PROTECTION CABINET

- A. Cabinet Type: Suitable for fire extinguisher.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Fire End & Croker Corporation.
 - b. J. L. Industries, Inc., a division of Activar Construction Products Group.
 - c. Kidde Residential and Commercial Division, Subsidiary of Kidde plc.
 - d. Larsen's Manufacturing Company.
 - e. Modern Metal Products, Division of Technico Inc..
 - f. Moon-American.
 - g. Potter Roemer LLC; Cabinet 7120.
 - h. Watrous Division, American Specialties, Inc..

- B. Cabinet Construction: Nonrated.
- C. Cabinet Material: Steel sheet.
 - 1. Shelf: Same metal and finish as cabinet.
- D. Retain one of first three paragraphs below.
- E. Semi-recessed Cabinet: Cabinet box partially recessed in walls of sufficient depth to suit style of trim indicated; with one-piece combination trim and perimeter door frame overlapping surrounding wall surface with exposed trim face and wall return at outer edge (backbend). Provide where walls are of insufficient depth for recessed cabinets but are of sufficient depth to accommodate semirecessed cabinet installation.
 - 1. Square-Edge Trim: 1-1/4- to 1-1/2-inch (32- to 38-mm) backbend depth.
- F. Cabinet Trim Material: Steel sheet.
- G. Door Material: Steel sheet.
- H. Door Style: Fully glazed panel with frame.
- I. Door Glazing: Tempered break glass.
- J. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.
 - 1. Provide projecting lever handle with cam-action latch.
 - 2. Provide continuous hinge, of same material and finish as trim, permitting door to open 180 degrees.
- K. Accessories:
 - 1. Mounting Bracket: Manufacturer's standard steel, designed to secure fire extinguisher to fire protection cabinet, of sizes required for types and capacities of fire extinguishers indicated, with plated or baked-enamel finish.
 - 2. Break-Glass Strike: Manufacturer's standard metal strike, complete with chain and mounting clip, secured to cabinet.
 - 3. Lettered Door Handle: One-piece, cast-iron door handle with the word "FIRE" embossed into face.
 - 4. Door Lock: Cylinder lock, keyed alike to other cabinets.
 - 5. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as directed by Architect.
 - a. Identify fire extinguisher in fire protection cabinet with the words "FIRE EXTINGUISHER."
 - 1) Location: Applied to cabinet door.
 - 2) Application Process: Decals.

- 3) Lettering Color: Red.
- 4) Orientation: Vertical.

L. Finishes:

1. Manufacturer's standard baked-enamel paint for the following:
 - a. Exterior of cabinet , door, and trim except for those surfaces indicated to receive another finish.
 - b. Interior of cabinet and door.
2. Steel: Baked enamel or powder coat.

2.3 FABRICATION

- A. Fire Protection Cabinets: Provide manufacturer's standard box (tub) with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated.
1. Weld joints and grind smooth.
 2. Provide factory-drilled mounting holes.
 3. Prepare doors and frames to receive locks.
 4. Install door locks at factory.
- B. Cabinet Doors: Fabricate doors according to manufacturer's standards, from materials indicated and coordinated with cabinet types and trim styles selected.
1. Fabricate door frames with tubular stiles and rails and hollow-metal design, minimum 1/2 inch (13 mm) thick.
 2. Fabricate door frames of one-piece construction with edges flanged.
 3. Miter and weld perimeter door frames.
- C. Cabinet Trim: Fabricate cabinet trim in one piece with corners mitered, welded, and ground smooth.

2.4 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces of fire protection cabinets from damage by applying a strippable, temporary protective covering before shipping.
- C. Finish fire protection cabinets after assembly.
- D. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.5 STEEL FINISHES

- A. Surface Preparation: Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning". After cleaning, apply a conversion coating suited to the organic coating to be applied over it.
- B. Baked-Enamel or Powder-Coat Finish: Immediately after cleaning and pretreating, apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat. Comply with coating manufacturer's written instructions for applying and baking to achieve a minimum dry film thickness of 2 mils (0.05 mm).
 - 1. Color and Gloss: As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine walls and partitions for suitable framing depth and blocking where semi-recessed cabinets will be installed.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Prepare recesses for semi-recessed fire protection cabinets as required by type and size of cabinet and trim style.

3.3 INSTALLATION

- A. General: Install fire protection cabinets in locations and at mounting heights indicated or, if not indicated, at heights acceptable to authorities having jurisdiction.
 - 1. Fire Protection Cabinets: 54 inches (1372 mm) above finished floor to top of cabinet.
- B. Fire Protection Cabinets: Fasten cabinets to structure, square and plumb.
 - 1. Unless otherwise indicated, provide recessed fire protection cabinets. If wall thickness is not adequate for recessed cabinets, provide semirecessed fire protection cabinets.
 - 2. Provide inside latch and lock for break-glass panels.
 - 3. Fasten mounting brackets to inside surface of fire protection cabinets, square and plumb.
- C. Identification: Apply decals at locations indicated.

3.4 ADJUSTING AND CLEANING

- A. Remove temporary protective coverings and strippable films, if any, as fire protection cabinets are installed unless otherwise indicated in manufacturer's written installation instructions.
- B. Adjust fire protection cabinet doors to operate easily without binding. Verify that integral locking devices operate properly.
- C. On completion of fire protection cabinet installation, clean interior and exterior surfaces as recommended by manufacturer.
- D. Touch up marred finishes, or replace fire protection cabinets that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by fire protection cabinet and mounting bracket manufacturers.
- E. Replace fire protection cabinets that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION

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SECTION 10451
FIRE EXTINGUISHERS

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 portable, hand-carried fire extinguishers.
- B. Related Sections:
 - 1. Section 10441 "Fire Extinguisher Cabinets."

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include rating and classification, material descriptions, dimensions of individual components and profiles, and finishes for fire extinguisher.
- B. Product Schedule: For fire extinguishers. Coordinate final fire extinguisher schedule with fire protection cabinet schedule to ensure proper fit and function. Use same designations indicated on Drawings.

1.4 INFORMATIONAL SUBMITTALS

- A. Warranty: Sample of special warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For fire extinguishers to include in maintenance manuals.

1.6 QUALITY ASSURANCE

- A. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Portable Fire Extinguishers."
- B. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.
 - 1. Provide fire extinguishers approved, listed, and labeled by FMG.
- C. Preinstallation Conference: Conduct conference at Project site.
 - 1. Review methods and procedures related to fire extinguishers including, but not limited to, the following:
 - a. Schedules and coordination requirements.

1.7 COORDINATION

- A. Coordinate type and capacity of fire extinguishers with fire protection cabinets to ensure fit and function.

1.8 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace fire extinguishers that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Failure of hydrostatic test according to NFPA 10.
 - b. Faulty operation of valves or release levers.
 - 2. Warranty Period: Six years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PORTABLE, HAND-CARRIED FIRE EXTINGUISHERS

- A. Fire Extinguishers: Type, size, and capacity for each fire protection cabinet indicated.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

- a. Amerex Corporation.
 - b. Ansul Incorporated; Tyco International Ltd.
 - c. Badger Fire Protection; a Kidde company.
 - d. Buckeye Fire Equipment Company.
 - e. Fire End & Croker Corporation.
 - f. J. L. Industries, Inc.; a division of Activar Construction Products Group.
 - g. Kidde Residential and Commercial Division; Subsidiary of Kidde plc.
 - h. Larsen's Manufacturing Company.
 - i. Moon-American.
 - j. Pem All Fire Extinguisher Corp.; a division of PEM Systems, Inc.
 - k. Potter Roemer LLC.
 - l. Pyro-Chem; Tyco Safety Products.
3. Valves: Manufacturer's standard.
 4. Handles and Levers: Stainless steel.
 5. Instruction Labels: Include pictorial marking system complying with NFPA 10, Appendix B and bar coding for documenting fire extinguisher location, inspections, maintenance, and recharging.
- B. Multipurpose Dry-Chemical Type in Steel Container: UL-rated 2-A:10-B:C, 5-lb (2.3-kg) nominal capacity, with monoammonium phosphate-based dry chemical in enameled-steel container.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine fire extinguishers for proper charging and tagging.
 1. Remove and replace damaged, defective, or undercharged fire extinguishers.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Install fire extinguishers in locations indicated and in compliance with requirements of authorities having jurisdiction.

END OF SECTION

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SECTION 10671
METAL STORAGE SHELVING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Manufactured modular steel storage shelving.

1.2 RELATED SECTIONS

- A. Section 09110 - Non-Load Bearing Metal Framing: Support framing and backing in interior partitions.

1.3 REFERENCES

- A. CBC California Building Code, 2010 edition.

1.4 DESIGN REQUIREMENTS

- A. Shelf Load Capacity: Minimum 600 pounds per shelf.
- B. Sustainable Design Requirements: Steel used in work of this section is intended to contribute to meeting requirements for recycled content outlined in LEED™-NC 2009 Credit MR4.1.

1.5 SUBMITTALS

- A. Shop Drawings: Indicate shelving layout with components, elevations; component details; anchorage and bracing details; overall dimensions for installation.
- B. Product Data: Provide data on components and accessories. Include shelf load capacities.
- C. Samples: Submit samples, minimum 3 x 6 inches in size, of factory finish applied to steel substrate illustrating specified color and sheen.
- D. Manufacturer's Installation Instructions: Indicate special preparation criteria and sequence of installation.
- 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. Submit hard copies of completed Online Documentation required for LEED™ MR Credit 4.1.

1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacture of steel storage shelving of type specified in this section with minimum 10 years documented experience.
- B. Installer: Company specializing in installation of steel storage shelving of type specified in this section with minimum 3 years documented experience.

1.7 REGULATORY REQUIREMENTS

- A. Comply with requirements of CBC Chapter 16.

1.8 DELIVERY, STORAGE AND HANDLING

- A. Deliver products to site, store, handle and protect in accordance with manufacturer's instructions and recommendations.
- B. Pack and ship products in manner to prevent damage.
- C. Do not accept or install damaged products at site.

1.9 FIELD MEASUREMENTS

- A. Verify that field measurements are as indicated on shop drawings.

1.10 COORDINATION

- A. Coordinate installation of shelving with installation of flooring and painting. Do not install shelving until flooring and painting are complete.

1.11 EXTRA MATERIALS

- A. Deliver 100 additional shelf clips to Owner. Wrap and label to identify type and locations installed. Obtain receipt upon delivery.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Lyon Metal Products, Inc.: 8000 Series Stand Alone Offset Angle Shelving.
- B. Manufacturer Offering Acceptable Equivalent Product: Penco Products, Inc.
- C. Substitutions: Under provisions of Division 1.

2.2 COMPONENTS

- A. Offset Angle Uprights: 13 gauge hot- rolled formed steel 1 x 2-3/8 inch offset angles; punched on 1-1/2 inch centers with pairs of parallel slots with 11/32 inch diameter hole to receive bolts for accessories and anchors; end of each slot embossed to ensure clip fit.
- B. Shelf Clips: 12 gauge hot-rolled steel; one-piece construction; four required to install each shelf.
- C. Shelves: 22 gauge roll formed sheet steel with front and rear flanges boxed not less than 1-11/64 inch x 27/32 inch x 1-1/8 inch with 9/16 inch return flange spot welded to broom surface of shelf; 10 degree bend in center of 27/32 inch portion of box; front and rear flanges punched to accept bin fronts, label holders and accessories; ends flanged not less than 1-11/64 inch with 90 degree return flange not less than 5/8 inch; corners lapped and welded; shelves punches at 3 inch centers for divider attachment; front and rear flanges embossed with "22 GA"; Lyon Type "A" Medium Duty Industrial Shelves with Box "W" formation.
- D. Cross Braces: 1 inch x 12 gauge band formed steel; punched at each end to bolt to uprights.

2.3 FABRICATION

- A. Fabricate steel storage shelving as stand alone units with open uprights and open backs for single row installation against framed partitions.
- B. Fabricate with interchangeable parts.
- C. Fabricate units 24 inches deep x 48 inches wide x 84 inches high with 5 shelves per unit including top and bottom shelves.
- D. Fabricate shelves permitting bolt attachment of upper and lower shelves and clip attachment of intermediate shelves.
- E. Provide lateral cross bracing at uprights and backs. Provide 1 pair braces at each upright and 1 pair at back of each cabinet.
- F. Provide pins and clips required for assembling components.

2.4 FINISHES

- A. Exposed Steel Surfaces: Factory applied enamel; color to be determined.
 - 1. Preparation: Clean and treat surfaces with detergent/iron phosphate coating. Rinse with cold water. Seal with non-chrome treatment.
 - 2. Electrostatically apply modified epoxy primer.

3. Electrostatically apply high solids polyester paint finish coat.

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 support framing and backing have been installed and are properly located and secured.
- C. Verify that wall and ceiling finishes are installed and cured.
- D. Do not begin installation until unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean substrate surfaces. Ensure surfaces are dust and dirt free.
- B. Protect elements surrounding work of this section from damage or disfiguration.

3.3 INSTALLATION

- A. Assemble and install steel storage shelving in accordance with final reviewed shop drawings and manufacturer's instructions and recommendations.
- B. Install components plumb and level, accurately fitted and free from distortion or defects.
- C. Assemble units with top and bottom shelves secured to uprights with nuts and bolts.
- D. Set intermediate shelves evenly spaced.
- E. Secure shelving units to walls.
- F. After installation, touch up scratched and damaged surfaces to match factory finish.

3.4 ERECTION TOLERANCES

- A. Maximum Variation from Plumb or Level: 1/4 inch.
- B. Maximum Misalignment from True Position: 1/4 inch.

3.5 CLEANING

- A. Remove labels and manufacturer's temporary marks.
- B. Clean surfaces of shelving using products and tools recommended by shelving manufacturer.

END OF SECTION

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SECTION 12241
ROLLER WINDOW SHADES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Manually operated single roller sunscreen window shades.

1.2 RELATED SECTIONS

- A. Section 06100 – Rough Carpentry: Blocking and grounds for mounting roller shades and accessories; framing for shade pockets.
- B. Section 08911- Glazed Aluminum Curtain Wall: Aluminum glazed lite frames.
- C. Section 09250 - Gypsum Board: Adjacent ceiling finish.
- D. Section 09511 - Acoustical Panel Ceilings: Adjacent ceiling finish.

1.3 REFERENCES

- A. ASTM G21 - Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.
- B. CEC - California Electric Code, 2010 edition.
- C. NFPA 701 - Methods of Fire Tests for Flame-Resistant Textiles and Films.

1.4 SYSTEM DESCRIPTION

- A. Manually Operated Single Roller Sunscreen Window Shades: Manual chain drive operated sun control roller shades complete with related mounting systems and accessories for recessed mounting into suspended acoustical ceilings and for surface mounting to walls.

1.5 DESIGN REQUIREMENTS

- A. Sustainable Design Requirements:
 - 1. Steel and aluminum used in work of this section are intended to contribute to meeting requirements for recycled content outlined in LEED™-NC3.0 Credit MR4.
 - 2. Refer to Division 1 LEED Requirements section for detailed sustainable design requirements.

1.6 SUBMITTALS

- A. Shop Drawings: Indicate shade locations, control locations, opening sizes, tolerances required, details of mounting and method of attachment, operational clearances, conditions between adjacent shades and relationship to adjacent work.
 - 1. Include plans, elevations, sections and details.
 - 2. Include window treatment schedule listing each shade using same room designations as indicated on Drawings with opening sizes and key to typical mounting details.
- B. Product Data: Submit manufacturer's product data sheets, specifications, performance data, and physical properties for each item specified.
 - 1. Shadecloth: Provide additional data including size limitations, fire-resistance information, and toxicity information.
 - 2. Warranty: Include manufacturer's proposed warranty defining terms, conditions, and time periods for warranty coverage.
- C. Samples:
 - 1. Shadecloth: Submit samples, minimum 2 x 4 inches in size, illustrating material, weave and color of each specified shade cloth.
 - 2. Baked Enamel Finish: Submit samples, minimum 1 x 1 inch in size, illustrating manufacturer's standard colors for Architect's selection.
- D. Manufacturer's Installation Instructions: Submit manufacturer's printed installation instructions for each item specified. Include preparation instructions and recommendations.
- E. Manufacturer's Certifications:
 - 1. Compliance with Contract Documents: Certify compliance with requirements of specification including statement that specified warranties will be provided without restriction.
 - 2. Code Compliance: Certify that materials proposed for use comply with applicable building codes and environmental regulations.
 - 3. Installer Approval: Certify that installer is and approved installer of manufacturer.
 - 4. Environmental Certifications: Submit recycling characteristics and perpetual use certifications with third party evaluation for solar shadebands.

- a. Recycling Characteristics:
 - 1) Provide documentation that shade cloth can and is part of closed loop of perpetual use and not required to be down cycled, incinerated or otherwise thrown away.
 - 2) Provide documentation that scrap material can be sent back to mill for processing and recycling into same quality yarn and woven into new material without down cycling.
 - 3) Certify that this process is currently underway and will be utilized for this project.
 - b. Perpetual Use Certification: Certify that, at end of useful life of shade cloth, shade cloth material can be sent back to manufacture for recapture as part of closed loop of perpetual use and that shade cloth material can and will be reconstituted into new yarn for weaving into new shade cloth. Provide information on each shade band indicating that shade band can be sent back to manufacturer for this purpose.
 - c. Third Party Evaluation: Provide documentation stating that shade cloth had undergone third party evaluation for chemical inputs down to scale of 100 parts per million that have been evaluated for human and environmental safety.
 - 1) Identify inputs which have been known to be carcinogenic, mutagenic, teratogenic, reproductively toxic and endocrine disrupting.
 - 2) Identify items that are toxic to aquatic systems, contain heavy metals and organohalogens.
 - 3) Shade cloth material shall contain no inputs that are known problems to human and environmental health per major criteria cited above except for input required to meet local fire codes.
- F. LEED Documentation: Refer to and comply with LEED submittal requirements specified in Division 1 "LEED Requirements" section. Provide additional information required by that section for stipulated LEED credit in addition to that listed below.

1. Steel: Submit letter or product data from manufacturer indicating recycled content. Designate percentage by weight of post-consumer and post-industrial recycled content. Include statement indicating cost for each product having recycled content.
2. Aluminum: Submit letter or product data from manufacturer indicating recycled content. Designate percentage by weight of post-consumer and post-industrial recycled content. Include statement indicating cost for each product having recycled content.
3. Submit hard copies of completed Online Documentation required for LEED™ MR Credit 4.

1.7 OPERATION AND MAINTENANCE DATA

- A. Operation Data: Provide operating instructions for operating hardware and controls.
- B. Maintenance Data: Provide fabric maintenance data and recommended cleaning materials for shade cloth. Include stain removal methods.

1.8 QUALITY ASSURANCE

- A. Source Limitations: Work of this section to be performed by single manufacturer and their authorized installer with unity responsibility for design, engineering, submittals, field measurements, fabrication, installation and warranty for manual roller shade systems.
- B. Shade cloth:
 1. Fire-Test-Response Characteristics: Passes NFPA 701 small and large scale burn with materials tested identical to products proposed for use.
 2. Anti-Microbial Characteristics: "No Growth" when tested in accordance with ASTM G21 for fungi ATCC9542, ATCC9644 and ATCC9645.

1.9 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturer of commercial roller shades with minimum 20 years documented experience.
- B. Installer: Company specializing in installation of commercial roller shades with minimum 10 years documented experience and approved by manufacturer.

1.10 MOCK-UPS

- A. Construct mock-up of 1 full size window for each type manual window shade specified for evaluation of mounting, appearance and accessories.

- B. Locate where directed by Architect.
- C. Rework mock-up installations not meeting specified requirements as directed by Architect.
- D. Accepted mock-ups will establish minimum standard of quality and workmanship for window shade mounting, appearance and accessories.
- E. Retain accepted mock-ups in undisturbed condition until work of this section is complete.
- F. Incorporate accepted mock-ups as part of work.

1.11 DELIVERY, STORAGE AND HANDLING

- A. Deliver products to site, store, handle and protect in accordance with manufacturer's instructions and recommendations.
- B. Schedule delivery to prevent delays but minimize on-site storage.
- C. Do not deliver products to site until concrete, masonry, plaster, painting, and other wet work had been completed and is dry.
- D. Deliver products in factory-labeled packages marked with manufacture and product names, fire-test response characteristics and locations of installation using room designations indicated on Drawings.
- E. Store products in clean, dry area, laid flat and blocked off ground to prevent sagging, twisting or warping.
- F. Protect products from weather, direct sunlight, surface contamination, corrosion and damage from construction traffic or other causes.

1.12 ENVIRONMENTAL REQUIREMENTS

- A. Install roller shades after finish work including painting is complete and ambient temperature and humidity conditions are maintained at levels indicated for Project when occupied for its intended use.

1.13 FIELD MEASUREMENTS

- A. Take field measurements before preparation of shop drawings and fabrication to ensure proper fitting of window shade system.

1.14 COORDINATION

- A. Coordinate installation of shade pockets, closures and related accessories with installation of ceiling framing specified under Section 06 10 00 – Rough Carpentry and

with installation of adjacent ceilings specified under Section 09 29 00 - Gypsum Board and Section 09511 - Acoustical Panel Ceilings.

- B. Coordinate installation of surface mounted brackets with installation of wall framing specified under Section 06100 – Rough Carpentry and with installation of wall finish specified under Section 09250 - Gypsum Board.

1.15 WARRANTY

- A. Provide manufacturer's standard non-depreciating warranties for operating components and shade cloth.

1. Roller Shade Hardware and Chain: 25 year limited warranty.
2. Shade cloth: 10 year limited warranty.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. MechoShade Systems, Inc.: Mecho©/5 System.
- B. Substitutions: Under provisions of Division 1.

2.2 COMPONENTS

- A. Shade cloth: Visually transparent shade cloth; fabricated from TPO for both core yarn and jacket; single thickness; non-raveling 0.030 inch fabric thickness; 3 percent open; 96 inches wide; MechoShade Systems EuroTwill™ Reversible Weave 6000 Series; color #6006R Silver Birch."
- B. Shade Hardware: Configuration to allow for removal of shade roller tube from brackets without removing of hardware from opening and without requiring removal of end or center supports and to allow removal and reinstallation of shade bands without requiring removal of shade tube, drive or operating support brackets.
 1. Chain Drive Hardware and Brackets: Shade hardware system constructed of minimum 1/8 inch thick plated steel or heavier as required to support 150 percent of full weight of each shade; universal, regular and offset drive capacity allowing drive chain to fall at front, rear or offset for shade drive end brackets with universal offset adjustable for future change; allows for operation of multiple shade bands by single chain operator with connectors offset to ensure alignment of shade bands; provides positive mechanical engagement of drive mechanism to roller shade tube.

- a. Drive Bracket/Brake Assembly: Fully integrated with pockets, supports and connectors; mounted on steel support bracket fully independent of shade tube assembly; can be removed and reinstalled without affecting rolled shade limit adjustments.
 - 1) Sprocket and Brake Assembly: Rotates supported on welded 3/8 inch steel pin.
 - 2) Brake: Over-running clutch design which disengages to 90 percent during raising and lowering of shade; capable of withstanding 50 lb pull force in stopped position.
 - 3) Braking Mechanism: Permanently lubricated; applied to oil-impregnated hub on which brake system is mounted; oil-impregnated hub design includes articulated brake assembly for smooth operation of shades.
 - b. Drive Chain: #10 stainless steel; minimum 90 lb breaking strength.
2. Shade Rollers: Extruded aluminum tube; 6063-T6 aluminum alloy; diameter and wall thickness as required to support shade fabric without excessive deflection and to house motor; internal keyways to receive tubular motor; 2 integral fabric mounting channels configured to prevent fabric from disengaging from tube.
 3. Shade Mounting Splines: Extruded vinyl spline with asymmetrical insertion-locking channels and embossed fabric guide for use with specified shade roller; sufficient capacity to hold fabric and additional hem/batten weights without disengaging from shade roller; readily removable from shade roller without having to remove shade roller from mounting brackets.
 4. Shade Pockets: Extruded aluminum recessed pocket; 6063-T5 aluminum alloy; configured for flush placement against window wall; 1-piece with exposed flush mounted tile support and concealed closure mount; 5-15/32 inches wide x 5-1/4 inches high; available in continuous lengths up to 15 feet without seams or joints; standard "white" baked enamel finish; #4124 Recessed Pocket.
 5. Shade Pocket Closures: Extruded aluminum pocket closure assembly; 6063-T5 alloy; 3 inches wide x 1-1/8 inch high; standard "white" baked enamel finish; #UCLX 3015 AL WH.
 6. Fascia: Extruded aluminum continuous removable fascia; 6063-T5 alloy; configured to fully conceal brackets, shade roller and fabric on tube and to attach to shade mounting brackets without use of adhesives, magnetic strips or exposed fasteners; standard "colonial white" baked enamel finish; SnapLoc Fascia.

7. Fascia End Caps: Manufacturer's standard bracket/fascia end caps configured to fully conceal outside of roller shade brackets at surface mounted shades; standard "colonial white" baked enamel finish.
8. Hem Bar Weights for Solar Shades: Extruded aluminum bars; continuous single lengths; appropriate size and weight for shadeband; configured to concealing in fabric hem pocket; mill finish.

2.3 SHADE FABRICATION

- A. Fabricate shades to completely cover glazed openings.
 1. Fabricate pocket mounted shades to extend from ceiling to sill; fabricate surface mounted shades to extend from head to sill.
 2. Fabricate shade to extend from jamb to mullion, from mullion to mullion and from mullion to mullion with individual shadebands for each pane of glass.
- B. Fabricate shades with multiple shadebands over single mullioned windows within same space to be controlled by single chain operator. Do not multiband shades over:
 1. Glazed openings with single panes of glass.
 2. Portions of glazed openings in mullioned windows left with single pane of glass on 1 side of framed partition after installation of partition.
- C. Fabricate shades in single width with warp running vertically; fabricate without horizontal seams.
- D. Fabricate shadecloth to hang flat without buckling or distortion.
 1. Fabricate with heat-sealed trimmed edges to hang straight without curling or raveling.
 2. Fabricate unguided shadecloth to roll true and straight without shifting sideways more than 1/8 inch in either direction per 8 feet of shade height due to warp distortion or weave design.
 3. Fabricate hems to conceal hem bar weights; RF-weld pocket seams and ends.
- E. Provide battens of roll-formed stainless or tempered steel in shades as required for proper tracking and uniform rolling of shadebands. Ensure width-to-height ratios do not exceed manufacturer's standards.
 1. Roll form battens concave to match contour of roller tube.
 2. Conceal battens in totally opaque fabric pockets matching inside and outside colors of shadeband. Form pockets no more than 1-1/2 inches high; RF weld

batten pockets into shade cloth.

- F. Provide information on each solar shadeband indicating that shadeband material can be sent back to manufacturer for recapture as part of closed loop of perpetual use and that shade cloth material can and will be reconstituted into new yarn for weaving into new shade cloth.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine condition of substrate to determine acceptability for installation. Verify that substrate conditions are acceptable for product installation in accordance with manufacturer's instructions and recommendations.
- B. Verify that glazed openings are ready to receive work.
- C. Verify that support framing and backing has been installed and are properly located and secured.
- D. Do not begin installation until unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare surfaces using methods recommended by roller shade manufacturer for specific substrate under project conditions.

3.3 INSTALLATION

- A. Install roller shades in accordance with manufacturer's instructions and recommendations for type of mounting and operation required and in accordance with final reviewed shop drawings.
- B. Install roller shades level, plumb, square, true, and securely anchored in place with recommended hardware and accessories to provide smooth operation without binding. Locate so that shadeband is not closer than 2 inches to interior face of glass.
- C. Secure in place with concealed fasteners.

3.4 TOLERANCES

- A. Maximum Variation of Gap at Window Opening Perimeter: 1/4 inch (+/- 1/8 inch) per 8 feet of shade height.
- B. Maximum Offset from Level: 1/8 inch.

3.5 ADJUSTING

- A. Adjust and balance roller shades to operate smoothly, easily, safely and free from binding or malfunction throughout entire operational range.
- B. Adjust shade and fabric to hang flat without buckling or distortion. Replace units or components that do not hang properly or operate smoothly.
- C. Touch-up damaged finishes and repair minor damage in manner to eliminate evidence of repair. Remove and replace work that cannot be satisfactorily repaired.

3.6 CLEANING

- A. Clean exposed surfaces including metal and fabric using non-abrasive materials and methods recommended by shade manufacturer. Replace work that cannot be satisfactorily cleaned.

3.7 DEMONSTRATION

- A. Engage factory-trained service representative to train Owner's designated personnel to properly operate, adjust, and maintain roller shade system.
- B. Conduct demonstration and training on project site.
- C. Allow minimum 6 hours duration for demonstration and training.

3.8 PROTECTION OF INSTALLED WORK

- A. Protect installed products until completion of project.
- B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION

SECTION 15010

BASIC MECHANICAL REQUIREMENTS

PART 1 - GENERAL

1.1 SCOPE

- A. Basic mechanical requirements specifically applicable to Division 15 Sections.
- B. Work includes but is not necessarily limited to the following:
 - 1. Labor, materials, services, equipment, and appliances required for completion of tasks as indicated on drawing or in specification or as inherently necessary to prepare spaces and systems for new installations as follows;
 - a. Heating, ventilating and air conditioning systems and equipment
 - b. Plumbing systems and equipment
 - c. Testing, adjusting and balancing

1.2 DRAWINGS AND SPECIFICATIONS

- A. Drawings accompanying these Specifications show intent of Work to be done. Specifications shall identify quality and grade of installation and where equipment and hardware is not particularly specified, Contractor shall provide submittals for all products and install them per manufacturers' recommendations, and in a first class manner.
- B. Examine Drawings and Specifications for elements in connection with this Work; determine existing and new general construction conditions and be familiar with all limitations caused by such conditions.
- C. Plans are intended to show general arrangement and extent of Work contemplated. Exact location and arrangement of parts shall be determined after the University has approved equipment, as Work progresses, to conform in best possible manner with surroundings, and as directed by the University's Representative.
- D. Contract Documents are in part diagrammatic and intended to show the scope and general arrangement of the Work under this Contract. The Contractor shall follow these drawings in laying out the equipment, piping and ductwork. Drawings are not intended to be scaled for roughing in measurements or to serve as shop drawings. Where job conditions require minor changes or adjustments in the indicated locations or arrangement of the Work, such changes shall be made without change in the Contract amount.
- E. Follow dimensions without regard to scale. Where no figures or notations are given, the Plans shall be followed.

1.3 UTILITIES

- A. Location and sizes of electrical, mechanical and plumbing service facilities are shown in accordance with data secured from existing record drawings and site observations. Data shown are offered as an estimating guide without guarantee of accuracy. Check and verify all data given, and verify exact location of all utility services pertaining to Work prior to excavation or performing Work.

1.4 UNIVERSITY FURNISHED PRODUCTS

- A. Unless noted otherwise, all items shall be furnished by the Contractor for a complete and operational installation.

1.5 APPLICABLE REFERENCE STANDARDS, CODES AND REGULATIONS:

- A. Meet requirements of all state codes having jurisdiction.
- B. State of California Code of Regulations:
 - 1. Title 8, Industrial Relations
 - 2. Title 19, State Fire Marshal Regulations
 - 3. 2010 California Building Code (CBC), Title 24, Part 2
 - 4. 2010 California Electrical Code, Title 24, Part 3
 - 5. 2010 California Mechanical Code, Title 24, Part 4
 - 6. 2010 California Plumbing Code, Title 24, Part 5
 - 7. 2010 California Fire Code, Title 24, Part 9
 - 8. 2010 California Standards Code, Title 24, Part 12
 - 9. 2008 California Energy Commission Building Energy Efficiency Standards
- C. Additional Referenced Standards:
 - 1. AABC Associated Air Balance Council
 - 2. AMCA Air Moving and Conditioning Association
 - 3. ARI Air-Conditioning and Refrigeration Institute
 - 4. ASHRAE American Society of Heating, Refrigeration and Air Conditioning Engineers
 - 5. ASME American Society of Mechanical Engineers
 - 6. ASTM American Society for Testing and Materials.
 - 7. NEMA National Electrical Manufacturer's Association
 - 8. NFPA National Fire Protection Association Standards
 - 9. PDI Plumbing and Drainage Institute.
 - 10. UL Underwriters Laboratories, Inc.
- D. Codes and ordinances having jurisdiction over Work are minimum requirements; but, if Contract Documents indicate requirements which are in excess of those minimum requirements, then requirements of the Contract Documents shall be followed. Should there be any conflicts between Contract Documents or codes or any ordinances having jurisdiction, report these to the University's Representative.
- E. Obtain permits, and request inspections from authority having jurisdiction.

1.6 PROJECT/SITE CONDITIONS

- A. The arrangement of and connection to equipment shown on the drawings is based upon information available and is not intended to show exact dimensions peculiar to a specific manufacturer. The Drawings are, in part, diagrammatic and some features of the illustrated equipment installations may require revision to meet actual equipment installation requirements. Structural supports, housekeeping pads, piping connections and adjacent equipment may have to be altered to accommodate the equipment provided. No additional payment will be made for such revisions or alterations.
- B. Examine all Drawings and Specifications to be fully cognizant of all work required under this Division.
- C. Examine site related work and surfaces before starting work of any Section.
- D. Install Work in locations shown on approved Drawings, unless prevented by Project conditions.
- E. Prepare revised shop drawings showing proposed rearrangement of Work to meet Project conditions, including changes to Work specified in other Sections. Obtain permission from the University's Representative before proceeding.
- F. Beginning work of any Section constitutes acceptance of conditions.

1.7 COOPERATION WITH WORK UNDER OTHER DIVISIONS

- A. Cooperate with other trades to facilitate general progress of Work. Allow all other trades every reasonable opportunity for installation of their work.
- B. Work under this Division shall follow general building construction closely. Set pipe sleeves and inserts and verify that openings for chases and pipes are provided.
- C. Work with other trades in determining exact location of outlets, pipes, and pieces of equipment to avoid interference with lines required to maintain proper installation of Work.
- D. Make such progress in the Work to not delay work of other trades.
- E. Mechanical Work shall have precedence over the other in the following sequence:
 - 1. Soil and waste piping
 - 2. Hydronic piping
 - 3. Fire sprinkler piping
 - 4. Domestic water piping

1.8 DISCREPANCIES

- A. The Contractor shall check all Drawings furnished him immediately upon their receipt and shall promptly notify the University's Representative of any discrepancies. Figures marked on Drawings shall in general be followed in preference to scale measurements. Piping and instrumentation diagrams shall in general govern floor plans and sections. Large-scale drawings shall in general govern small-scale drawings. The Contractor shall compare all drawings and verify the figures before laying out the work and will be responsible for any errors, which might have been avoided thereby.
- B. Where requirements between Drawings and Specifications conflict, the more restrictive provisions shall apply.
- C. If any part of the Specifications or Drawings appears unclear or contradictory, apply to University's Representative for interpretation and decision as early as possible, including during bidding period. Do not proceed with such work without University's decision. Beginning work of any Section constitutes acceptance of conditions.

1.9 CHANGES

- A. The Contractor shall be responsible to make and obtain approval from the University's Representative for all necessary adjustments in piping and equipment layouts as required to accommodate the relocations of equipment and/or devices, which are affected by any approved authorized changes or Product substitutions. All changes shall be clearly indicated on the "Record" drawings.

1.10 SUBMITTALS

- A. Refer to Division 1 for additional requirements.
- B. The manufacturer, contractor or supplier shall include a written statement that the submitted equipment, hardware or accessory complies with the requirement of that particular specification section. The manufacturer shall resubmit the specification section showing compliance with each respective paragraphs and specified items and features in that particular specification section. All exceptions shall be clearly identified by referencing respective paragraph and other requirements along with proposed alternative.
- C. Note that prior to acceptance of shop drawings for review, a submittal schedule shall be submitted to the University's Representative.

- D. Submit all Division 15 shop drawings and product data grouped and referenced by the specification technical section numbers in one complete submittal package. Individual submittal packages, submitted at different times will not be reviewed and returned to the contractor.
- E. Shop Drawings: Drawings shall be a minimum of 8.5 inches by 11 inches in size with a minimum scale of 1/4-inch per foot, except as specified otherwise. Include installation details of equipment indicating proposed location, layout and arrangement, accessories, piping, and other items that must be shown to assure a coordinated installation. Indicate adequate clearance for operation, maintenance, and replacement of operating equipment devices. If equipment is disapproved, revise drawings to show acceptable equipment and resubmit.
- F. Whenever more than one (1) manufacturer's product is specified, the first named product is the basis of design used in the Work and the use of alternate-named manufacturer's products or substitutes may require modifications in that design. If such alternatives are proposed by the Contractor, there may be additional design work required. Within 15 days of the submittal of a proposed alternate, as presented in the Contractor's submittal, the Architect and Engineers will provide the design fees to modify the issued drawings and obtain DSA approvals for the work to incorporate that alternate into the documents. The contractor shall assume all costs required to make necessary revisions and modifications to the design, including all professional fees to the Architect and Engineers for the evaluation and revisions or modifications of the documents resulting from the substitution or selection of an alternate manufacturer submitted by the Contractor.
- G. All submittals must be turned in to the General Contractor and/or Owner within 30 days of the award to the Subcontractor. Failure to submit any or all items shall not result in a delay in the schedule or a schedule extension. If more time is required to compile a specific submittal, then a formal request in writing may be submitted, requesting more time. This request should list the item or system, the CSI Division Section, the reason for the delay, and the date when this item will be submitted. This will be reviewed by the University and Architect and a response will be prepared within one week. Selection of alternates or substitutions can significantly affect the design, especially with regard to appearance, performance, and integration with other elements. All criteria must be evaluated to maintain the integrity of the design as approved by the University and the University's Representatives.
- H. Proposed Products List: Include Products as required by the individual section in this Division.
- I. The Contractor shall be responsible for all equipment ordered and/or installed prior to receipt of shop drawings returned from the University's Representative bearing the University's Representative stamp of "Reviewed". All corrections or modifications to the equipment as noted on the shop drawings shall be performed and equipment removed from the job site at the request of the University's Representative without additional compensation.
- J. Manufacturer's Data: For each manufactured item, provide current manufacturer's descriptive literature of cataloged products, certified equipment drawings, diagrams, performance and characteristic curves if applicable, and catalog cuts.
- K. Standard Compliance: When materials or equipment provided by the Contractor must conform to the standards of organizations such as American National Standards Institute (ANSI) or American Water Works Association (AWWA), submit proof of such conformance to the University for approval. If an organization uses a label or listing to indicate compliance with a particular standard, the label or listing will be acceptable evidence, unless otherwise specified. In lieu of the label or listing, submit a certificate from an independent testing organization, which is competent to perform acceptance testing and is approved by the University. The certificate shall state that the item has been tested in accordance with the specified organization's test methods and that the item conforms to the specified organization's standard.
- L. Certified Test Reports: Before delivery of materials and equipment, certified copies of all test reports specified in individual sections shall be submitted for approval.

- M. Certificates of Compliance or Conformance: Submit manufacturer's certifications as required on products, materials, finish, and equipment indicated in the technical sections. Certifications shall be documents prepared specifically for this Contract. Pre-printed certifications and copies of previously submitted documents will not be acceptable. The manufacturer's certifications shall name the appropriate products, equipment, or materials and the publication specified as controlling the quality of that item. Certification shall not contain statements to imply that the item does not meet requirements specified, such as "as good as"; or "achieve the same end use and results as materials formulated in accordance with the referenced publications"; or "equal or exceed the service and performance of the specified material." Certifications shall simply state that the item conforms to the requirements specified. Certificates shall be printed on the manufacturer's letterhead and shall be signed by the manufacturer's official authorized to sign certificates of compliance or conformance.

1.11 PRODUCT ALTERNATIVES OR SUBSTITUTIONS

- A. Refer to Division 1 for additional requirements.

1.12 GUARANTEE

- A. Refer to Division 1 for additional requirements.
- B. Except as may be specified under other sections in the Specifications, guarantee all equipment furnished under the Specifications for a period of one year from date of project acceptance against defective workmanship and material and improper installation. Upon notification of failure, correct deficiency immediately and without cost to the University.
- C. Standard warranty of manufacturer shall apply for replacement of parts after expiration of the above period. Manufacturer shall furnish replacement parts to the University for their service agency as directed.

1.13 OPERATION AND MAINTENANCE MANUAL

- A. Refer to Division 1 for additional requirements.
- B. Format
1. Prepare data in the form of an instructional manual.
 2. Binders:
 - a. Commercial quality, 8-1/2 x 11 inch three-ring binders with hardback, cleanable, plastic covers; one inch maximum ring size.
 - b. When multiple binders are used, correlate data into related consistent groupings.
 3. Cover:
 - a. Identify each binder with typed or printed title OPERATION AND MAINTENANCE INSTRUCTIONS; list title of Project and separate building; identify subject matter of contents.
 4. Arrange content by systems and process flow under section numbers and sequence of Table of Contents of this Project Manual.
 5. Provide tabbed fly leaf for each separate product and system, with typed description of product and major component parts of equipment.
 6. Text:
 - a. Manufacturer's printed data, or typewritten data on 20 pound paper.
 7. Drawings:
 - a. Provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.
- C. Contents, Each Volume (Provide 4 copies)
1. Table of Contents: Provide title of Project; names, addresses, and telephone numbers of the Engineer, and Contractor with name of responsible parties; schedule of products and systems, indexed to content of the volume.

2. For Each Product or System: List names, addresses and telephone numbers of Subcontractors and suppliers, including local source of supplies and replacement parts.
3. Product Data: Mark each sheet to clearly identify specific products and component parts, and data applicable to installation. Delete inapplicable information.
4. Drawings: Supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams.
5. Type Text: As required to supplement product data. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions.

D. Manual for Equipment and Systems

1. Each item of equipment and each system: include description of unit or system, and component parts. Identify function, normal operating characteristics, and limiting conditions. Include performance curves, with engineering data and tests, and complete nomenclature and commercial number of replaceable parts.
2. Panelboard Circuit Directories: Provide electrical service characteristics, controls and communications.
3. Include color coded wiring diagrams as installed.
4. Operating Procedures: Include start-up, break-in, and routine normal operating instructions and sequences. Include regulation, control, stopping, shut-down, and emergency instructions. Include summer, winter, and any special operating instructions.
5. Maintenance Requirements: Include routine procedures and guide for trouble-shooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.
6. Provide servicing and lubrication schedule, and list of lubricants required.
7. Include manufacturer's printed operation and maintenance instructions.
8. Include sequence of operation by controls manufacturer.
9. Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.
10. Provide control diagrams by controls manufacturer as installed.
11. Provide Contractor's coordination drawings, with color coded piping diagrams as installed.
12. Provide charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.
13. Provide list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.
14. Additional Requirements: As specified in individual product specification sections.
15. Provide a listing in Table of Contents for design data, with tabbed fly sheet and space for insertion of data.

1.14 POSTED OPERATING INSTRUCTIONS

- A. Furnish approved operating instructions for systems and equipment indicated in the technical sections for use by operation and maintenance personnel.
- B. The operating instructions shall include 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. Provide weather-resistant materials or weatherproof enclosures for operating instructions exposed to the weather. Operating instructions shall not fade when exposed to sunlight and shall be secured to prevent easy removal or peeling.

1.15 INSTRUCTION TO THE UNIVERSITY PERSONNEL

- A. Refer to Division 1 for additional requirements.
- B. Provide training as specified in individual sections.

- C. Before final inspection, instruct the University's designated personnel in operation, adjustment, and maintenance of products, equipment, and systems, at agreed upon times. Furnish the services of competent instructors to give full instruction to the University personnel in the adjustment, operation, and maintenance of systems and equipment, including pertinent safety requirements. Each instructor shall be thoroughly familiar with all parts of the installation and shall be trained in operating theory as well as practical operation and maintenance work.
- D. The amount of time required for instruction on each item of equipment and system is that specified in individual sections.
- E. Utilize operation and maintenance manuals as basis for instruction. Review contents of manual with the University's personnel in detail to explain all aspects of operation and maintenance.
- F. Contractor shall video tape all in service training and instruction sessions and provide DVD, properly indexed, for training additional and future maintenance personnel.
- G. Prepare and insert additional data in operations and maintenance manuals when need for additional data becomes apparent during instruction.
- H. Submit six copies of Manufacturer's Instruction Certificates as specified in individual specification Sections.

1.16 MANUFACTURER'S RECOMMENDATIONS

- A. Where installation procedures or any part thereof are required to be in accordance with manufacturer's recommendations, furnish printed copies of the recommendations prior to installation. Installation of the item shall not proceed until recommendations are received. Failure to furnish recommendations shall be cause for rejection of the equipment or material.

1.17 DELIVERY AND STORAGE

- A. Refer to Division 1 for additional requirements.
- B. Handle, store, and protect equipment and materials in accordance with the manufacturer's recommendations and with the requirements of NFPA 70B P, Appendix I, titled "Equipment Storage and Maintenance During Construction." Replace damaged or defective items with new items.

1.18 EXTRA MATERIALS

- A. Refer to Division 1 for additional requirements.
- B. Unless otherwise specified, spare parts, wherever required by detailed specification sections, shall be stored in accordance with the provisions of this paragraph. Spare parts shall be tagged by project equipment number and identified as to part number, equipment manufacturer, and subassembly component (if appropriate). Spare parts subject to deterioration such as ferrous metal items and electrical components shall be properly protected by lubricants or desiccants and encapsulated in hermetically sealed plastic wrapping. Spare parts with individual weights less than 50 pounds and dimensions less than 2 feet wide, or 18 inches high, or 3 feet in length shall be stored in a wooden box with a hinged wooden cover and locking hasp. Hinges shall be strap type. The box shall be painted and identified with stenciled lettering stating the name of the equipment, equipment numbers, and the words "spare parts." A neatly type inventory of spare parts shall be taped to the underside of the cover.

1.19 PROJECT RECORD DOCUMENTS

- A. Maintain on site, one set of the following record documents; record actual revisions to the Work:
 1. Contract Drawings.

2. Specifications.
 3. Addenda.
 4. Change Orders and other Modifications to the Contract.
 5. Reviewed shop drawings, product data, and samples.
 6. STORE RECORD DOCUMENTS SEPARATE FROM DOCUMENTS USED FOR CONSTRUCTION. RECORD DOCUMENTS SHALL BE AVAILABLE FOR REVIEW BY THE CONSTRUCTION INSPECTOR AND ENGINEER AT ALL TIMES.
- B. Record information concurrent with construction progress.
- C. Specifications: Legibly mark and record at each Product section description of actual Products installed, including the following:
1. Manufacturer's name and product model and number.
 2. Product substitutions or alternates utilized.
 3. Changes made by Addenda and Modifications.
- D. Record Documents and Shop Drawings: Legibly mark each item to record actual construction including:
1. Field changes of dimension and detail.
 2. Details not on original Contract Drawings.
- E. All changes and information recorded on the set of prints maintained during the Work shall be neatly drawn and printed on a new set of plans in an orderly and legible manner, using approved permanent materials and methods. Any additional sheets necessary to complete the record drawings shall be provided by the Contractor and shall be of the same size, borderline, titling identification, and media as the record drawings.
- F. Submit completed documents to the University prior to Completion.

PART 2 - PRODUCTS

NOT USED

PART 3 - EXECUTION

3.1 GENERAL

- A. Obtain and pay for all permits and inspections, including any independent testing required to verify standard compliance, and deliver certificates for same to the University.

3.2 WORK RESPONSIBILITIES

- A. The drawings indicate diagrammatically the desired locations or arrangement of piping, equipment, etc., and are to be followed as closely as possible. Proper judgment must be exercised in executing the work so as to secure the best possible installation in the available space and to overcome local difficulties due to space limitations or interference with structural conditions.
- B. The Contractor is responsible for the correct placing of Work and the proper location and connection of Work in relation to the work of other trades. Advise appropriate trade as to locations of access panels.
- C. In the event changes in the indicated locations or arrangements are necessary, due to developed conditions in the building construction or rearrangement of furnishings or equipment, such changes shall be made without extra cost, providing the change is ordered

before the ductwork, piping, etc. and work directly connected to same is installed and no extra materials are required.

- D. Where equipment is furnished by others, verify dimensions and the correct locations of this equipment before proceeding with the roughing-in of connections.
- E. All scaled and figured dimensions are approximate of typical equipment of the class indicated. Before proceeding with any work, carefully check and verify all dimensions, sizes, etc. with the drawings to see that the equipment will fit into the spaces provided without violation of applicable codes.
- F. Should any changes to the Work indicated on the Drawings or described in the Specifications be necessary in order to comply with the above requirements, notify the University immediately and cease work on all parts of the contract, which are affected until approval for any required modifications to the construction has been obtained from the University.
- G. Be responsible for any cooperative work, which must be altered due to lack of proper supervision or failure to make proper provisions in time. Such changes shall be under direction of the University and shall be made to his satisfaction. Perform all Work with competent and skilled personnel.
- H. All work, including aesthetic as well as mechanical aspects of the Work, shall be of the highest quality consistent with the best practices of the trade.
- I. Replace or repair, without additional compensation, any work, which, in the opinion of the University, does not comply with these requirements.

END OF SECTION

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SECTION 15011

GENERAL REQUIREMENTS FOR EQUIPMENT

PART 1 - GENERAL

1.1 SCOPE

- A. This section specifies general requirements, which are applicable to all mechanical equipment. The Contractor is responsible for ensuring that all mechanical equipment meets the requirements of this section in addition to the specific requirements of the individual equipment specification section.
- B. Equipment Lists: Equipment lists, presented in these specifications and as specified on the Drawings, are included for the convenience of the contractor and are not complete listings of all equipment, devices and material to be provided under this Contract. The Contractor agrees to prepare his own material and equipment takeoff lists as necessary to meet the requirements of this Project Specification.

1.2 QUALITY ASSURANCE

- A. Arrangement: The arrangement of equipment shown on the drawings is based upon information available and is not intended to show exact dimensions peculiar to a specific manufacturer. The Drawings are, in part, diagrammatic, and some features of the illustrated equipment installation may require revision to meet actual equipment installation requirements. Structural supports, foundations, connected piping, valves, and electrical conduit specified may have to be altered to accommodate the equipment provided. No additional payment will be made for such revisions and alterations.
- B. References: This section contains references to the following documents. They are a part of this section as specified and modified. In case of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

AFBMA 9	Load Ratings and Fatigue Life for Ball Bearings.
AFBMA 11	Load and Fatigue Life for Roller Bearings.
ANSI B1.1	Unified Screw Threads
ANSI B1.20.1	Pipe Threads, General Purpose (inch).
ANSI B16.1	Cast Iron Pipe Flanges and Flanged Fittings, Class 125.
ANSI B18.2.1	Square and Hex Bolts and Screws, Including Askew Head Bolts, Hex Cap Screws, and Log Screws.
ANSI B18.2.2	Square and hex Nuts

- C. Unit Responsibility: the responsible manufacturer shall provide Equipment systems made up of two or more components as a unit. Unless otherwise specified, the Contractor shall obtain each system from the supplier of the driven equipment, which supplier shall provide all components of the system to enhance compatibility, ease of construction and efficient maintenance. Contractor is responsible to the University for performance of all systems.

1.3 SUBMITTALS

- A. Refer to Section 15010 for additional requirements.

PART 2 - PRODUCTS

2.1 FLANGES AND PIPE THREADS

- A. Flanges on equipment and appurtenances provided under this section shall conform in dimensions and drilling to ANSI B16.1, Class 125. Pipe threads shall conform in dimension and limits of size to ANSI B1.1, coarse thread series, and Class 2 fit.
- B. Threaded flanges shall have a standard taper pipe thread conforming to ANSI B1.20.1. Unless otherwise specified, flanges shall be flat faced.
- C. Flange assembly bolts shall be heavy pattern, hexagonal head, carbon steel machine bolts with heavy pattern, hot pressed, hexagonal nuts conforming to ANSI B18.2.1 and B18.2.2. Threads shall be Unified Screw Threads, Standard Coarse Thread Series, Class 2A and 2B, ANSI B1.1.

2.2 BEARINGS

- A. Unless otherwise specified, equipment bearings shall be oil or grease lubricated, ball or roller type, designed to withstand the stresses of the service specified. Each bearing shall be rated in accordance with the latest revisions of AFBMA Methods of Evaluation Load Ratings of Ball and Roller Bearings. Unless otherwise specified, equipment bearings shall have a minimum L-10 rating life of 50,000 hours. The rating life shall be determined using the maximum equipment operating speed.
- B. Grease lubricated bearings, except those specified to be factory sealed and lubricated, shall be fitted with easily accessible grease supply, flush, drain and relief fittings. Extension tubes shall be used when necessary. Grease supply fittings shall be standard hydraulic alemite type.
- C. Oil lubricated bearings shall be equipped with either a pressure lubricating system or a separate oil reservoir type system. Each oil lubricating system shall be of sufficient size to safely absorb the heat energy normally generated in the bearing under a maximum ambient temperature of 60°C and shall be equipped with a filler pipe and an external level indicator gage. External level indicator gage shall not be required on motors less than 5 horsepower.

2.3 ANCHOR BOLTS

- A. Anchor bolts shall be designed for lateral forces for both pullout and shear.

2.4 COUPLINGS

- A. Unless otherwise specified in the particular equipment sections, equipment with a driver greater than 1/2 HP, and where the input shaft of a driven unit is directly connected to the output shaft of the driver, shall have its two shafts connected by a flexible coupling which can accommodate angular misalignment, parallel misalignment and end float, and which cushions shock loads and dampens torsional vibrations. The flexible member shall consist of a tire with synthetic tension members bonded together in rubber. The flexible member shall be attached to flanges by means of clamping rings and cap screws, and the flanges shall be attached to the stub shaft by means of taper lock bushings, which shall give the equivalent of a shrunk-on fit. There shall be no metal-to-metal contact between the driver and the driven unit. Each coupling shall be sized and provided as recommended by the coupling manufacturer for the specified application, considering horsepower, speed of rotation, and type of service.

2.5 GUARDS

- A. Exposed moving parts shall be provided with guards, which meet the requirements of CAL-OSHA. Guards shall be fabricated of 14-gage steel, 1/2-13-15 expanded metal screens to provide visual inspection of moving parts without removal of the guard. Guards shall be galvanized after fabrication and shall be designed to be readily removable to facilitate maintenance of moving parts. Reinforced holes shall be provided. Provisions shall be made to extend lube fittings through guards.

2.6 CAUTION SIGNS

- A. Equipment with guarded moving parts which operates automatically or by remote control shall be identified by signs reading "CAUTION - AUTOMATIC EQUIPMENT MAY START AT ANY TIME". Signs shall be constructed of fiberglass material, minimum 1/8 inch thick, rigid, and suitable for post mounting. Letters shall be white on a red background. Sign shall be installed near guarded moving parts.

2.7 GAGE TAPS, TEST PLUGS AND GAGES

- A. Gage taps shall be provided where specified. Gage taps, test plugs, and gages shall be as specified in Section 15980.

2.8 NAMEPLATES

- A. Nameplates shall be provided on each item of equipment and shall contain the specified equipment name or abbreviation and equipment number. Equipment nameplates shall be engraved or stamped stainless steel and fastened to the equipment in an accessible location with stainless steel screws or drive pins.

2.9 LUBRICANTS

- A. The Contractor shall provide for each item of mechanical equipment a supply of the lubricant required for the commissioning period and one full change of lubricants. Lubricants shall be of the type recommended by the equipment manufacturer and shall be products of the University's current lubricant supplier. The Contractor shall limit the various types of lubricants by consolidating them, with the equipment manufacturer's approval, into the least number of different types. Not less than 90 days before the date shown in his construction schedule for starting, testing and adjusting equipment, the Contractor shall provide the University with three copies of a list showing the required lubricants, after consolidation, for each item of mechanical equipment. The list shall show estimated quantity of lubricant needed for a full year's operation, assuming the equipment will be operating continuously.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Installation of equipment accessories included in this section shall be as recommended by the equipment manufacturer unless otherwise specified in the individual equipment specification section.

END OF SECTION

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SECTION 15020
MECHANICAL DEMOLITION

PART 1 - GENERAL

1.1 SCOPE

- A. This section specifies the demolition and removal of all mechanical and plumbing systems in SSPA Building.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT

- A. Provide all materials and equipment necessary for the removal and capping of existing mechanical and plumbing systems in Buildings.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify in field existing mechanical and plumbing system arrangements are as shown on Drawings.
- B. Verify that demolition serves only area of scope.
- C. Demolition drawings are based on cursory field observation and existing record documents. The demolition shown is diagrammatic and shows the general scope of demolition work and does not show all the construction detail of the original record drawings. Contractor shall coordinate with the University Representative and report discrepancies before disturbing existing installation.
- D. Contractor shall visit the existing buildings and grounds and review the existing building record drawings for details of existing installation to familiarize themselves with existing conditions prior to submitting bid. No allowance will be made subsequently, in this connection, on behalf of the Contractor for any error or negligence on his part.
- E. Beginning of installation or demolition in each area means the Contractor accepts existing conditions.

3.2 PREPARATION

- A. Before disruption of existing systems, Contractor shall prepare and submit to the University Representative a plan identifying all services that may be disrupted by the demolition. This plan shall include but is not limited to the following:
 - 1. Hazardous Waste
 - a. Asbestos
 - 2. Dates, Times and Duration's of Services Shut-Down:

- a. Heating systems
- b. Cooling systems
- c. Mechanical control systems
- d. Ventilation systems
- 3. Items to be Returned to the University
 - a. Coordinate with University Representative for mechanical equipment.

3.3 DEMOLITION AND EXTENSION OF EXISTING MECHANICAL WORK

- A. Demolish and remove from site, and extend existing mechanical work under provisions of this Division and as indicated on the Drawings unless otherwise noted.
- B. Unless otherwise noted on the Drawings, all salvage items removed in connection with this Contract are to become the property of the Contractor. Salvage items noted to remain the property of the University shall be delivered to a location to be designated by the University Representative. Contractor shall remove from construction areas all trash or debris as it accumulates and dispose of it off campus at no additional cost to the University. All construction areas shall be kept clean, safe, and orderly at all times. At the completion and acceptance for work, Contractor shall remove from the site all debris and surplus materials resulting from this Work and dispose of them off campus at no additional cost to the University.
- C. Remove, relocate, and extend existing installations to accommodate new construction as required for proper installation and system operation.
- D. Repair adjacent construction and finishes damaged during demolition and extension work.
- E. Maintain access to existing mechanical installations which remain active.
- F. The Contractor shall remove all existing mechanical systems and their appurtenances no longer required unless otherwise noted in its entirety.

3.4 CLEANING AND REPAIR

- A. Clean and repair existing materials and equipment which remain or are to be reused.
- B. All building surfaces damaged and openings left by new work or the removal or relocation of ductwork, etc., shall be repaired to original condition and painted by the Contractor.
- C. Fill in holes and unused openings left by removed mechanical systems as approved by the University Representative.

END OF SECTION

SECTION 15060

PIPE AND PIPE FITTINGS GENERAL

PART 1 - GENERAL

1.1 SCOPE

- A. This section specifies systems and general requirements for piping systems. Detailed specifications for the components listed in this Section are found in other sections of Division 15. This section shall be used in conjunction with those sections.
- B. Definitions: Pressure terms used in Section 15060 and elsewhere in Division 15 are defined as follows:
1. Maximum: The greatest continuous pressure at which the piping system operates.
 2. Test: The hydrostatic pressure used to determine system acceptance.

1.2 QUALITY ASSURANCE

- A. References: This section contains references to the following documents. They are a part of this section as specified and modified. In case of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

ANSI A13.1	Scheme for the Identification of Piping Systems.
ANSI B1.20.1	Pipe Threads, General Purpose (Inch).
ANSI/ASME B16.1	Cast Iron Pipe Flanges and Flanged Fittings Class 25, 125, 250, and 800.
ANSI/ASME B16.5	Pipe Flanges and Flanged Fittings.
ANSI/ASME B16.9	Factory-Made Wrought Steel Butt welding Fittings.
ANSI/ASME B16.22	Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
ANSI/ASME B16.26	Cast Copper Alloy Fittings for Flared Copper Tubes.
ANSI/ASME B31.1	Power Piping
ANSI/ASME B31.9	Building Services Piping.
ANSI/AWS D1	Structural Welding Code.
ASTM A47	Malleable Iron Castings.
ASTM A53	Pipe, Steel, Black and Hot Dipped, Zinc-Coated Welded and Seamless.
ASTM A74	Cast Iron Soil Pipe and Fittings.
ASTM A105/A105M	Forging, Carbon Steel, for Piping Components.
ASTM A106	Seamless Carbon Steel Pipe for High-Temperature Service.
ASTM A269	Seamless and Welded Austenitic Stainless Steel Tubing for General Service.
ASTM A312	Seamless and Welded Austenitic Stainless Steel Pipes.
ASTM A570/A570M	Hot-Rolled Carbon Steel Sheet and Strip, Structural Quality.
ASTM B88	Seamless Copper Water Tube.
ASTM C564	Rubber Gaskets for Iron Soil Pipe and Fittings.
ASTM D1248	Polyethylene Plastic Molding and Extrusion Materials.
ASTM D2513	Thermoplastic Gas Pressure Pipe, Tubing, and Fittings.
AWWA C111	Rubber Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
AWWA C200	Steel Water Pipe 6 Inches and Larger.
AWWA C206	Field Welding of Steel Water Pipe.
AWWA C208	Dimensions for Fabricated Steel Water Pipe Fittings.
AWWA C600	Installation of Ductile-Iron Water Mains and Their Appurtenances

- B. Fittings and coupling compatibility: To assure uniformity and compatibility of piping components, fittings and couplings for grooved end piping systems shall be furnished by the same manufacturers.
- C. Welding materials and labor to conform to ASME Code and applicable state labor regulations.
- D. Welders shall be fully qualified and certified by an approved welding bureau and state authorities. Each welder shall be required to identify his work with a marking. Mark of welder shall be stamped on each weld joint of pipe, valve or fitting. A listing of the names of the welder, together with corresponding marks, shall be submitted. Welders making defective welds after passing qualification test shall be given a requalification test and upon failing to pass a requalification test shall not be permitted to work on this project.
- E. Domestic water, drainage and vent piping per applicable building code for the system type specified herein.

1.3 SUBMITTALS

- A. Submit under provisions of Division 1.
- B. Refer to Section 15010 or additional requirements.
- C. Submit piping shop drawings to the University a minimum of 4 weeks prior to construction for all new piping to be installed.
- D. Certification:
 - 1. Submit mill certification sheets for all pipe materials prior to delivery or shop fabrication.
- E. Welding Documentation:
 - 1. Submit Welding Procedure Specification (WPS) documentation prior to any fabrication activity.
 - 2. Submit Welder Performance Qualification documents that reference the specific WPS to University Representative for all welders and welding operators, shop or field, employed on this Work prior to beginning any fabrication activity.
 - 3. The above documentation is required for welding performed under any ASME B-31 series Code including B-31.9
- F. Brazing Documentation:
 - 1. Submit Brazing and Soldering Procedure Specification documentation prior to any fabrication activity.
 - 2. Contractor shall submit Brazer/Solderer Performance Qualification documents that reference the specific Brazing and Soldering Procedure Specification to the University Representative for all brazers/solderers and brazing/soldering operators, shop or field, employed on this Work prior to beginning any fabrication activity.
 - 3. The above documentation is required for brazing performed under any ASME B-31 series Code including B-31.9.

1.4 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Deliver pipe and tube with factory-applied end caps. Maintain end caps through shipping, storage and handling to prevent pipe-end damage and entrance of dirt, debris and moisture.
- B. Upon receipt, the Contractor shall visually inspect every pipe and component and reject items that contain an injurious defect. Injurious defects include internal and external surface gouges, scars, scratches, blisters, or discontinuities that produce a notch effect.
- C. Project material shall be stored in an area specifically assigned to this project where exposure to heat, dirt, and contamination are avoided.
 - 1. Elevate stored pipe and tube above grade to protect from moisture and dirt. When stored within buildings, do not exceed structural capacity of the floor.
 - 2. Protect stored plastic pipes from direct sunlight.
 - 3. Support piping to prevent sagging.

1.5 PIPING INSTALLATION

- A. Unless otherwise indicated, installation of piping shall be made substantially as indicated on drawings, installed in accordance with the ANSI/ASME Standard Code for Pressure Piping B31.1, latest issue, including anchorage of piping, guides and supports for such piping. Installation of plumbing piping shall be installed in accordance with ANSI/ASME B31.9, latest issue.
- B. Drawings: The accompanying drawings are intended for the Contractor's guidance, and the contractor shall verify the drawing accuracy and immediately notify the University Representative of any discrepancies so that such discrepancies may be resolved prior to actual fabrication or installation of work. Minor changes in position of piping as necessary to meet job conditions shall be anticipated by the Contractor and shall not be made the basis for change order. Changes affecting accessibility to or clearance about equipment or accessories shall be promptly communicated to the University Representative.
- C. Sizes: Sizes and arrangement of piping shall be as shown on the drawings. Conflict or inconsistencies of detail for final connections shall be resolved by the University Representative.
- D. Piping Diagrams: Piping diagrams are not for the purpose of giving physical dimensions or locations but rather to make clear the interconnection, by the piping, of the various units of the process. If an item is shown on either the piping diagram or the piping detail drawings, but not on both, it will be assumed that the Contractor has included such item in his estimate of the cost of the work and that he shall install the same.
- E. Pipe Lengths: In the assembly of the piping system, the longest available commercial standard piping lengths shall be utilized to minimize number of piping joints. Piping shall be accurately cut to field measurements to permit placement without forcing or springing, except where provisions for cold springing are required.
- F. Piping Layout: All piping shall be run straight and parallel with adjacent walls, presenting a uniform and neat appearance.
- G. Provide galvanized steel drip pans for all piping above electrical equipment. Drip pans shall extend minimum twelve inches on all sides.
- H. Fittings and Coupling Compatibility: To assure uniformity and compatibility of piping components, fittings and couplings for grooved end piping systems shall be furnished by the same manufacturer.

- I. Provide drip pans for piping above electrical equipment.

PART 2 - PRODUCTS

2.1 PIPING MATERIAL

- A. Unless otherwise specified, piping materials, including pipe, gaskets, fittings, connection and joint assemblies, linings and coatings, and shall be selected from those listed on the piping system specification sheets.
- B. Piping materials shall conform to detailed specifications for each type of pipe and piping appurtenance specified in other sections of Division 15.

2.2 VALVES

- A. Valves of the same size and service shall be provided by a single valve manufacturer.
- B. Packing shall be nonasbestos material.
- C. Actual length of valves shall be within 1/16 inch (plus or minus) of the manufacturer's specified length.
- D. Flanges shall meet the requirement of ANSI/ASME B16.5.
- E. Push-on and mechanical joints shall meet the requirements of AWWA C111.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Ream pipes and tubes. Clean off scale and dirt, inside and outside, before assembly. Remove welding slag or other foreign material from piping.

3.2 CONNECTIONS

- A. Screw joint steel piping up to and including 2". Weld piping 2-1/2" and larger, including branch connections.
- B. Use full-cut standard taper pipe threads. Make up joints using PTFE tape, Teflon based pipe joint compound, or other approved nontoxic joint compound applied to male threads only.
- C. Use main-sized "Weld-O-Let" or "Thread-O-Let" male branch connections or "Stub-in" in steel piping if main is at least one pipe size larger than the branch for up to 6" mains and main is at least two pipe sizes larger than branch for 8" and larger mains. Do not project branch pipes inside the main pipe.
- D. Joints for cast iron bell and spigot pipe shall have a Neoprene gasketing system. Joint for plain end pipe shall have clamp-type mechanical fasteners and gaskets.

- E. Use grooved mechanical couplings only as shown on Drawings. Grooved mechanical couplings are acceptable at equipment connections.
- F. Make connections to equipment and branch mains with unions or flanges.
- G. Provide nonconducting type connections wherever jointing dissimilar metals in all systems. Brass adapters and valves are acceptable.
- H. On copper piping systems, tee drilling shall be permitted for sizes up to and including 1" provided the main service pipe size is a minimum four pipe sizes larger than the size of the tee drill connection.

3.3 ROUTE AND GRADES

- A. Route piping in orderly manner and maintain proper grades. Install to conserve headroom and interfere as little as possible with use of space. Run exposed piping parallel to walls. Grouping piping whenever practical at common elevations. Install concealed pipes close to building structure to keep furring to a minimum.
- B. Slope water piping above grade 1 inch in 40 feet and arrange to drain at low points.
- C. On closed systems:
 - 1. Provide 3/4" isolation drain valves and hose nipples at all low points.
 - 2. Provide manual air vents with isolation valves at high points. Provide 1/2" piping from manual air vents to nearest drain location.
- D. Make reductions in water pipes with eccentric reducing fittings installed to provide drainage and venting.
- E. Grade horizontal drainage and vent piping at minimum 2% slope unless otherwise noted.
- F. Install piping to allow for expansion and contraction without stressing pipe or connected equipment.
- G. Provide clearance for installation of insulation and for access to valves, air vents, drains and unions.
- H. Install same type piping material specified for inside building to 5 feet outside of building unless otherwise indicated.

3.4 IDENTIFICATION

- A. Identify piping, flow direction and contents as specified in Section 15077.

3.5 CLEANING

- A. General: Piping systems shall be cleaned following completion of testing and prior to connection to operating, control, regulating or instrumentation equipment. The Contractor may clean sections of buried or exposed piping systems. Use of this procedure, however, will not waive the requirement for a full flushing of the completed system. Unless specified otherwise, piping 24 inches in diameter and smaller first be cleaned by pulling a tightly fitting cleaning ball or swab through the system. Use the campus standard cleaning solution San Joaquin Chemicals Sanasolv#6103, inhibitor Sanacor#2301.

- B. Temporary Screens: Upon completion of the cleaning, the Contractor shall connect the piping systems to the main piping system that was previously cleaned and tested. Temporary screens, provided with locator tabs which remaining visible from the outside when the screens are in place, shall be inserted in pipelines at the interface with previously cleaned and tested piping in accordance with the following table:

Equipment Suction or Piping Size, Inches	Maximum Screen Opening, Inches
0 - 1	1/16
1-1/4 - 3	1/4
3-1/2 - 6	1/2
Over 6	3/4

- C. The Contractor shall maintain the screens during testing, initial start-up, and initial operating phases of the commissioning process. In special cases, screens may be removed as required for performance tests. The Contractor shall remove the temporary screens and make the final piping connections after the screens have remained clean for at least 24 consecutive hours of operation.
- D. Liquid Systems: After completion of cleaning, liquid systems, unless otherwise specified, shall be flushed with clean water. With temporary screens in place, the liquid shall be circulated through the piping system using connected equipment for a minimum period of 60 minutes and until no debris is collected on the screens.

3.6 TESTING

- A. General: Upon completion of piping, the Contractor shall test the piping systems. Pressures, media and test durations shall be as specified in paragraph 15060-3.8. Equipment, which may be damaged by the specified test conditions, shall be isolated. Testing shall be performed using calibrated test gages and calibrated volumetric measuring equipment to determine leakage rates. Each test gage shall be selected so that the specified test pressure falls with in the upper half of the gages range. Unless otherwise specified, the Contractor shall notify the University's representative 48 hours prior to each test. The University's representative must be present during testing of new and existing piping. Unless otherwise specified, testing, as specified herein, shall include existing piping systems, which connect with new pipe systems. Existing pipe shall be tested to the nearest existing valve. Any piping, which fails the test, shall be repaired. Repair of existing piping will be considered and paid for as extra work and shall be coordinated with the University.
- B. Complete and test pipe rough in before insulation or other finish work is applied. Covering of work before acceptance is prohibited.
- C. Do not test relief valves, pressure-regulating valves, valves, or equipment beyond its rated capacity.
- D. The allowable leakage rate for systems tested with air shall be based on a maximum pressure drop of 5 percent of the specified test pressure for the duration of the period. Prior to starting a test interval using air, the air shall be at ambient temperature and specified test pressure.
- E. Liquid Systems: Leakage shall be zero at the specified test pressure throughout the specified duration for exposed piping. Leakage for buried insulated piping shall not exceed allowed leakage per AWWA C600.

3.7 PIPNG SERVICE COLOR CODING

- A. The following table indicates fluid category, pipe and pipe marker background color of each service:

Symbol	Service	Fluid Category	Pipe Color
CHWS	Chilled Water Supply	Water	Medium Blue
CHWR	Chilled Water Return	Water	Medium Blue
HHWS	Heating Hot Water Supply	Water	Medium Yellow
HHWR	Heating Hot Water Return	Water	Medium Yellow
IW	Indirect Waste	Water	Green

3.8 PIPING SERVICES

Piping Service:

Chilled Water Supply
Chilled Water Return

1. Test Requirements:
 - a. Medium: Water; refer to specification paragraph 15060-3.6.
 - b. Pressure: 150 psig for above ground piping.
 - c. Pressure: 120 psig for underground piping.
 - d. Duration: 4 Hours
2. Gasket Requirements:
 - a. Flange: Compressed gasketing consisting of organic fibers (Kevlar) and neoprene binder.
 - b. Mechanical Coupling: Styrene Butadiene Rubber (SBR)
 - c. Silver Solder/Braze: AWS A5.8; Material shall have 15% minimum silver content.
3. Exposed Pipe and Valves:
 - a. Pipe (2" and smaller):

(See drawings for pipe size and valve type)

Copper Tube; ASTM B88, Type L, hard drawn.

Refer to Section 15066.

Connections shall be silver solder /braze joint.

Fittings shall be solder type with threaded adapters for valves.

All elbows shall be 1-1/2 times diameter, full radius.

Insulate per Section 15088.
 - b. Valves (2-1/2" and smaller):

Ball valve.

Refer to Section 15102.

Insulate per Section 15088.
 - c. Pipe (larger than 2-1/2"):

Steel; ASTM A53, Schedule 40 Black Steel, Type S seamless pipe.

Refer to Section 15061.

Connections in all other areas may be butt weld or flanged. Grooved connections at equipment only.

Fitting shall be malleable iron, ductile iron, or steel per Section 15061; ends to match pipe.

All elbows shall be 1-1/2 times diameter, full radius.

Insulate per Section 15088.
 - d. Valves (larger than 2-1/2"):

Butterfly valve.

Refer to Section 15110.

Globe, style silent check valve.

Refer to Section 15110.

Insulate per Section 15088.

1. Test Requirements:
 - a. Medium: Water; ref. spec paragraph 15060-3.6.
 - b. Pressure: 100 psig for above grade piping.
 - c. Pressure: 120 psig for underground piping.
 - d. Duration: 4 Hours
 2. Gasket Requirements:
 - a. Flange: Compressed gasketing consisting of organic fibers (Kevlar) and neoprene binder.
 - b. Mechanical Coupling: EPDM
 - c. Silver Solder/Braze: AWS A5.8; Material shall have 15% minimum silver content.
 3. Exposed Pipe and Valves:
 - a. Pipe (2" and smaller): See drawings for pipe size and valve type
Copper Tube; ASTM B88, Type L, hard drawn.
Refer to Section 15066.
Connections shall be silver solder /braze joint.
Fittings shall be solder type with threaded adapters for valves.
Insulate per Section 15088.
 - b. Valves (2" and smaller): Ball valves.
Insulate per Section 15088.
 - c. Pipe (larger than 2-1/2"): Steel; ASTM A120, Schedule 40 Black Steel, seamless pipe.
Refer to Section 15061.
Connections in all other areas may be butt weld or flanged. Grooved connections at equipment only.
Fitting shall be malleable iron, ductile iron, or steel per Section 15061; ends to match pipe.
All elbows shall be 1-1/2 times diameter, full radius.
Insulate per Section 15088.
 - d. Valves (larger than 2-1/2"): Butterfly valves.
Refer to Section 15110.
Globe, style silent check valve.
Refer to Section 15110.
Insulate per Section 15088.
- Remarks: Provide manual air vents with isolation valves at high points. Provide 1/2" piping from manual air vents to nearest drain location.

1. Test Requirements:
 - a. Medium: Clean water free of debris.
 - b. Test: Visual Inspection
2. Joint Requirements: Solder; ASTM B32: "Lead Free" solder.
3. Piping 1" and smaller:
 - a. Pipe: Copper Pipe; ASTM B88; Type L, hard drawn. Type L soft drawn 1/2" or smaller is approved.
Refer to Section 15066.
 - b. Fittings: Wrought Copper; ANSI/ASME B16.22; wrought copper and copper alloy solder joint pressure fittings.
Refer to Section 15066.
4. Piping 1-1/4" and larger:
 - a. Pipe: Copper Pipe; ASTM B88; Type L, hard drawn.
Refer to Section 15066.
 - b. Fittings: Wrought Copper; ANSI B16.29 & ANSI B16.23; wrought copper and copper alloy solder joint drainage fittings.
5. Insulation:
 - a. Pipe and Fittings: Insulate pipe in ceiling space per Section 15088.

END OF SECTION

SECTION 15061

STEEL PIPE AND FITTINGS

PART 1 GENERAL

1.1 SCOPE

- A. This section specifies steel pipe and fittings specified in paragraph 15060-3.8.

1.2 QUALITY ASSURANCE

- A. REFERENCES: This section contains references to the following documents. They are a part of this section as specified and modified. In case of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

ANSI/ASME B16.3	Malleable Iron Threaded Fittings, Class 150 and 300.
ANSI/ASME B16.9	Factory - Made Wrought Steel Butt welding Fittings.
ANSI/ASME B16.11	Forged Steel Fittings, Socket - Welding and Threaded.
ANSI/ASME B31.1	Power Piping.
ANSI/ASME B31.8	Gas Transmission and Distribution Piping Systems.
ANSI/ASME B31.9	Building Service Piping.
ASME B31.2	Fuel Gas Piping.
ASTM A36 / A36M	Structural Steel.
ASTM A47	Ferritic Malleable Iron Castings.
ASTM A53	Pipe, Steel, Black and Hot - Dipped, Zinc - Coated Welded and Seamless.
ASTM A105 / A105M	Forgings, Carbon Steel, for Piping Components.
ASTM A106	Seamless Carbon Steel Pipe for High - Temperature Service.
ASTM A197	Cupola Malleable Iron.
ASTM A234 / A234M	Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures.
ASTM A269	Seamless and Welded Austenitic Stainless Steel Tubing for General Service.
ASTM A283 / A283M	Low and Intermediate Tensile Strength Carbon Steel Plates, Shapes and Bars.
ASTM A312	Seamless and Welded Austenitic Stainless Steel Pipes
ASTM A450	Carbon, Ferritic Alloy, and Austenitic Alloy Steel Tubing.
ASTM A536	Ductile Iron Castings.
ASTM A570 / A570M	Hot - Rolled Carbon Steel Sheet and Strip, Structural Quality.
AWWA C200	Steel Water Pipe 6 Inches and Larger.
AWWA C206	Field Welding of Steel Water Pipe.
AWWA C207	Steel Pipe Flanges for Waterworks Services-- Sizes 4 In. Through 36 In.
AWWA C208	Dimensions for Fabricated Steel Water Pipe Fittings.
AWWA M11	Steel Pipe -- A Guide for Design and Installation.
ANSI/AWS D1.1	Structural Welding Code.

- B. TESTING: Factory testing shall conform to the requirements of ASTM A53, ASTM A106, ASTM A269 or AWWA C200 as applicable.

1.03 SUBMITTALS

- A. Submit under provisions of Division 1.
- B. Refer to Section 15010 for additional requirements.
- C. The following information shall be provided:
 - 1. Affidavits of Compliance with AWWA C200, ASTM A53, ASTM A106, ASTM A312, or ASTM A269 as applicable.
 - 2. Contractor's piping layout drawings.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturer shall be Bethlehem Steel Company, Kaiser Steel or National Tube Company.

2.2 PIPE MATERIALS

- A. Steel pipe and fittings shall be provided in accordance with ASTM A53, ASTM A106, ASTM A269, ASTM A312, or AWWA C200 as specified in Section 15060, Pipe and Pipe Fittings - General.
- B. Steel for pipe fabricated to meet requirements of AWWA C200 shall conform to the requirements of ASTM A36, ASTM A572, Grade 42, ASTM A570, Grades 33 and 36, or ASTM A283, Grade D. Steel for ASTM A53 and ASTM A106 pipe shall be Grade B.
- C. Steel for pipe fabricated to meet the requirements of ASTM A269 shall conform to the requirements of ASTM A450.
- D. Unless otherwise indicated, conform to ANSI/ASME B31.1 Power Piping Code, ANSI/ASME B31.8 Gas Transmission Code, and ASME B31.2 Fuel Gas Piping.

2.3 PIPE MANUFACTURING

- A. Unless otherwise specified, ASTM A53 pipe shall be Type S, seamless pipe as specified in Section 15060. The minimum wall thickness for ASTM A53 or ASTM A106 pipe shall be Schedule 40 for pipe 10-inch diameter and less. Increased shell thickness shall be provided where specified.
- B. AWWA C200 pipe shall be straight or spiral seam. The minimum wall thickness shall be 7 gauge for pipe 6 inch through 24-inch diameter. Increased shell thickness shall be provided where specified. Unless otherwise specified inside pipe diameter, including lining shall not be less than normal pipe diameter.

2.4 CONNECTIONS

- A. Connections shall be as specified in Section 15060. Fabricated steel fittings and appurtenances should be designed in accordance with AWWA M11.

2.5 FITTINGS AND APPURTENANCES

- A. Malleable iron threaded fittings and appurtenances shall conform to the requirements of ASTM A47 or ASTM A197, ANSI B16.3.

- B. Unless otherwise specified, steel fittings and appurtenances shall conform to the requirements of ASTM A234, ASTM A105, or ANSI B16.11; and fabricated steel fittings and appurtenances shall conform to AWWA C208. Unless otherwise specified, stainless steel fittings and appurtenances shall conform to the requirements of ASTM A269 or ASTM A312.
- C. Unless otherwise specified, all fittings shall be rated for pressure and loadings equal to the pipe.

2.6 JOINT GASKETS

- A. Joint gaskets shall be as specified in Section 15060.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Pipe shall be installed in accordance with AWWA M11, Chapter 16. Welded joints shall be in accordance with AWWA C206 and Section 15085. Sleeve - type mechanical pipe couplings shall be provided in accordance with AWWA M11. Pipe lining and coatings at field joints shall be applied as specified in paragraphs 15061-2.5 and 2.6. Unless otherwise specified, buried mechanical couplings and valves shall be field coated as specified in paragraph 15085-2.5.
- B. Anchorage: Anchorage shall be provided as specified. Calculations and drawings for proposed alternative anchorage shall be submitted in accordance with Division 1.
- C. Natural Gas piping system shall be electrically grounded in accordance with NFPA 54, 3.14.

3.2 TESTING

- A. Test pressures and allowable leakage shall be as listed in Section 15060.

END OF SECTION

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SECTION 15077

IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Equipment labels.
2. Warning signs and labels.
3. Pipe labels.
4. Duct labels.

1.2 SUBMITTAL

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

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Metal Labels for Equipment:

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

B. Plastic Labels for Equipment:

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
2. Letter Color: White.
3. Background Color: Black or Blue.
4. Maximum Temperature: Able to withstand temperatures up to 140 deg F.
5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
7. Fasteners: Stainless-steel rivets or self-tapping screws.
8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

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

- D. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number and identify drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 WARNING SIGNS AND LABELS

- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
- B. Letter Color: Black.
- C. Background Color: Yellow.
- D. Maximum Temperature: Able to withstand temperatures up to 140 deg F.
- E. Minimum Label Size: Length and width vary for required label content, but not less than 12 inch by 6 inch).
- F. Minimum Letter Size: 1/2 inch for name of units if viewing distance is less than 24 inches, 3/4 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
- G. Fasteners: Stainless-steel rivets or self-tapping screws.
- H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- I. Label Content: Include caution and warning information, plus emergency notification instructions.

2.3 PIPE LABELS

- A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.
- B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to partially cover circumference of pipe and to attach to pipe without fasteners or adhesive.
- C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
- D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.
 - 1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
 - 2. Lettering Size: At least 1-1/2 inches high.

2.4 DUCT LABELS

- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
- B. Letter Color: White.

- C. Background Color: Green.
- D. Maximum Temperature: Able to withstand temperatures up to 140 deg F.
- E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
- F. Minimum Letter Size: 1/2 inch for name of units if viewing distance is less than 24 inches, 3/4 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
- G. Fasteners: Stainless-steel rivets or self-tapping screws.
- H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- I. Duct Label Contents: Include identification of duct service using same designations or abbreviations as used on Drawings, duct size, and an arrow indicating flow direction.
 - 1. Flow-Direction Arrows: Integral with duct system service lettering to accommodate both directions, or as separate unit on each duct label to indicate flow direction.
 - 2. Lettering Size: At least 1-1/2 inches high.

PART 3 - EXECUTION

3.1 PREPARATION

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

3.2 EQUIPMENT LABEL INSTALLATION

- A. Install or permanently fasten labels on each major item of mechanical equipment.
- B. Locate equipment labels where accessible and visible.

3.3 PIPE LABEL INSTALLATION

- A. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
 - 1. Near each valve and control device.
 - 2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
 - 3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
 - 4. At access doors, manholes, and similar access points that permit view of concealed piping.
 - 5. Near major equipment items and other points of origination and termination.
 - 6. Spaced at maximum intervals of 25 feet along each run. Reduce intervals to 10 feet in areas of congested piping and equipment.
 - 7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.
- B. Pipe Label Color Schedule:

1. Chilled-Water Piping:
 - a. Background Color: Blue.
 - b. Letter Color: White.
2. Heating Water Piping:
 - a. Background Color: Red.
 - b. Letter Color: White.

3.4 DUCT LABEL INSTALLATION

- A. Install plastic-laminated or self-adhesive duct labels with permanent adhesive on air ducts in the following color codes:
 1. Blue: For cold-air supply ducts.
 2. Red: For hot-air supply ducts.
 3. Green: For exhaust-, outside-, relief-, return-, and mixed-air ducts.
 4. ASME A13.1 Colors and Designs: For hazardous material exhaust.
- B. Locate labels near points where ducts enter into concealed spaces and at maximum intervals of 25 feet in each space where ducts are exposed or concealed by removable ceiling system.

END OF SECTION

SECTION 15088

HVAC PIPING INSULATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes insulating the following HVAC piping systems:

1. Chilled-water piping, indoors.
2. Heating hot-water piping, indoors.

- B. Related Sections:

1. Division 15 Section "Duct Insulation."
2. Division 15 Section "HVAC Equipment Insulation."

1.2 SUBMITTALS

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

- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
2. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
3. Detail removable insulation at piping specialties.
4. Detail application of field-applied jackets.
5. Detail application at linkages of control devices.

1.3 QUALITY ASSURANCE

- A. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

- A. Products shall not contain asbestos, lead, mercury, or mercury compounds.

- B. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

- C. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- D. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- E. Cellular Glass: Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Products: Subject to compliance with requirements, provide one of the following:

- a. Pittsburgh Corning Corporation; Foamglas.
- b. Approved alternates.

2. Block Insulation: ASTM C 552, Type I.

3. Special-Shaped Insulation: ASTM C 552, Type III.

4. Board Insulation: ASTM C 552, Type IV.

5. Preformed Pipe Insulation without Jacket: Comply with ASTM C 552, Type II, Class 1.

6. Preformed Pipe Insulation with Factory-Applied ASJ or ASJ-SSL: Comply with ASTM C 552, Type II, Class 2.

7. Factory fabricate shapes according to ASTM C 450 and ASTM C 585.

- F. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials.

1. Products: Subject to compliance with requirements, provide one of the following:

- a. Aeroflex USA, Inc.; Aerocel.
- b. Armacell LLC; AP Armaflex.
- c. K-Flex USA; Insul-Lock, Insul-Tube, and K-FLEX LS.

- G. Mineral-Fiber, Preformed Pipe Insulation:

1. Products: Subject to compliance with requirements, provide one of the following:

- a. Johns Manville; Micro-Lok.
- b. Knauf Insulation; 1000-Degree Pipe Insulation.
- c. Owens Corning; Fiberglas Pipe Insulation.

2. Type I, 850 deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ or ASJ-SSL. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

2.2 INSULATING CEMENTS

- A. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449.

1. Products: Subject to compliance with requirements, provide one of the following.

- a. Ramco Insulation, Inc.; Ramcote 1200 and Quik-Cote.
- b. Approved alternate.

2.3 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.
- B. Cellular-Glass Adhesive: Two-component, thermosetting urethane adhesive containing no flammable solvents, with a service temperature range of minus 100 to plus 200 deg F.
 - 1. Products: Subject to compliance with requirements, provide one of the following.
 - a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 81-84.
 - b. Approved alternate.
- C. Flexible Elastomeric Adhesive: Comply with MIL-A-24179A, Type II, Class I.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Aeroflex USA, Inc.; Aeroseal.
 - b. Armacell LLC; Armaflex 520 Adhesive.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-75.
 - d. K-Flex USA; R-373 Contact Adhesive.
- D. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-127.
 - b. Eagle Bridges - Marathon Industries; 225.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-60/85-70.
 - d. Mon-Eco Industries, Inc.; 22-25.
- E. ASJ Adhesive, and FSK and PVDC Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-82.
 - b. Eagle Bridges - Marathon Industries; 225.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-50.
 - d. Mon-Eco Industries, Inc.; 22-25.
- F. PVC Jacket Adhesive: Compatible with PVC jacket.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Dow Corning Corporation; 739, Dow Silicone.
 - b. Johns Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.
 - c. P.I.C. Plastics, Inc.; Welding Adhesive.
 - d. Speedline Corporation; Polyco VP Adhesive.

2.4 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.
 - 1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below-ambient services.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-80/30-90.
 - b. Vimasco Corporation; 749.
 - 2. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm at 43-mil dry film thickness.
 - 3. Service Temperature Range: Minus 20 to plus 180 deg F.
 - 4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
 - 5. Color: White.

2.5 SEALANTS

- A. Joint Sealants:
 - 1. Joint Sealants for Cellular-Glass Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
 - b. Eagle Bridges - Marathon Industries; 405.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-45.
 - d. Mon-Eco Industries, Inc.; 44-05.
 - e. Pittsburgh Corning Corporation; Pittseal 444.
 - 2. Materials shall be compatible with insulation materials, jackets, and substrates.
 - 3. Permanently flexible, elastomeric sealant.
 - 4. Service Temperature Range: Minus 100 to plus 300 deg F.
 - 5. Color: White or gray.
- B. FSK and Metal Jacket Flashing Sealants:
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
 - b. Eagle Bridges - Marathon Industries; 405.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 95-44.
 - d. Mon-Eco Industries, Inc.; 44-05.
 - 2. Materials shall be compatible with insulation materials, jackets, and substrates.
 - 3. Fire- and water-resistant, flexible, elastomeric sealant.

4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: Aluminum.

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

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
 - b. Approved alternate.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: White.

2.6 FACTORY-APPLIED JACKETS

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

1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.
4. FSP Jacket: Aluminum-foil, fiberglass-reinforced scrim with polyethylene backing; complying with ASTM C 1136, Type II.
5. PVDC Jacket for Indoor Applications: 4-mil- thick, white PVDC biaxially oriented barrier film with a permeance at 0.02 perm when tested according to ASTM E 96/E 96M and with a flame-spread index of 5 and a smoke-developed index of 20 when tested according to ASTM E 84.
 - a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) Dow Chemical Company; Saran 540 Vapor Retarder Film and Saran 560 Vapor Retarder Film.
 - 2) Approved alternate.
6. PVDC-SSL Jacket: PVDC jacket with a self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip.
 - a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) Dow Chemical Company (The); Saran 540 Vapor Retarder Film and Saran 560 Vapor Retarder Film.
 - 2) Approved alternate.
7. Vinyl Jacket: White vinyl with a permeance of 1.3 perms when tested according to ASTM E 96/E 96M, Procedure A, and complying with NFPA 90A and NFPA 90B.

2.7 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

- B. FSK Jacket: Aluminum-foil face, fiberglass-reinforced scrim with kraft-paper backing.
- C. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.

1. Products: Subject to compliance with requirements, provide one of the following:

- a. Johns Manville; Zeston.
- b. P.I.C. Plastics, Inc.; FG Series.
- c. Proto Corporation; LoSmoke.
- d. Speedline Corporation; SmokeSafe.

2. Adhesive: As recommended by jacket material manufacturer.

3. Color: White.

4. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.

- a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.

- D. Aluminum Jacket: Comply with ASTM B 209, Alloy 3003, 3005, 3105, or 5005, Temper H-14.

1. Products: Subject to compliance with requirements, provide one of the following:

- a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Metal Jacketing Systems.
- b. ITW Insulation Systems; Aluminum and Stainless Steel Jacketing.
- c. RPR Products, Inc.; Insul-Mate.

2. Sheet and roll stock ready for shop or field sizing.

3. Finish and thickness are indicated in field-applied jacket schedules.

4. Moisture Barrier for Indoor Applications: 1-mil thick, heat-bonded polyethylene and kraft paper.

5. Factory-Fabricated Fitting Covers:

- a. Same material, finish, and thickness as jacket.
- b. Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
- c. Tee covers.
- d. Flange and union covers.
- e. End caps.
- f. Beveled collars.
- g. Valve covers.
- h. Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

- E. PVDC Jacket for Indoor Applications: 4-mil thick, white PVDC biaxially oriented barrier film with a permeance at 0.02 perms when tested according to ASTM E 96/E 96M and with a flame-spread index of 5 and a smoke-developed index of 20 when tested according to ASTM E 84.

1. Products: Subject to compliance with requirements, provide one of the following:

- a. Dow Chemical Company (The); Saran 540 Vapor Retarder Film.
- b. Approved alternate.

- F. PVDC-SSL Jacket: PVDC jacket with a self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Dow Chemical Company (The); Saran 540 Vapor Retarder Film and Saran 560 Vapor Retarder Film.
 - b. Approved alternate.

2.8 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. ABI, Ideal Tape Division; 428 AWF ASJ.
 - b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0836.
 - c. Compac Corporation; 104 and 105.
 - d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.
2. Width: 3 inches .
3. Thickness: 11.5 mils .
4. Adhesion: 90 ounces force/inch in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

- B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. ABI, Ideal Tape Division; 491 AWF FSK.
 - b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
 - c. Compac Corporation; 110 and 111.
 - d. Venture Tape; 1525 CW NT, 1528 CW, and 1528 CW/SQ.
2. Width: 3 inches.
3. Thickness: 6.5 mils
4. Adhesion: 90 ounces force/inch in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

- C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. ABI, Ideal Tape Division; 370 White PVC tape.
 - b. Compac Corporation; 130.
 - c. Venture Tape; 1506 CW NS.
2. Width: 2 inches .

3. Thickness: 6 mils.
4. Adhesion: 64 ounces force/inch in width.
5. Elongation: 500 percent.
6. Tensile Strength: 18 lbf/inch in width.

D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. ABI, Ideal Tape Division; 488 AWF.
 - b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
 - c. Compac Corporation; 120.
 - d. Venture Tape; 3520 CW.
2. Width: 2 inches.
3. Thickness: 3.7 mils.
4. Adhesion: 100 ounces force/inch in width.
5. Elongation: 5 percent.
6. Tensile Strength: 34 lbf/inch in width.

E. PVDC Tape for Indoor Applications: White vapor-retarder PVDC tape with acrylic adhesive.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Dow Chemical Company (The); Saran 540 Vapor Retarder Tape.
 - b. Approved alternate.
2. Width: 3 inches.
3. Film Thickness: 4 mils.
4. Adhesive Thickness: 1.5 mils.
5. Elongation at Break: 145 percent.
6. Tensile Strength: 55 lbf/inch in width.

2.9 SECUREMENTS

A. Aluminum Bands: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide with wing seal or closed seal.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. ITW Insulation Systems; Gerrard Strapping and Seals.
 - b. RPR Products, Inc.; Insul-Mate Strapping, Seals, and Springs.

B. Staples: Outward-clinching insulation staples, nominal 3/4-inch wide, stainless steel or Monel.

C. Wire: 0.062-inch soft-annealed, stainless steel.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. C & F Wire.
 - b. Approved alternate.

PART 3 - EXECUTION

3.1 PREPARATION

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

3.2 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of pipe system as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- G. Keep insulation materials dry during application and finishing.
- H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- I. Install insulation with least number of joints practical.
- J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
 - 1. Install insulation continuously through hangers and around anchor attachments.
 - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
 - 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
 - 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- L. Install insulation with factory-applied jackets as follows:

1. Draw jacket tight and smooth.
 2. Cover circumferential joints with 3-inch wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
 3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.
 - a. For below-ambient services, apply vapor-barrier mastic over staples.
 4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.
- M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.
- P. For above-ambient services, do not install insulation to the following:
1. Vibration-control devices.
 2. Testing agency labels and stamps.
 3. Nameplates and data plates.
 4. Manholes.
 5. Handholes.
 6. Cleanouts.

3.3 PENETRATIONS

- A. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- B. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.
1. Comply with requirements in Division 7 Section "Through-Penetration Firestop Systems" for firestopping and fire-resistive joint sealers.

3.4 GENERAL PIPE INSULATION INSTALLATION

- A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.
- B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:
1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.

2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
 3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
 4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
 5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.
 6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
 7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
 8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
 9. Stencil or label the outside insulation jacket of each union with the word "union." Match size and color of pipe labels.
- C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.
- D. Install removable insulation covers at locations indicated. Installation shall conform to the following:
1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
 2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
 3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.
 4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached

- insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.5 INSTALLATION OF CELLULAR-GLASS INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

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

B. Insulation Installation on Pipe Flanges:

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

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
2. When preformed sections of insulation are not available, install mitered sections of cellular-glass insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

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

3.6 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

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

B. Insulation Installation on Pipe Flanges:

1. Install pipe insulation to outer diameter of pipe flange.

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

C. Insulation Installation on Pipe Fittings and Elbows:

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

D. Insulation Installation on Valves and Pipe Specialties:

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

3.7 INSTALLATION OF MINERAL-FIBER PREFORMED PIPE INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

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

B. Insulation Installation on Pipe Flanges:

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

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available.

2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

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

3.8 FIELD-APPLIED JACKET INSTALLATION

A. Where FSK jackets are indicated, install as follows:

1. Draw jacket material smooth and tight.
2. Install lap or joint strips with same material as jacket.
3. Secure jacket to insulation with manufacturer's recommended adhesive.
4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch wide joint strips at end joints.
5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

B. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints; for horizontal applications. Seal with manufacturer's recommended adhesive.

1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

C. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

D. Where PVDC jackets are indicated, install as follows:

1. Apply three separate wraps of filament tape per insulation section to secure pipe insulation to pipe prior to installation of PVDC jacket.
2. Wrap factory-presize jackets around individual pipe insulation sections with one end overlapping the previously installed sheet. Install presized jacket with an approximate overlap at butt joint of 2 inches over the previous section. Adhere lap seal using adhesive or SSL, and then apply 1-1/4 circumferences of appropriate PVDC tape around overlapped butt joint.
3. Continuous jacket can be spiral-wrapped around a length of pipe insulation. Apply adhesive or PVDC tape at overlapped spiral edge. When electing to use adhesives, refer to manufacturer's written instructions for application of adhesives along this spiral edge to maintain a permanent bond.
4. Jacket can be wrapped in cigarette fashion along length of roll for insulation systems with an outer circumference of 33-1/2 inches or less. The 33-1/2-inch- circumference limit allows for 2-inch overlap seal. Using the length of roll allows for longer sections of jacket to be installed at one time. Use adhesive on the lap seal. Visually inspect lap seal for "fishmouthing," and use PVDC tape along lap seal to secure joint.

5. Repair holes or tears in PVDC jacket by placing PVDC tape over the hole or tear and wrapping a minimum of 1-1/4 circumferences to avoid damage to tape edges.

3.9 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
 1. Inspect pipe, fittings, strainers, and valves, randomly selected by Engineer, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded or welded fittings, two locations of threaded or welded strainers, three locations of threaded or flanged valves, for each pipe service defined in the "Piping Insulation Schedule, General" Article.
- C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.10 PIPING INSULATION SCHEDULE, GENERAL

- A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.
- B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:
 1. Drainage piping located in crawl spaces.
 2. Underground piping.
 3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.11 INDOOR PIPING INSULATION SCHEDULE

- A. Chilled Water, above 40 Deg F: Insulation shall be one of the following:
 1. Cellular Glass: 1-1/2 inches thick.
 2. Mineral-Fiber, Preformed Pipe, Type I, 1-1/2 inches thick.
- B. Heating-Hot-Water Supply and Return, 200 Deg F and Below: Insulation shall be one of the following:
 1. Cellular Glass: 1-1/2 inches thick.
 2. Mineral-Fiber, Preformed Pipe, Type I: 1-1/2 inch thick.

3.12 INDOOR, FIELD-APPLIED JACKET SCHEDULE

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
- B. If more than one material is listed, selection from materials listed is Contractor's option.
- C. Pipe and fittings, Concealed:
 1. PVC: 20 mils thick.
 2. Aluminum, Corrugated: 0.016 inch thick.

D. Pipe Fittings, Exposed:

1. PVC: 20 mils thick.
2. Aluminum, Corrugated: 0.016 inch thick.

END OF SECTION

SECTION 15110

GENERAL-DUTY VALVES FOR HVAC PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Brass ball valves.
2. Bronze ball valves.
3. Iron, single-flange butterfly valves.
4. High-performance butterfly valves.
5. Bronze gate valves.
6. Iron gate valves.
7. Bronze globe valves.
8. Iron globe valves.
9. Chainwheels.

B. Related Sections:

1. Section 15060 "steel piping" for valves applicable to the chilled water and heating water piping.
2. Section 15088 "Identification for HVAC Piping and Equipment" for valve tags and schedules.

1.2 SUBMITTALS

- ###### A. Product Data:
- For each type of valve indicated.

1.3 QUALITY ASSURANCE

- ###### A. Source Limitations for Valves:
- Obtain each type of valve from single source from single manufacturer.
- ###### B. ASME Compliance:
- ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

- ###### A. Refer to HVAC valve schedule articles for applications of valves.
- ###### B. Valve Pressure and Temperature Ratings:
- Not less than indicated and as required for system pressures and temperatures for this project.
- ###### C. Valve Sizes:
- Same as upstream piping unless otherwise indicated.
- ###### D. Valve Actuator Types:
1. Gear Actuator: For quarter-turn valves NPS 6" And larger.

2. Handwheel: For valves other than quarter-turn types.
 3. Handlever: For quarter-turn valves NPS 4" and smaller.
 4. Chainwheel: Device for attachment to valve handwheel, stem, or other actuator; of size and with chain for mounting height, as indicated in the "Valve Installation" Article.
- E. Valves in Insulated Piping: With 2-inch stem extensions and the following features:
1. Gate Valves: With rising stem.
 2. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
 3. Butterfly Valves: With extended neck.
- F. Valve-End Connections:
1. Flanged: With flanges according to ASME B16.1 for iron valves.
 2. Solder Joint: With sockets according to ASME B16.18.
 3. Threaded: With threads according to ASME B1.20.1.

2.2 BRASS BALL VALVES

- A. Three-Piece, Full-Port, Brass Ball Valves with Stainless-Steel Trim:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Valves.
 - b. Jenkins Valves.
 - c. Flow-Tek, Inc.; a subsidiary of Bray International, Inc.
 - d. Hammond Valve.
 - e. Jamesbury; a subsidiary of Metso Automation.
 - f. Milwaukee Valve Company.
 2. Description:
 - a. Standard: MSS SP-110.
 - b. SWP Rating: 150 psig
 - c. CWP Rating: 600 psig
 - d. Body Design: Two piece.
 - e. Body Material: Forged brass.
 - f. Ends: Threaded.
 - g. Seats: PTFE or TFE.
 - h. Stem: Stainless steel.
 - i. Ball: Stainless steel, vented.
 - j. Port: Full.

2.3 BRONZE BALL VALVES

- A. Three-Piece, Full-Port, Bronze Ball Valves with Stainless-Steel Trim:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Conbraco Industries, Inc.; Apollo Valves.
 - b. Crane Co.; Crane Valve Group; Crane Valves.
 - c. Hammond Valve.
 - d. Milwaukee Valve Company.
 - e. NIBCO INC.

- f. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

- a. Standard: MSS SP-110.
- b. SWP Rating: 150 psig.
- c. CWP Rating: 600 psig.
- d. Body Design: Two piece.
- e. Body Material: Bronze.
- f. Ends: Threaded.
- g. Seats: PTFE or TFE.
- h. Stem: Stainless steel.
- i. Ball: Stainless steel, vented.
- j. Port: Full.

2.4 IRON, SINGLE-FLANGE BUTTERFLY VALVES

A. 150 CWP, Iron, Single-Flange Butterfly Valves with EPDM Seat and Aluminum-Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Bray Controls; a division of Bray International.
- b. Conbraco Industries, Inc.; Apollo Valves.
- c. Crane Co.; Crane Valve Group; Jenkins Valves.
- d. Crane Co.; Crane Valve Group; Stockham Division.
- e. DeZurik Water Controls.
- f. Hammond Valve.
- g. Milwaukee Valve Company.
- h. NIBCO INC.

2. Description:

- a. Standard: MSS SP-67, Type I.
- b. CWP Rating: 150 psig
- c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
- d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
- e. Seat: EPDM.
- f. Stem: One- or two-piece stainless steel.
- g. Disc: Aluminum bronze.

B. 150 CWP, Iron, Single-Flange Butterfly Valves with EPDM Seat and Ductile-Iron Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Bray Controls; a division of Bray International.
- b. Conbraco Industries, Inc.; Apollo Valves.
- c. Crane Co.; Crane Valve Group; Jenkins Valves.
- d. Crane Co.; Crane Valve Group; Stockham Division.
- e. DeZurik Water Controls.
- f. Hammond Valve.
- g. Milwaukee Valve Company.
- h. NIBCO INC.

2. Description:

- a. Standard: MSS SP-67, Type I.
- b. CWP Rating: 150 psig.
- c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
- d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
- e. Seat: EPDM.
- f. Stem: One- or two-piece stainless steel.
- g. Disc: Nickel-plated or -coated ductile iron.

2.5 BRONZE GATE VALVES

A. Class 125, 2" and smaller, Non-Rising Stem Bronze Gate Valves:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Jenkins Valves.
 - c. Crane Co.; Crane Valve Group; Stockham Division.
 - d. Hammond Valve.
 - e. Milwaukee Valve Company.
 - f. NIBCO INC.
 - g. Powell Valves.
- 2. Description:
 - a. Standard: MSS SP-80, Type 1.
 - b. CWP Rating: 200 psig.
 - c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
 - d. Ends: Threaded or solder joint.
 - e. Stem: Bronze.
 - f. Disc: Solid wedge; bronze.
 - g. Packing: Asbestos free.
 - h. Handwheel: Malleable iron or aluminum.

B. Class 125, 2" and smaller, Rising Stem Bronze Gate Valves:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Jenkins Valves.
 - c. Crane Co.; Crane Valve Group; Stockham Division.
 - d. Hammond Valve.
 - e. Milwaukee Valve Company.
 - f. NIBCO INC.
 - g. Powell Valves.
- 2. Description:
 - a. Standard: MSS SP-80, Type 2.
 - b. CWP Rating: 200 psig
 - c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
 - d. Ends: Threaded or solder joint.
 - e. Stem: Bronze.
 - f. Disc: Solid wedge; bronze.
 - g. Packing: Asbestos free.
 - h. Handwheel: Malleable iron or aluminum.

2.6 IRON GATE VALVES

A. Class 125, 2.5" and larger, Non-Rising Stem, Iron Gate Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Jenkins Valves.
 - c. Crane Co.; Crane Valve Group; Stockham Division.
 - d. Hammond Valve.
 - e. Milwaukee Valve Company.
 - f. NIBCO INC.
 - g. Powell Valves.
2. Description:
 - a. Standard: MSS SP-70, Type I.
 - b. NPS 2-1/2" to NPS 12", CWP Rating: 200 psig.
 - c. Body Material: ASTM A 126, gray iron with bolted bonnet.
 - d. Ends: Flanged.
 - e. Trim: Bronze.
 - f. Disc: Solid wedge.
 - g. Packing and Gasket: Asbestos free.

2.7 BRONZE GLOBE VALVES

A. Class 125, 2" and smaller, Bronze Globe Valves with Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Stockham Division.
 - c. Hammond Valve.
 - d. Milwaukee Valve Company.
 - e. NIBCO INC.
 - f. Powell Valves.
2. Description:
 - a. Standard: MSS SP-80, Type 1.
 - b. CWP Rating: 200 psig.
 - c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
 - d. Ends: Threaded or solder joint.
 - e. Stem and Disc: Bronze.
 - f. Packing: Asbestos free.
 - g. Handwheel: Malleable iron or aluminum.

B. Class 125, 2" and smaller, Bronze Globe Valves with Nonmetallic soft-seat Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Stockham Division.
 - c. Hammond Valve.
 - d. Milwaukee Valve Company.

- e. NIBCO INC.
- f. Powell Valves.

2. Description:

- a. Standard: MSS SP-80, Type 2.
- b. CWP Rating: 200 psig.
- c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
- d. Ends: Threaded or solder joint.
- e. Stem: Bronze.
- f. Disc: PTFE or TFE.
- g. Packing: Asbestos free.
- h. Handwheel: Malleable iron or aluminum.

2.8 IRON GLOBE VALVES

A. Class 125, 2.5" and larger, Iron Globe Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Crane Co.; Crane Valve Group; Crane Valves.
- b. Crane Co.; Crane Valve Group; Jenkins Valves.
- c. Crane Co.; Crane Valve Group; Stockham Division.
- d. Hammond Valve.
- e. Milwaukee Valve Company.
- f. NIBCO INC.
- g. Powell Valves.

2. Description:

- a. Standard: MSS SP-85, Type 1.
- b. CWP Rating: 200 psig.
- c. Body Material: ASTM A 126, gray iron with bolted bonnet.
- d. Ends: Flanged.
- e. Trim: Bronze.
- f. Packing and Gasket: Asbestos free.

2.9 CHAINWHEELS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- 1. Babbitt Steam Specialty Co.
- 2. Roto Hammer Industries.
- 3. Trumbull Industries.

B. Description: Valve actuation assembly with sprocket rim, brackets, and chain.

- 1. Brackets: Type, number, size, and fasteners required to mount actuator on valve.
- 2. Attachment: For connection to butterfly valve stems.
- 3. Sprocket Rim with Chain Guides: Ductile iron, of type and size required for valve.
- 4. Chain: Hot-dip, galvanized steel, of size required to fit sprocket rim.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
- B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
- C. Examine threads on valve and mating pipe for form and cleanliness.
- D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.
- E. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE INSTALLATION

- A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- B. Locate valves for easy access and provide separate support where necessary.
- C. Install valves in horizontal piping with stem at or above center of pipe.
- D. Install valves in position to allow full stem movement.
- E. Install chainwheels on operators for any valve 6" and larger and more than 96 inches above floor. Extend chains to 60 inches above finished floor.

3.3 ADJUSTING

- A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

- A. If valve applications are not indicated, use the following:
 - 1. Shutoff Service: Ball, butterfly, or gate valves.
 - 2. Throttling Service, Except Steam: Globe or ball or butterfly valves.
- B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP classes or CWP ratings may be substituted.
- C. Select valves, except wafer types, with the following end connections:
 - 1. For Copper Tubing, NPS 2" and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.
 - 2. For Steel Piping, NPS 2" and Smaller: Threaded ends.
 - 3. For Steel Piping, NPS 2-1/2" to NPS 4": Flanged ends

4. For Steel Piping, NPS 5" and Larger: Flanged ends.

3.5 CHILLED-WATER VALVE SCHEDULE

A. Pipe NPS 2" and Smaller:

1. Bronze or Brass Valves: threaded ends.
2. Ball Valves: Three piece, full port, brass or bronze with stainless-steel trim.
3. Bronze Gate Valves: Class 125 NRS or RS, bronze.
4. Bronze Globe Valves: Class 125, bronze or nonmetallic disc.

B. Pipe NPS 2-1/2" and Larger:

1. Iron Valves, NPS 2-1/2" to NPS 4": flanged ends.
2. Iron, Single-Flange Butterfly Valves, NPS 2-1/2" to NPS 12": 200 CWP, EPDM seat, aluminum-bronze or ductile-iron disc.
3. Iron Gate Valves: Class 125, Rising or Non-Rising Stem
4. Iron Globe Valves: Class 125, Rising or Non-Rising Stem

3.6 HEATING-WATER VALVE SCHEDULE

A. Pipe NPS 2" and Smaller:

1. Bronze or Brass Valves: threaded ends.
2. Ball Valves: Three piece, full port, brass or bronze with stainless-steel trim.
3. Bronze Gate Valves: Class 125, Non-Rising Stem or Rising Stem.
4. Bronze Globe Valves: Class 125, bronze or nonmetallic disc.

B. Pipe NPS 2-1/2" and Larger:

1. Iron Valves, NPS 2-1/2" to NPS 4": flanged ends.
2. Iron, Single-Flange Butterfly Valves, NPS 2-1/2" to NPS 12": 200 CWP, EPDM seat, aluminum-bronze or ductile-iron disc.
3. Iron Gate Valves: Class 125, Rising or Non-Rising Stem
4. Iron Globe Valves: Class 125, Rising or Non-Rising Stem

END OF SECTION

SECTION 15120

METERS AND GAUGES FOR HVAC PIPING AND DUCTWORK

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Bimetallic-actuated thermometers.
2. Liquid-in-glass thermometers.
3. Thermowells.
4. Dial-type pressure gauges.
5. Gauge attachments.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Wiring Diagrams: For power, signal, and control wiring.
- C. Product certificates.
- D. Operation and maintenance data.

PART 2 - PRODUCTS

2.1 BIMETALLIC-ACTUATED THERMOMETERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings, or comparable product by one of the following:
 1. Ashcroft Inc.
 2. Ernst Flow Industries.
 3. Marsh Bellofram.
 4. Palmer Wahl Instrumentation Group.
 5. Terice, H. O. Co.
 6. Weiss Instruments, Inc.
 7. WIKA Instrument Corporation - USA.
- B. Standard: ASME B40.200.
- C. Case: sealed type; stainless steel with 5-inch nominal diameter.
- D. Dial: Nonreflective aluminum with permanently etched scale markings and scales in deg F
- E. Connector Type(s): Union joint, adjustable angle, with unified-inch screw threads.
- F. Connector Size: 1/2 inch, with ASME B1.1 screw threads.

- G. Stem: 0.375 inch in diameter; stainless steel.
- H. Window: Plain glass.
- I. Ring: Stainless steel.
- J. Element: Bimetal coil.
- K. Pointer: Dark-colored metal.
- L. Accuracy: Plus or minus 1 percent of scale range.

2.2 LIQUID-IN-GLASS THERMOMETERS

A. Metal-Case, Industrial-Style, Liquid-in-Glass Thermometers:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings, or comparable product by one of the following:
 - a. Palmer Wahl Instrumentation Group.
 - b. Trerice, H. O. Co.
 - c. Weiss Instruments, Inc.
2. Standard: ASME B40.200.
3. Case: Cast aluminum; 9-inch nominal size unless otherwise indicated.
4. Case Form: Adjustable angle, unless otherwise indicated.
5. Tube: Glass with magnifying lens and or red organic liquid.
6. Tube Background: Nonreflective aluminum with permanently etched scale markings graduated in deg F
7. Window: Glass.
8. Stem: Aluminum and of length to suit installation.
 - a. Design for Air-Duct Installation: With ventilated shroud.
 - b. Design for Thermowell Installation: Bare stem.
9. Connector: 1-1/4 inches, with ASME B1.1 screw threads.
10. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

2.3 DUCT-THERMOMETER MOUNTING BRACKETS

- A. Description: Flanged bracket with screw holes, for attachment to air duct and made to hold thermometer stem.

2.4 THERMOWELLS

A. Thermowells:

1. Standard: ASME B40.200.
2. Description: Pressure-tight, socket-type fitting made for insertion into piping tee fitting.
3. Material for Use with Copper Tubing: CNR or CUNI.
4. Material for Use with Steel Piping: CRES or CSA.
5. Type: Stepped shank unless straight or tapered shank is indicated.
6. External Threads: NPS 3/4, with ASME B1.20.1 pipe threads.
7. Internal Threads: NPS 3/4, with ASME B1.1 screw threads.
8. Bore: Diameter required to match thermometer bulb or stem.

9. Insertion Length: Length required to match thermometer bulb or stem.
10. Lagging Extension: Include on thermowells for insulated piping and tubing.
11. Bushings: For converting size of thermowell's internal screw thread to size of thermometer connection.

B. Heat-Transfer Medium: Mixture of graphite and glycerin.

2.5 PRESSURE GAUGES

A. Direct-Mounted, Metal-Case, Dial-Type Pressure Gauges:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AMETEK, Inc.; U.S. Gauge.
 - b. Ashcroft Inc.
 - c. Ernst Flow Industries.
 - d. Palmer Wahl Instrumentation Group.
 - e. Terice, H. O. Co.
 - f. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
 - g. Weiss Instruments, Inc.
 - h. WIKA Instrument Corporation - USA.
2. Standard: ASME B40.100.
3. Case: Sealed type(s); cast aluminum or drawn steel; 4-1/2-inch nominal diameter.
4. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
5. Pressure Connection: Brass, with NPS 1/2, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
6. Movement: Mechanical, with link to pressure element and connection to pointer.
7. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi
8. Pointer: Dark-colored metal.
9. Window: Glass
10. Ring: Stainless steel.
11. Accuracy: Grade A, plus or minus 1 percent of middle half of scale range.

2.6 GAUGE ATTACHMENTS

- A. Siphons: Loop-shaped section of brass or steel pipe NPS 1/2 pipe threads.
- B. Valves: Brass ball, with NPS 1/2, ASME B1.20.1 pipe threads.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install thermowells with socket extending to center of pipe and in vertical position in piping tees.
- B. Install thermowells of sizes required to match thermometer connectors. Include bushings if required to match sizes.
- C. Install thermowells with extension on insulated piping.
- D. Fill thermowells with heat-transfer medium.

- E. Install direct-mounted thermometers in thermowells and adjust vertical and tilted positions.
- F. Install P/T's plugs adjacent to all temperature gauges and pressure gauges for temporary pressure and temperature gauges for testing and checking.
- G. Install remote-mounted thermometer bulbs in thermowells and install cases on panels; connect cases with tubing and support tubing to prevent kinks. Use minimum tubing length.
- H. Install duct-thermometer mounting brackets in walls of ducts. Attach to duct with screws.
- I. Install direct-mounted pressure gauges in piping tees with pressure gauge located on pipe at the most readable position.
- J. Install valve cock and snubber in piping for each pressure gauge for fluids (except steam).
- K. Install differential-pressure-type flowmeter elements, with at least ten diameters minimum straight lengths of pipe, upstream and downstream from element according to manufacturer's written instructions.
- L. Install airflow measuring stations with enough upstream and downstream straight lengths of duct per the manufacturer's recommendations. Avoid fittings just before or after sensing element. Allow for recovery of laminar flow.
- M. Install permanent indicators on walls or brackets in accessible and readable positions.
- N. Install connection fittings in accessible locations for attachment to portable indicators.
- O. Install thermometers in the following locations:
 - 1. Inlet and outlet of each hydronic coil in the air-handling unit.
 - 2. Outside air, return air, and supply air, ducts.
- P. Install pressure gauges in the following locations:
 - 1. Inlet and outlet of each heating and cooling coil at the airhandler.

3.2 CONNECTIONS

- A. Install gauges adjacent to machines and equipment to allow service and maintenance of gauges and equipment.
- B. Install gauges in the ductwork as specified and recommended by the manufacturer.

3.3 ADJUSTING

- A. After installation, calibrate meters according to manufacturer's written instructions.
- B. Adjust faces of meters and gauges to proper angle for best visibility.

3.4 THERMOMETER SCHEDULE

- A. Thermometers at inlet and outlet of each hydronic coil in air-handling units shall be one of the following:
 - 1. Industrial-style, liquid-in-glass type.

B. Thermometers at outside-, return-, supply-, air ducts shall be the following:

1. Sealed, bimetallic-actuated type.

C. Thermometer stems shall be of length to match thermowell insertion length.

3.5 THERMOMETER SCALE-RANGE SCHEDULE

A. Scale Range for Chilled-Water Piping: 0 to 100 deg F

B. Scale Range for Heating, Hot-Water Piping: 20 to 240 deg F

C. Scale Range for Air Ducts: 0 to 160 deg F.

3.6 PRESSURE-GAUGE SCHEDULE

A. Pressure gauges at inlet and outlet of each chilled water and heating water connection at the air handler coil shall be one of the following:

1. Sealed, direct-mounted, metal case.

3.7 PRESSURE-GAUGE SCALE-RANGE SCHEDULE

A. Scale Range for Chilled-Water Piping: 0 to 100 psi.

B. Scale Range for Heating, Hot-Water Piping: 0 to 100 psi.

END OF SECTION

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SECTION 15140

HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Scope: This section specifies pipe and equipment hangers, brackets, and supports. Pipe supports shall be furnished complete with all necessary inserts, bolts, nuts, rods, washers and other accessories. Piping seismic restraints are specified in Section 15150.
- B. Operating Conditions: The hangers and supports specified in this section are provided to resist pipe loads occurring primarily in the downward (gravity) direction. For the purpose of pipe hanger and support selection, this section establishes pipe support classifications based on the operating temperatures of the piping contents. Pipe support classifications are as follows:
- | | |
|------------------|-----------------|
| Cold Systems: | 32°F to 59°F. |
| Ambient Systems: | 60°F to 119°F. |
| Hot Systems: | 120°F to 250°F. |
- C. Hanger and Support Selection:
1. In certain locations, pipe supports, anchors, and expansion joints have been indicated on the Drawings, but no attempt has been made to indicate every pipe support, anchor and expansion joint. It shall be the Contractor's responsibility to provide a complete system of pipe supports, to provide expansion joints, and to anchor all piping, in accordance with the requirements set forth herein. Additional pipe supports may be required adjacent to expansion joints, couplings, or valves.
 2. Concrete or fabricated steel and FRP supports shall be as indicated on the Drawings, as specified in other sections, or, in the absence of such requirements, as permitted by the University's representative.
 3. The Contractor shall select pipe hangers and supports as specified in this Section. Stock hanger and support components shall be used wherever practical. Selections shall be based upon the pipe support classifications specified in this Section; the piping insulation thickness specified in Section 23 07 00, and any special requirements, which may be specified in the Project Specification.
 4. The Contractor shall review the piping layout in relation to the surrounding structure and adjacent piping and equipment before selecting the type of support to be used at each hanger point.
 5. All piping shall be rigidly supported and anchored so there is no movement or visible sagging between supports.
 6. Hangers and supports shall withstand all static and specified dynamic conditions of loading to which the piping and associated equipment may be subjected. As a minimum, consideration should be given to the following conditions:
 - a. Weights of pipe, valves, fittings, insulating materials, suspended hanger components, and normal fluid contents.
 - b. Weight of hydrostatic test fluid or cleaning fluid if normal operating fluid contents are lighter.
 - c. Reaction forces due to the operation of safety or relief valves.
 - d. Wind loadings on outdoor piping.
 7. Hangers and supports shall be sized to fit the outside diameter of pipe, tubing, or, where specified, indicated or required, the outside diameter of insulation.
 8. Where negligible movement occurs at hanger locations, rod hangers should be used for suspended lines, wherever practical. For piping supported from below, bases, brackets or structural cross members should be used.
 9. Hangers for the suspension of size 2-1/2 inches and larger pipe and tubing shall be capable of vertical hanger component adjustment under load.

10. The supporting systems shall provide for and control the free or intended movement of the piping including its movement in relation to that of connected equipment.
11. Where there is horizontal movement at a suspended type hanger location, hanger components shall be selected to allow for swing. The vertical angle of the hanger rod shall not, at any time, exceed 4 degrees.
12. There shall be no contact between a pipe and hanger or support component of dissimilar metals when supporting copper tubing by use of felt isolator inserts, rubber, plastic or vinyl coated, or felt lined hanger and support components.
13. Unless otherwise specified, existing pipes and supports shall not be used to support new piping.
14. Unless otherwise specified, pipe support components shall not be attached to pressure vessels.
15. Plumber's tape shall not be used to support piping.

1.2 QUALITY ASSURANCE

- A. References: This section contains references to the following standards for manufacturer and installation requirements. They are a part of this section in their entirety or as specifically modified. In case of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail. In case of conflict between the listed documents, the more stringent requirement shall prevail.

AISC M016	Manual of Steel Construction - 9th Edition
ASME B31.1	Power Piping
ASME B31.2	Fuel Gas Piping
ASME B31.9	Building Services Piping
ASTM E84	Surface Burning Characteristics of Building Materials, Test Method for
MSS SP58	Pipe Hangers and Supports - Materials, Design and Manufacturer.
MSS SP69	Pipe Hangers and Supports - Selection and Application.
NFPA 13	Installation of Sprinkler Systems.
NFPA 14	Installation of Standpipe and Hose Systems.
SMACNA	Seismic Restraint Manual Guidelines for Mechanical Systems.
UL 203	Pipe Hanger Equipment for Fire Protection Service

- B. Supports for Mechanical Systems and Plumbing Piping Systems: In conformance with MSS SP-58 and SP-69.
- C. Supports for Sprinkler Piping: In conformance with minimum requirements as established in NFPA 13.
- D. Supports for Standpipes: In conformance with minimum requirements as established in NFPA 14.

1.3 SUBMITTALS

- A. Submit the following under provisions of paragraph 23 05 00-1.11:
1. Shop Drawings: Indicate system layout with location and detail of trapeze hangers.
 2. Product Data: Provide manufacturers catalog data including load capacity.
 3. Design Data: Indicate load carrying capacity of trapeze, multiple pipe, and riser support hangers. For every piece of material or equipment with an operating weight of 500 pounds or more, the Contractor shall submit a design support drawing prepared and sealed by a California Licensed Structural Engineer. All designs shall conform to 2007 CBC requirements.

PART 2 - PRODUCTS

2.1 ACCEPTABLE PRODUCTS

- A. Standard pipe supports and components shall be manufactured by B-Line, Carpenter & Patterson, Kin-Line, ITT Grinnell, Michigan, Pipe Shields Incorporated, Superstrut, Unistrut, Tolco, Piping Technology & Products, Inc. or equal.
- B. Plumbing Piping - DWV:
Conform to ASME B31.9, MSS SP58 and MSS SP69.
Hangers for Pipe Sizes 1/2 to 1-1/2 Inch: Malleable iron, adjustable swivel, and split ring.
Hangers for Pipe Sizes 2 Inches and Over: Carbon steel, adjustable, clevis.
Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
Wall Support for Pipe Sizes to 3 Inches: Cast iron hook.
Wall Support for Pipe Sizes 4 Inches and Over: Welded steel bracket and wrought steel clamp.
Vertical Support: Steel riser clamp.
Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
Copper Pipe Support: Carbon steel ring, adjustable, felt lined or vinyl coated.
- C. Plumbing Piping - Water:
1. Conform to ASME B31.9, MSS SP58 and MSS SP69.
2. Hangers for Pipe Sizes 1/2 to 1-1/2 Inch: Malleable iron, adjustable swivel, and split ring.
3. Hangers for Cold Pipe Sizes 2 Inches and Over: Carbon steel, adjustable, clevis.
4. Hangers for Hot Pipe Sizes 2 to 4 Inches: Carbon steel, adjustable, clevis.
5. Hangers for Hot Pipe Sizes 6 Inches and Over: Adjustable steel yoke, cast iron roll, double hanger.
6. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
7. Multiple or Trapeze Hangers for Hot Pipe Sizes 6 Inches and Over: Steel channels with welded spacers and hanger rods, cast iron roll.
8. Wall Support for Pipe Sizes to 3 Inches: Cast iron hook.
9. Wall Support for Pipe Sizes 4 Inches and Over: Welded steel bracket and wrought steel clamp.
10. Vertical Support: Steel riser clamp.
11. Floor Support for Cold Pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
12. Copper Pipe Support: Carbon steel ring, adjustable, felt lined or vinyl coated.
- D. Hydronic Piping:
1. Conform to ASME B31.9, MSS SP58 and MSS SP69.
2. Hangers for Pipe Sizes 1/2 to 1-1/2 Inch: Malleable iron, adjustable swivel, split ring, and spring hanger.
3. Hangers for Cold Pipe Sizes 2 Inches and Over: Carbon steel, adjustable, clevis, spring hanger.
4. Hangers for Hot Pipe Sizes 2 to 6 Inches: Carbon steel, adjustable, roller, spring hanger.
5. Hangers for Hot Pipe Sizes 6 Inches and Over: Not Used.
6. Pipe Anchor:
a. Manufacturers:
1) Piping Technology & Products, Inc.
2) ITT Grinnell
3) B-Line
4) Or equal.
b. Factory fabricated, double saddle, welded construction, made of high strength carbon steel.
c. Anchor shall be capable of withstanding a deadweight (downward force) equivalent to the weight 28 feet of Sch.40 pipe filled with water of the pipe size it supports.
d. Provide with critical dimensions as indicated on the Drawings.
e. Anchors shall be degreased, and deburred, shop coat primed and ready for welding when delivered to the jobsite.
f. Pipe anchor shall be capable of withstanding a lateral seismic force equal to 0.6 times the deadweight force. Pipe anchor shall be capable of withstanding an axial thrust load equal to 1/2 of the deadweight force.

- 1) Pipe Slide Support Assembly:
- g. Manufacturers:
 - 1) Piping Technology & Products, Inc.
 - 2) ITT Grinnell
 - 3) B-Line
 - 4) Or equal.
- h. Factory fabricated, (2) piece assembly, as indicated on the Drawings.
- i. Top piece shall consist of saddle support with double U-bolt hold down assembly. Assembly shall be completely factory fabricated and have slots for the four (4) hold down bolts of the bottom assembly. Slots shall be sized as follows:
 - 1) Chilled Water: Provisions for 3/4" slide, either direction along pipe axis.
 - 2) Refer to the front and side view shown on the drawings.
- j. Assembly shall be capable of withstanding a downward deadweight force equal to the weight of 28 feet of Schedule 40 pipe filled with water of the pipe size it supports. Assembly shall also be capable of withstanding a lateral or tangential seismic horizontal force equal to 0.6 times the deadweight.
- k. Pipe Guide Assembly:
- l. Manufacturers:
 - 1) Piping Technology & Products, Inc.
 - 2) ITT Grinnell
 - 3) B-Line
 - 4) Or equal.
- m. Factory fabricated, two (2) piece, welded construction, and made entirely of carbon steel.
- n. Unit shall consist of retainer outer tube and spider slide/pipe clamp assembly.
- o. Assembly shall be capable of withstanding a downward deadweight force equal to the weight of 28 feet of Schedule 40 pipe filled with water of the pipe size it supports. Assembly shall also be capable of withstanding a lateral or tangential seismic horizontal force equal to 0.6 times the deadweight.
- p. Elbow Supports:
- q. Welded steel pipe stand with steel base plate anchored and grouted to floor, seismic spring support and welded steel extension off pipe elbow. Use U-bolt cradle where support is below horizontal pipe; refer to the Drawings.
- r. Spring shall have minimum 2" deflection.
Wall Support for Pipe Sizes to 4" shall be as indicated on the Drawings.

2.2 STRUCTURAL ATTACHMENTS

- A. Steel beam clamp with Eye Nut: Beam clamp and eye nut shall be forged steel. Configuration and components shall comply with MSS and FEDSPEC Type 28. Grinnell Fig. 292, Carpenter & Patterson Fig. 297, or equal.
- B. Welded Beam Attachment: Beam attachment shall be carbon steel and comply with MSS and FEDSPEC Type 22. B-Line B3083, Grinnell Fig. 66, or equal.
- C. Welded Steel Bracket: Bracket shall be carbon steel and comply with MSS Type 32 and FEDSPEC Type 33 for medium welded bracket shall comply with MSS Type 33 and FEDSPEC Type 34.
- D. Beam "C" Clamp with Locknut and Retaining Strap: Beam clamp and locknut shall be forged steel. Configuration and components shall comply with MSS and FEDSPEC Type 19. Tolco Fig. 65 or 66 with Fig. 69 retaining strap, B-Line B3036 with B3362 strap, or equal.
- E. Concrete Wall Attachment: Concrete wall attachments shall conform to SMACNA Seismic Restraint Manual Guidelines for Mechanical Systems.

2.3 ACCESSORIES

- A. Hanger Rods: Rods shall be carbon steel or 304 stainless steel, threaded on both ends or continuous threaded and sized as specified.
- B. Weldless Eye Nut: Eye nut shall be forged steel and shall comply with MSS and FEDSPEC Type 17. Eye nut shall be Grinnell Fig. 290, B-Line B2300, or equal.
- C. Welded Eye Rod: Eye rod shall be carbon steel with eye welded closed. Inside diameter of eye shall accommodate a bolt diameter 1 / 8 inch larger than the rod diameter. Eye rod shall be Grinnell Fig. 278, B-Line B2311, or equal.
- D. Turnbuckle: Turnbuckle shall be forged steel and shall comply with MSS and FEDSPEC Type 15. Turnbuckle shall be Grinnell Fig. 230, B-Line B2311, or equal.
- E. Metal Framing Channel: Framing channel shall conform to the Metal Framing Manufacturers Association Standard MFMA-1. Framing channel shall be 1-5/8 inches square, roll formed, and 12-gage carbon steel. Channel shall have a continuous slot along one side with intumed clamping ridges. Framing channel shall be Unistrut P-1000 series, Superstrut A-1200 series, or equal.
- F. Vinylester Resin Fiberglass Framing Channel: Framing channel shall conform to ASTM E84 and shall be Class 1 fire-rated. Framing channel shall be 1-5/8" square. All channels shall be supplied with integral notches at 1" on center. Notches shall be located on the interior flange to prevent stoppage of pipe clamps and fittings after installation. Seal exposed glass fibers at cuts with manufacturer's sealant. Framing channel shall be StruTech, Series 200, vinylester resin fiberglass or equal (no known equal).
- G. Thermal Pipe Hanger Shield: Thermal shields shall be provided at hanger, support and guide locations on pipe requiring insulation. The shield shall consist of an insulation layer encircling the entire circumference of the pipe and a steel jacket encircling the insulation layer and shall be as specified in Section 23 07 00. The thermal shield shall be the same thickness as the piping system insulation specified in Section 23 07 00. The vapor barrier shield shall be used for cold systems. Stainless steel band clamps shall be used where specified to ensure against slippage between the pipe wall and the thermal shield.

2.4 INSERTS:

- A. Malleable iron case of galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods and load.

PART 3 - EXECUTION

3.1 INSERTS

- A. Provide inserts for placement in concrete formwork.
- B. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
- C. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches.
- D. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
- E. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut recessed into and grouted flush with slab.

3.2 PIPE HANGER AND SUPPORT LOCATIONS

- A. The Contractor shall locate hangers and supports as near as possible to concentrated loads such as valves, flanges, etc. Locate hangers, supports and accessories within the maximum

span lengths specified in the project specifications to support continuous pipeline runs unaffected by concentrated loads.

- B. At least one hanger or support shall be located within 2 feet from a pipe change in direction.
- C. The Contractor shall locate hangers and supports to ensure that connections to equipment, tanks, etc., are substantially free from loads transmitted by the piping.
- D. Where piping is connected to equipment, a valve, piping assembly, etc. that will require removal for maintenance, the piping shall be supported in such a manner that temporary supports shall not be necessary for this procedure.
- E. Pipe shall not have pockets formed in the span due to sagging of the pipe between supports caused by the weight of the pipe, medium in the pipe, insulation, valves and fittings.
- F. Support horizontal cast iron pipe within 18 inches of each joint.
- G. Support vertical piping at every floor. Support vertical cast iron pipe at each floor level, not to exceed 8 feet on center spacing.

3.3 INSTALLATION

- A. Welded and bolted attachments to the building structural steel shall be provided where required and shall be in accordance with the requirements of SMACNA Seismic Restraint Guide and AISC M016. Unless otherwise specified, there shall be no drilling or burning of holes in the building structural steel.
- B. Unless otherwise indicated, attachments to the building concrete shall be in accordance with the requirements of SMACNA Seismic Restraint Guide.
- C. Hanger components shall not be used for purposes other than, for which they were designed. They shall not be used for rigging and erection purposes.
- D. The Contractor shall install items to be embedded before concrete is poured. Fasten embedded items securely to prevent movement when concrete is poured.
- E. Embedded anchor bolts shall be used instead of concrete inserts for support installations in areas below water surface or normally subject to submerging.
- F. The Contractor shall install thermal pipe hanger shields on insulated piping at required locations during hanger and support installation. Butt joint connections to pipe insulation shall be made at the time of insulation installation in accordance with the manufacturer's recommendations.
- G. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
- H. Support riser piping independently of connected horizontal piping.
- I. Provide felt lined inserts for copper piping.
- J. Hanger and support components in contact with plastic or FRP pipe shall be free of burrs and sharp edges.
- K. Rollers shall roll freely without binding.
- L. Finished floor beneath pipe stand and framing channel post bases shall be roughed prior to grouting. Grout between base plate and floor shall be free of voids and foreign material.
- M. Base plates shall be cut and drilled to specified dimensions prior to welding stanchions or other attachments and prior to setting anchor bolts.

- N. Plastic or rubber end caps shall be provided at the exposed ends of all framing channels that are located up to 7 feet above the floor.
- O. Prime coat all exposed steel hangers and supports. Refer to Section 09900 for finish painting. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.
- P. Unless otherwise indicated, exposed exterior steel pipe supports, channel, and clamps shall have hot dipped galvanized finish of minimum 1.50 ounces per square foot on each side in conformance with ASTM A123.
- Q. Welds on pipe supports, either interior or exterior shall be cleaned of flux and finished with a "zinc rich" primer.
- R. The Contractor shall adjust hangers and supports to obtain required pipe slope and elevation. Shims made of material that is compatible with the piping material may be used. Stanchions shall be adjusted prior to grouting their base plates.
- S. Beam clamps shall not be installed on piping greater than 8 inches in diameter. All beam clamps shall have beam clamp retaining straps.

3.4 EQUIPMENT BASES AND SUPPORTS

- A. Provide housekeeping pads of concrete, thickness as indicated on the Drawings and extending 6 inches beyond supported equipment.
- B. Provide templates, anchor bolts, and accessories for mounting and anchoring equipment.
- C. Construct supports of steel members. Brace and fasten with flanges bolted to structure.
- D. Provide rigid anchors for pipes after vibration isolation components are installed.

3.5 FLASHING

- A. Provide flashing where indicated or necessary.
- B. Provide acoustical lead flashing around ducts and pipes penetrating equipment rooms installed in accordance with manufacturer's instructions for sound control.

3.6 SLEEVES

- A. Set sleeves in position in formwork. Provide reinforcing around sleeves.
- B. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.
- C. Extend sleeves through floors one inch above finished floor level. Caulk sleeves.
- D. Where piping or ductwork penetrates floor, ceiling, or wall, close off space between pipe or duct and adjacent work with fire stopping insulation and caulk airtight. Provide close fitting metal collar or escutcheon covers at both sides of penetration.
- E. Install chrome plated steel escutcheons at finished surfaces.

PIPE SIZE (Inches)	MAXIMUM SUPPORT SPACING (Feet)	HANGER ROD DIAMETER (Inches)
<u>Steel (sched 40)</u>		
1/2	6	3/8
3/4 to 1	8	3/8
1-1/4 to 2	9	3/8
2-1/2 to 3	10	1/2
4 to 6	14	5/8
 <u>Copper Type L</u>		
1/2 to 3/4	5	3/8
1 to 1-1/4	6	3/8
1-1/2 to 2	8	3/8
2-1/2 to 3	9	1/2
4 to 6	12	5/8

END OF SECTION

SECTION 15150

VIBRATION ISOLATION AND SEISMIC CONTROL

PART 1 - GENERAL

1.1 SUMMARY

- A. Scope: This section specifies seismic restraints for bracing all piping systems specified in Section 23 21 13. This section does not include seismic restraints for fire sprinkler piping or pipe slide supports for chilled water piping, which are seismically restrained and specified under Section 23 05 29. It also specifies seismic restraint for ductwork and mechanical equipment.
- B. This Section includes the following:
1. Freestanding and restrained spring isolators.
 2. Elastomeric isolation pads and mounts.
 3. Elastomeric hangers.
 4. Spring hangers.
 5. Spring hangers with vertical-limit stops.
 6. Thrust limits.
 7. Resilient pipe guides.
 8. Seismic snubbers.
 9. Restraining cables.

1.2 DEFINITIONS

- A. A_v : Effective peak velocity related acceleration coefficient.
- B. OSHPD: Office of Statewide Health Planning & Development for the State of California. OSHPD assigns a unique anchorage preapproval "R" number to each seismic restraint it tests. The number describes a specific device applied as tested.
- C. Longitudinal direction - Parallel to the run.
- D. Transverse (lateral) direction - Perpendicular to the run.

1.3 PERFORMANCE REQUIREMENTS

- A. A_v : 0.56
- B. Component Seismic Coefficient: 3.0.
- C. Performance Criteria Factor: 1.0.
- D. Attachment Amplification Factor: 1.0.

1.4 DESIGN PARAMETERS

- A. Operating Conditions: The seismic restraints specified in this section are provided to resist pipe movements and loads occurring as a result of an earthquake or other seismic event. All piping shall be provided with seismic restraints in accordance with the Seismic Hazard Level of the SMACNA Seismic Restraint Manual and UBC 16A-8 Volume 2, Earthquake Design:

SMACNA Seismic Hazard Level (SHL)	A
SMACNA Connection Level	3
Seismic Zone Factor from UBC Table No. 16A-I (Z)	0.4
Seismic Importance Factor from UBC Table No 16A-K (I)	1.5

Horizontal Force Factor from Table 16-O (aP)	1.0
Horizontal Force Factor from Table 16-O (RP)	3.0

1.5 RESTRAINT SELECTION

- A. Unless otherwise specified, the Contractor shall select, locate and provide seismic restraints for piping in accordance with paragraph 23 05 48-1.02-C. The Contractor shall review the piping layout in relation to the surrounding structure and adjacent piping and equipment before selecting the restraints to be used at each point. Seismic restraints may be omitted from the following:

1. Piping in mechanical equipment rooms less than 1-1/4 inch nominal diameter.
2. All other piping less than 2-1/2 inch nominal diameter.
3. All piping suspended by individual hangers 12 inches or less in length, as measured from the top of the pipe to the bottom of the support where the hanger is attached.

Piping systems shall not be braced to dissimilar parts of a building or to dissimilar building systems that may respond in a different mode during an earthquake (i.e. - wall and a roof; solid concrete wall and a metal deck with lightweight concrete fill, etc.). Restraints shall be sized to fit the outside diameter of the pipe, tubing, or, where specified, the outside diameter of insulation. There shall be no contact between a pipe and restraint component of dissimilar metals. The Contractor shall prevent contact between dissimilar metals when restraining copper tubing by the use of copper-plated, rubber, plastic or vinyl coated, or stainless steel restraint components.

- B. Branch lines shall not be used to brace main lines. Seismic bracing shall not be used to limit the expansion and contraction of the piping system.

1.6 SUBMITTALS

- A. Product Data: Include load deflection curves for each vibration isolation device.
- B. Shop Drawings: Signed and sealed by a qualified professional engineer. Include the following:
- C. Design Calculations: Calculate requirements for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.
1. Vibration Isolation Base Details: Detail fabrication, including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails, base weights, equipment static loads, power transmission, component misalignment, and cantilever loads.
 2. Seismic-Restraint Details: Detail fabrication and attachment of seismic restraints and snubbers. Show anchorage details and indicate quantity, diameter, and depth of penetration of anchors.
 3. Submittals for Interlocking Snubbers: Include load deflection curves up to 1/2-inch deflection in x, y, and z planes.
- D. Welding certificates.
- E. Manufacturer Seismic Qualification Certification: Submit certification that all specified equipment will withstand seismic forces identified in "Performance Requirements" Article above. Include the following:
- F. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculations.
1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."

2. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

G. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.

1. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

1.7 CODES AND REFERENCES

A. References: This section contains references to the following documents. They are a part of this section as specified and modified. In case of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

AISC M016	Manual of Steel Construction - 9th Edition
ANSI A58.1	Minimum Design Loads for Buildings and Other Structures.
FEDSPEC WW-H-171e	Hangers and Supports, Pipe.
MFMA-1	Metal Framing Standards Publication.
MSS SP-58	Pipe Hangers and Supports - Materials, Design and Manufacturers.
MSS SP-69	Pipe Hangers and Supports - Selection and Application.
SMACNA	Seismic Restraint Manual Guidelines for Mechanical Systems.
UBC 23 Part III	Earthquake Design

1.8 QUALITY ASSURANCE

- A. Seismic-restraint devices shall have horizontal and vertical load testing and analysis performed according to OSHPD and shall bear anchorage preapproval "R" number, from OSHPD or another agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are not available, submittals based on independent testing are preferred. Testing and calculations must include both shear and tensile loads and 1 test or analysis at 45 degrees to the weakest mode.
- B. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code-Steel."
- C. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional structural engineer licensed in the State of California.

1.9 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into base. Concrete, reinforcement, and formwork requirements are specified in Division 3.
- B. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 7 Section "Roof Accessories."

1.10 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

- B. Seismic Snubber Units: Furnish replacement neoprene inserts for all snubbers.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
- B. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.2 SEISMIC BRACING

- A. Manufacturers
1. Carpenter & Patterson,
 2. B-line,
 3. Tolco,
 4. Kin-line,
 5. ITT Grinnell,
 6. Michigan Pipe Hangers
 7. Pipe Shields Incorporated,
 8. Superstrut,
 9. Unistrut
- B. Pipe Attachments:
1. Clevis Restraint Attachment: Clevis attachment shall be MSS Type 1, Clevis pipe hanger.
 2. Roller Restraint Attachment: Roller attachment shall be MSS Type 43, adjustable roller hanger. Hold down strap shall be carbon steel and sized as follows: pipe size 1 inch through 2 inches shall be 1 inch by 1/8 inch thick, pipe sizes 2-1/2 inch through 4 inch shall be 1-1/4 inch by 3/16 inch thick, 6 inch pipe shall be 2 inch by 3/16 inch thick, 8 inch pipe shall be 2-1/2 by 3/16 inch thick, 10 inch through 16 inch pipe shall be 2-1/2 inch by 1/4 inch thick, 20 inch pipe shall be 3 inch by 1/4 inch thick, and 24 inch pipe shall be 3 inch by 3/8 inch thick.
 3. U-Bolt Restraint: U-bolt restraint shall be MSS Type 24 as specified in Section 23 05 29.
 4. Framing Channel Pipe Strap: Pipe strap shall be carbon steel; with configuration equivalent to MSS Type 26.
- C. Trapeze Restraints
1. General: Unless otherwise specified, trapeze members shall have a minimum steel thickness of 12 gage, with a maximum deflection 1/240 of the span.
 2. Single Channel Lateral Restraint: Trapeze restraint cross member shall be 1-5/8 inch square carbon steel framing channel, Unistrut P1000, Superstrut A-1200, or equal. Pipe attachments shall be equivalent to those indicated on the plans for single pipe support.
- D. Tangential and Longitudinal Structural Attachments: Unless otherwise specified, structural attachments for tangential and longitudinal seismic braces shall conform to SMACNA Seismic Restraint Manual Table 8-1.
- E. Accessories:
1. Hanger Rods: Rods shall be carbon steel or 304 stainless steel, threaded on both ends or continuous threaded and sized per SMACNA Seismic Restraint Manual.
 2. Framing Channel: Framing channel shall conform to the Metal Framing Manufacturers Association Standard MFMA-1. Framing channel shall be roll formed, with 12-gage of carbon steel as indicated.

3. Rod Coupling: Rod coupling shall be carbon steel, with sight hole in center of coupling body, Grinnell Fig. 135, Superstrut H-119, or equal.

- F. Thermal shields shall be provided at seismic restraint locations on pipe requiring insulation. Thermal pipe hanger shields shall be as specified in paragraph 23 05 29-2.03-G. Stainless steel band clamps shall be provided on thermal shields at longitudinal pipe restraint locations.

2.3 VIBRATION ISOLATORS

A. Manufacturers:

1. Amber/Booth Company, Inc.
2. B-Line Systems, Inc.
3. California Dynamics Corp.
4. Isolation Technology, Inc.
5. Kinetics Noise Control, Inc.
6. Mason Industries, Inc.
7. Vibration Eliminator Co., Inc.
8. Vibration Isolation Co., Inc.
9. Vibration Mountings & Controls/Korfund.
10. Or equal.

- B. Elastomeric Isolator Pads EIP: 1/4-inch to 5/16-inch thick ribbed or waffled neoprene, arranged in single or multiple layers, molded with a nonslip pattern and galvanized steel baseplates of sufficient stiffness for uniform loading over pad area, and factory cut to sizes that match requirements of supported equipment.

1. Material: Standard neoprene.
2. Durometer Rating: 40 or 50.
3. Number of Layers: 2.

- C. Elastomeric Mounts EM: Neoprene-in-shear type with steel reinforced top and base. All metal surfaces shall be covered with neoprene. The top and bottom surfaces shall be ribbed. Bolt holes shall be provided in the base and the top shall have a threaded fastener. The mounts shall include leveling bolts that may be rigidly connected to the equipment. Color-code or otherwise identify to indicate capacity range.

1. Durometer Rating: 40 or 50.

- D. Spring Isolators SI: Freestanding, laterally stable, open-spring isolators.

- E. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.

1. Minimum Additional Travel: 50 percent of the required deflection at rated load.
2. Lateral Stiffness: More than 80 percent of the rated vertical stiffness.
3. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
4. Baseplates: Factory drilled for bolting to structure and bonded to 1/4-inch- thick, rubber or neoprene isolator pad attached to baseplate underside. Baseplates shall limit floor load to 100 psig.
5. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.

- F. Restrained Spring Isolators RSI: Freestanding, steel, open-spring isolators with seismic restraint.

1. Housing: Steel with resilient vertical-limit stops to prevent spring extension due to wind loads or if weight is removed; factory-drilled baseplate bonded to 1/4-inch- thick, elastomeric isolator pad attached to baseplate underside; and adjustable equipment mounting and leveling bolt that acts as blocking during installation.
2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.

3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 4. Lateral Stiffness: More than 80 percent of the rated vertical stiffness.
 5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
- G. Elastomeric Hangers EH: Neoprene-in-shear type with molded, oil-resistant rubber or neoprene isolator elements bonded to steel housings with threaded connections for hanger rods. Color-code or otherwise identify to indicate capacity range.
- H. Spring Hangers SH: Combination coil-spring and elastomeric-insert hanger with spring and insert in compression.
- I. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
1. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 2. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 3. Lateral Stiffness: More than 80 percent of the rated vertical stiffness.
 4. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
 5. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.
- J. Spring Hangers with Vertical-Limit Stop SHVLS: Combination coil-spring and elastomeric-insert hanger with spring and insert in compression and with a vertical-limit stop.
- K. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
1. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 2. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 3. Lateral Stiffness: More than 80 percent of the rated vertical stiffness.
 4. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
 5. Elastomeric Element: Molded, oil-resistant rubber or neoprene.
 6. Adjustable Vertical Stop: Steel washer with neoprene washer "up-stop" on lower threaded rod.
- L. Thrust Limits TL: Combination coil spring and elastomeric insert with spring and insert in compression and with a load stop. Include rod and angle-iron brackets for attaching to equipment.
- M. Frame: Steel, fabricated for connection to threaded rods and to allow for a maximum of 30 degrees of angular rod misalignment without binding or reducing isolation efficiency.
1. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 2. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 3. Lateral Stiffness: More than 80 percent of the rated vertical stiffness.
 4. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
 5. Elastomeric Element: Molded, oil-resistant rubber or neoprene.
 6. Coil Spring: Factory set and field adjustable for a maximum of 1/4-inch movement at start and stop.
- N. Pipe Riser Resilient Support PRRS: All-directional, acoustical pipe anchor consisting of 2 steel tubes separated by a minimum of 1/2-inch-thick, 60-durometer neoprene. Include steel and neoprene vertical-limit stops arranged to prevent vertical travel in both directions. Design

support for a maximum load on the isolation material of 500 psig and for equal resistance in all directions.

- O. Resilient Pipe Guides RPS: Telescopic arrangement of 2 steel tubes separated by a minimum of 1/2-inch- thick, 60-durometer neoprene. Factory set guide height with a shear pin to allow vertical motion due to pipe expansion and contraction. Shear pin shall be removable and reinsertable to allow for selection of pipe movement. Guides shall be capable of motion to meet location requirements.
- P. Flexible Pipe Connections FPC: Flexible pipe connectors shall be fabricated of Kevlar or nylon cord, fabric, and neoprene. Flexible pipe connections shall result in a flexible and highly compliant connection that can allow longitudinal, transverse, and angular movements and provide micro-vibration isolation. The flexible connections shall be selected and specially fitted, if necessary, to suit the system temperature, pressure, and fluid type. Rods or cables may be used to control extension of the connector if required by the manufacturer, but shall not inhibit movement necessary to provide sufficient vibration isolation. Flexible pipe connections shall be equivalent to Mason Industries' Type SFDEJ twin-sphere connectors, or equal (no known equal).
- Q. Flexible Duct Connections FDC: Flexible duct connections shall be supplied in accordance with industry standards. Material width shall be 150 percent of clear dimension in addition to width required for attachment. Flexible duct connections shall result in a loose and highly compliant connection.
- R. Flexible Conduit Connections: Flexible conduit shall be formed of one continuous length of electro-galvanized spiral-wound steel strip. Liquid-tight flexible conduit shall be formed of one continuous length of electro-galvanized spiral-wound steel strip, with neoprene gasket.

2.4 SEISMIC-RESTRAINT DEVICES

- A. Manufacturers:
 - 1. B-Line Systems, Inc.
 - 2. Amber/Booth Company, Inc.
 - 3. California Dynamics Corp.
 - 4. Kinetics Noise Control, Inc.
 - 5. Loos & Co., Inc.; Cableware Technology Division.
 - 6. Mason Industries, Inc.
 - 7. TOLCO Incorporated.
 - 8. Unistrut Diversified Products Co.; Wayne Manufacturing Division.
 - 9. Vibration Eliminator Co., Inc.
 - 10. Vibration Isolation Co., Inc.
 - 11. Vibration Mountings & Controls/Korfund.
- B. Resilient Isolation Washers and Bushings: 1-piece, molded, bridge-bearing neoprene complying with AASHTO M 251 and having a durometer of 50, plus or minus 5, with a flat washer face.
- C. Seismic Snubbers: Factory fabricated using welded structural-steel shapes and plates, anchor bolts, and replaceable resilient isolation washers and bushings.
- D. Anchor bolts for attaching to concrete shall be seismic-rated, drill-in, and stud-wedge or female-wedge type.
 - 1. Resilient Isolation Washers and Bushings: 1-piece, molded, bridge-bearing neoprene complying with AASHTO M 251 and having a durometer of 50, plus or minus 5.

- E. Restraining Cables: Galvanized steel aircraft cables with end connections made of steel assemblies that swivel to final installation angle and utilize two clamping bolts for cable engagement.
- F. Anchor Bolts: Seismic-rated, drill-in, and stud-wedge or female-wedge type. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488/E 488M.

2.5 VIBRATION ISOLATION EQUIPMENT BASES

- A. Manufacturers:
 - 1. Amber/Booth Company, Inc.
 - 2. California Dynamics Corp.
 - 3. Isolation Technology, Inc.
 - 4. Kinetics Noise Control, Inc.
 - 5. Mason Industries, Inc.
 - 6. Vibration Eliminator Co., Inc.
 - 7. Vibration Isolation Co., Inc.
 - 8. Vibration Mountings & Controls/Korfund.
- B. Steel Base SB: Factory-fabricated, welded, structural-steel bases and rails.
 - 1. Design Requirements: Lowest possible mounting height with not less than 1-inch clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails. Include supports for suction and discharge elbows for pumps.
 - 2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A 36/A 36M. Bases shall have shape to accommodate supported equipment.
 - 3. Support Brackets: Factory-welded steel angles on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.

2.6 FACTORY FINISHES

- A. Manufacturer's standard prime-coat finish ready for field painting.
- B. Finish: Manufacturer's standard paint applied to factory-assembled and -tested equipment before shipping.
- C. Powder coating on springs and housings.
 - 1. All hardware shall be electrogalvanized. Hot-dip galvanize metal components for exterior use.
 - 2. Baked enamel for metal components on isolators for interior use.
 - 3. Color-code or otherwise mark vibration isolation and seismic-control devices to indicate capacity range.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and equipment to receive vibration isolation and seismic-control devices for compliance with requirements, installation tolerances, and other conditions affecting performance.
- B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Thrust restraints shall be provided in accordance with manufacturers recommendations for all horizontal discharge vibration isolated fans and air handlers where the air thrust exceeds 10 percent of the vibration isolated equipment weight. Thrust is calculated in accordance with the following formula:

$$\text{THRUST(LB)} = \text{TOTAL PRESSURE (INCHES W.C.)} \times 5.3 \times \text{AREA (SQ. FT.)}$$

Thrust restraints shall be oriented parallel to the direction of thrust and located symmetrically about the center of thrust. Ducting at thrust restraints shall be designed to withstand thrust loading or an auxiliary structure shall be provided for thrust restraint mounting. Thrust restraint shall not interfere with or restrict free operation of vibration isolation systems.

- B. Install seismic snubbers on isolated equipment. Locate snubbers as close as possible to vibration isolators and bolt to equipment base and supporting structure.
- C. Install restraining cables at each trapeze and individual pipe hanger. At trapeze anchor locations, shackle piping to trapeze. Install cables so they do not bend across sharp edges of adjacent equipment or building structure.
- D. Install steel angles or channel, sized to prevent buckling, clamped with ductile-iron clamps to hanger rods for trapeze and individual pipe hangers. At trapeze anchor locations, shackle piping to trapeze. Requirements apply equally to hanging equipment. Do not weld angles to rods.
- E. Install resilient bolt isolation washers on equipment anchor bolts.
- F. Rod stiffener assemblies shall be used at seismic restraints for hanger rods over 6 inches in length. A minimum of two rod stiffener clamps shall be used on any rod stiffener assembly.
- G. Lateral and longitudinal bracing shall be installed between 45 degrees above 45 degrees below horizontal, inclusive, relative to the horizontal centerline of the pipe.
- H. Welded and bolted attachments to the building structural steel shall be in accordance with the requirements of SMACNA Seismic Restraint Guide and AISC M016. There shall be no drilling or burning of holes in the building structural steel without approval of the University's representative.
- I. Embedded anchor bolts shall be used instead of concrete inserts for seismic brace installations in areas below water surface or normally subject to submerging.
- J. The Contractor shall install thermal pipe hanger shields on insulated piping at required locations during restraint installation. Butt joint connections to pipe insulations shall be made at the time of insulation installation in accordance with the manufacturer's recommendations.
- K. Restraint components in contact with plastic and FRP pipe shall be free of burrs and sharp edges.
- L. Roller shall roll freely without binding.
- M. Plastic or rubber end caps shall be provided at the exposed ends of all framing channels that are located up to 7 feet above the floor.

3.3 EQUIPMENT BASES

- A. Cast-in-place concrete materials and placement requirements are specified in Division 3.
- B. Concrete Bases: Anchor equipment to concrete base according to supported equipment manufacturer's written instructions for seismic codes at Project site.

1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the base.
2. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base and anchor into structural concrete floor.
3. Place and secure anchorage devices. Use Setting Drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
4. Install anchor bolts to elevations required for proper attachment to supported equipment.
5. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
6. Cast-in-place concrete materials and placement requirements are specified in Division 3.

3.4 FIELD QUALITY CONTROL

- A. Testing: University will engage a qualified testing agency to perform the following field quality-control testing:
- B. Testing: Engage a qualified testing agency to perform the following field quality-control testing:
- C. Testing: Perform the following field quality-control testing:
- D. Isolator seismic-restraint clearance.
 1. Isolator deflection.
 2. Snubber minimum clearances.
 3. Air-Mounting System Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 4. Air-Mounting System Operational Test: Test the compressed-air leveling system. Remove malfunctioning units, replace with new units, and retest.
 5. Test and adjust air-mounting system controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.5 ADJUSTING

- A. Adjust isolators after piping systems have been filled and equipment is at operating weight.
- B. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.
- C. Attach thrust limits at centerline of thrust and adjust to a maximum of 1/4-inch movement during start and stop.
- D. Adjust air spring leveling mechanism.
- E. Adjust active height of spring isolators.
- F. Adjust snubbers according to manufacturer's written recommendations.
- G. Adjust seismic restraints to permit free movement of equipment within normal mode of operation.
- H. Torque anchor bolts according to equipment manufacturer's written recommendations to resist seismic forces.

3.6 CLEANING

- A. After completing equipment installation, inspect vibration isolation and seismic-control devices. Remove paint splatters and other spots, dirt, and debris.

3.7 DEMONSTRATION

- A. Engage a factory-authorized service representative to train University's maintenance personnel to adjust, operate, and maintain air-mounting systems. Refer to Division 1 Section.

3.8 VIBRATION BALANCE CRITERIA

- A. All rotating equipment shall operate at speeds less than 80% of their true critical speed. Unless otherwise required, equipment shall be balanced according to recommendations given in the following sections.
- B. Equipment components such as motors, pump rotors, fan wheels, etc. shall be factory balanced, both statically and dynamically, to meet the filed balance requirements described in section below.
- C. Following field installation, each fan and pump over 25 HP shall be balanced in accordance with the following maximum rms velocity levels:
 - 1. Fans: 0.15 inch/sec.
- D. Final in-field balance shall be measured with each fan and pump over 25 HP installed on springs specified for unit. Fans shall be loaded with design static pressure. Measurement shall be carried out in vertical and horizontal and axis planes at impeller shaft bearing location when the equipment is mounted on its vibration isolation mounts.
- E. If the equipment is inertia base or skid-mounted, the weight of inertia bases or skids (and of any other components mounted on the same inertia base or skid) will reduce the vibration response when equipment is balanced. Therefore, the balance criteria shall be multiplied by the following factor for such equipment.

$$\text{Factor} = \frac{W}{WT+W}$$

Where WT = Inertia weight (base + other components)

W = Weight of the subject equipment

3.9 PIPE ISOLATION

- A. Piping connected to vibration isolated equipment should be isolated from the equipment using twin-sphere flexible pipe connectors as described in Paragraph 2.2.M.
- B. Piping, 4 inches diameter or greater, which is connected to vibration isolated equipment should be supported, for a distance of 25 feet or 50 pipe diameters, whichever is greater, from the building structure by spring isolators, resilient pipe riser, and resilient penetration sleeves.
- C. The spring isolators should be selected for a static deflection, under the actual load, of not less than 1 inch. Unit SI and SH isolators (whichever is applicable to the mounting condition) should be used.
- D. Resilient pipe risers and guides should be used to support pipe risers, 6" or greater in diameter and within the limits specified in Paragraph 3.9.B. We recommend Mason Industries' type ADA anchors, or equivalent. The piping should make no direct contact with the gypsum board shaft walls.
- E. Pipes within the limits specified in Paragraph 3.9.B that penetrate the building structure should be isolated from the structure by the use of resilient penetration sleeve/seals. A ½-inch clear space should be left all around the penetrating duct or pipe. The clear space should be filled with fiberglass for the full depth of the penetration. Both ends of the clear space should be sealed airtight with a non-hardening resilient sealant.
- F. Paragraphs C, D, and E above also apply to piping 2 inches diameter or over suspended below or near noise-sensitive spaces.

- G. Piping smaller than 2 inches diameter suspended below or near noise-sensitive spaces should be supported with a resilient element of felt, neoprene, or other suitable material inserted between the pipe and pipe clamp.

3.10 DUCT ISOLATION

- A. Flexible canvas or rubber duct connections as described in Paragraph 2.2.N should be used at the intake and discharge of each fan or air handling unit. The duct openings should be squarely aligned prior to installation of the flexible connection, so that the clear length is approximately equal all the way around the perimeter. Minimum metal-to-metal clearance should be 4 inches. Flexible duct connections should not be installed until these provisions are met. The fan unit or adjacent duct section should be able to move 1 inch in any direction without causing metal-to-metal contact or stretching out the flexible connection. There should be a distance of at least 3 duct diameters between the inlet of a vaneaxial fan and a flexible connector.
- B. When ducts are suspended below or near a noise-sensitive area, they should be isolated, especially for large ducts with air velocities above 1,500 fpm. or with duct static pressure of 2 inches water gage or higher. The isolators should be Unit FSN (Paragraph 2.2.B) or Unit HS (Paragraph 2.2.G) (whichever is applicable to the mounting condition). The isolators should be selected for a static deflection, under the actual load, of not less than 1 inch.
- C. No vibration isolation will be required for other ducts.

3.11 ELECTRICAL ISOLATION

- A. Electrical service connections to all vibration isolated mechanical equipment shall be made with flexible conduit. Conduit shall provide a minimum 360 degree turn and result in a loose and compliant connection.
- B. Transformers shall be supported on Type DNP vibration isolation pads or provided with integral internal neoprene vibration mounts. For dry transformers, install the isolation beneath the core; for oil-filled transformers, install the isolation beneath the tank.

END OF SECTION

SECTION 15171

VARIABLE FREQUENCY DRIVES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Variable Frequency Drives (VFDs)

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Danfoss Graham VLT 6000 Series or approved equal.

2.2 GENERAL

- A. Furnish complete variable frequency VFDs as specified herein for the fans designated on the drawing schedules to be variable speed. All standard and optional features shall be included within the VFD enclosure, unless otherwise specified. The VFD shall be housed in a metal NEMA 1 enclosure, or other NEMA type according to the installation and operating conditions at the job site. The VFD's UL listing shall allow mounting in plenum or other air handling compartments. If a NEMA 12 enclosure is required for the plenum rating, the manufacturer must supply a NEMA 12 rated VFD. Plastic type enclosures of any type are not acceptable. VFD shall be provided with disconnect switch.
- B. The circuit boards shall be uniformly coated to protect them from the sea coast environment.
- C. All VFD's located outdoors shall be provided with NEMA 3 enclosures complete with internal ventilation and heaters, air filters and rain hoods. The outdoor enclosures shall be designed and manufactured in the VFD manufacturers factory.
- D. The VFD and options shall be tested to ANSI/UL Standard 508. The complete VFD, including all specified options, shall be assembled by the manufacturer, which shall be UL-508 certified for the building and assembly of option panels. Assembly of the option panels by a third-party panel shop is not acceptable. The appropriate UL stickers shall be applied to both the VFD and option panel, in the case where these are not contained in one panel. When these VFDs are to be located in Canada, CSA or C-UL certifications shall apply. Both VFD and option panel shall be manufactured in ISO 9001 certified facilities.
- E. The VFD shall have DC link reactors on both the positive and negative rails of the DC bus to minimize power line harmonics. VFDs without DC link reactors shall provide a minimum 3% impedance line reactor.
- F. An automatic energy optimization selection feature shall be provided standard in the VFD. This feature shall automatically and continually monitor the motor's speed and load and adjust the applied voltage to maximize energy savings and provide up to an additional 3% to 10% energy savings.
- G. VFD shall minimize the audible motor noise through the used of an adjustable carrier frequency. The carrier frequency shall be automatically adjusted to optimize motor and VFD efficiencies while reducing motor noise.
- H. Interface Features

1. Hand/Start, Off/Stop and Auto/Start selector switches shall be provided to start and stop the VFD and determine the speed reference.
2. The keypads for all sizes of VFDs shall be identical and interchangeable.
3. To set up multiple VFDs, it shall be possible to upload all setup parameters to the VFD's keypad, place that keypad on all other VFDs in turn and download the setup parameters to each VFD. To facilitate setting up VFDs of various sizes, it shall be possible to download from the keypad only size independent parameters.
4. The VFD shall include a standard EIA-485 communications port and capabilities to be connected to a Johnson Controls N2 Metasys or Siemens "Apogee" FLN system at no additional cost to the owner. The connection shall be software selectable by the user.
5. Additionally an optional communication card allowing use of BACNET® , LonWorks®, ModBus®, RTU, Profibus® and DeviceNet® shall be available.
6. The VFD shall have full Serial Communications with the DDC / BAS (Direct Digital Control / Building Automation System) to allow for reviewing, changing and controlling VFD configuration and parameters. If serial communications is not provided, hardwiring is required to all (8) digital inputs, (3) analog inputs, (2) digital outputs and (2) analog outputs on the VFD, as selected by the owner, engineer and BAS / DDC installing company.
7. Two set-point control interface (PID control) shall be standard in the unit. VFD shall be able to look at two feedback signals, compare with two set-points and make various process control decisions.
8. If the temperature of the VFD's heat sink rises to 80°C, the VFD shall automatically reduce its carrier frequency to reduce the heat sink temperature. If the temperature of the heat sink continues to rise the VFD shall automatically reduce its output frequency to the motor. As the VFD's heat sink temperature returns to normal, the VFD shall automatically increase the output frequency to the motor and return the carrier frequency to its normal switching speed.

I. DUAL VFD

1. The contractor shall provide dual VFD's for the supply fan and for the return fan.

PART 3 - EXECUTION

3.1 START-UP SERVICE

- A. The manufacturer shall provide start-up and commissioning of the VFD and its optional circuits by a factory certified service technician who is experienced in start-up and repair services. Sales personnel and other agents who are not factory certified shall not be acceptable as commissioning agents. Start-up services shall include checking for verification of proper operation and installation for the VFD, its options and its interface wiring to the building automation system.

B. WARRANTY

1. The VFD shall be warranted by the manufacturer for a period of 36 months from date of start-up completion. The warranty shall include parts, labor, travel costs and living expenses incurred by the manufacturer to provide factory authorized on-site service. The warranty shall be provided by the VFD manufacturer.

END OF SECTION

SECTION 15290
DUCTWORK INSULATION

PART 1 - GENERAL

1.1 SCOPE

- A. This section specifies insulation used on ductwork and plenums.

1.2 QUALITY ASSURANCE

- A. References: This section contains references to the following documents. They are a part of this section as specified and modified. In case of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

ASC-A-7001C	Adhesive and Sealant Council Standards for Adhesives for Duct Liner.
ASTM C518	Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
ASTM C553	Mineral Fiber Blanket and Felt Insulation.
ASTM E96	Water Vapor Transmission of Materials.
SMACNA DCS	SMACNA Duct Construction Standards.
UL 723	Surface Burning Characteristics of Building Materials.

- B. Materials: Flame spread/smoke developed rating of 25/50 in accordance with UL 723 and UL790.
- C. Applicator: Company specializing in performing the work of this section with minimum three years experience.
- D. Store insulation in original wrapping and protect from weather and construction traffic.
- E. Protect insulation against dirt, water, chemical, and mechanical damage.
- F. Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics, and insulation cements.
- G. Maintain temperature during and after installation for minimum period of 24 hours.

1.3 SUBMITTALS

- A. Refer to Section 15010 for additional requirements.
- B. Submit:
1. Product Data: Provide product description, list of materials and thickness for each service, and locations.
 2. Samples: Submit two samples of any representative size illustrating each insulation type.
- C. The manufacturer or supplier shall include a written statement that the submitted product complies with all the requirements of this section.

1. The manufacturer or supplier shall resubmit this specification section and clearly indicate in writing, next to each respective paragraph, that the manufacture or supplier is "In Compliance" or "Take Exception, with Proposed Alternative".
2. All exceptions shall be clearly identified by referencing respective paragraph and other requirements along with proposed alternative.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Packaging: Ship insulation materials in containers marked by manufacturer with appropriate ASTM specification designation, type and grade, and maximum use temperature.

1.5 COORDINATION

- A. Coordinate clearance requirements with duct installer for insulation application.

1.6 SCHEDULING

- A. Schedule insulation application after testing duct systems. Insulation application may begin on segments of ducts that have satisfactory test results.

PART 2 - PRODUCTS

2.1 GLASS FIBER, FLEXIBLE (INDOOR APPLICATION)

- A. Manufacturer shall be Johns Manville Microlite XG Type 100 all-service faced duct wrap or equal.
- B. All ducts shall be insulated on the outside with flexible glass fiber blanket with a minimum installed R-Value of 4.5 and Type FSK facing,
- C. Insulation: ASTM C553; flexible, noncombustible blanket.
 1. Thermal conductivity or 'K-value': ASTM C518, 0.27 Btu-in/hr-ft²•°F at 75°F.
 2. Maximum service temperature: 250°F.
 3. Maximum moisture absorption: <3% at 120°F.
 4. Density: 1.0 lb/cu ft.
 5. Thickness: 1-1/2"
- D. Vapor Barrier Jacket
 1. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film.
 2. Moisture vapor transmission: ASTM E96; 0.02 perm.
 3. Secure with pressure sensitive tape.
- E. Vapor Barrier Tape
 1. Manufacturers: Owens-Corning or equal (no known equal).
 2. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film, with pressure sensitive rubber based adhesive.
- F. Tie Wire: Annealed steel, 16 gauge.

2.2 GLASS FIBER DUCT LINER

- A. Manufacturer shall be Johns Manville Permacote Linacoustic R-300 Rigid Fiber Coated Glass Liner.
- B. Insulation: ASTM C553; flexible, noncombustible blanket.
 - 1. Thermal conductivity or 'K-value': ASTM C518, 0.12 Btu-in/hr·ft²·°F at 75°F.
 - 2. Maximum service temperature: 250°F.
 - 3. Density: 3.0 lb/cu ft.
 - 4. Maximum Velocity on Coated Air Side: 6,000 ft/min.
 - 5. Thickness: 2"
- C. Liner Fasteners: Galvanized steel with press-on head conforming to SMACNA.
- D. Adhesive:
 - 1. Manufacturer shall be Johns Manville or equal.
 - 2. Waterproof fire-retardant type conforming to ASC-A-7001C.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that ductwork has been tested before applying insulation materials.
- B. Verify surfaces are smooth, dry, clean, and free from dust, debris, or other loose materials. Surfaces must be dry before the application of the insulation.

3.2 INSTALLATION

- A. Install materials in accordance with manufacturer's instructions.
- B. Deliver products to the job site in manufacturer's original sealed containers with seals and labels intact. All materials shall be stored at job site, in an enclosed space, protected from excessive heat and cold, in accordance with material manufacturer's instructions.
- C. Insulated ductwork conveying air below ambient temperature:
 - 1. Provide insulation with vapor barrier jackets.
 - 2. Finish with tape and vapor barrier jacket.
 - 3. Continue insulation through walls, sleeves, hangers, and other duct penetrations.
 - 4. Insulate entire system including fittings, joints, flanges, fire dampers, flexible connections, and expansion joints.
- D. The Contractor shall be responsible for providing and installing all protective covers, drops, and masking required to protect adjacent areas, equipment, utilities, parts, material, and other items from spills, mist, spray, etc.
- E. The Contractor shall be responsible for the removal of and repairing any damage caused by cleaning chemicals, gravel, dust, coating materials, etc. The contractor shall also be responsible for damage caused by workers, equipment, etc.

3.3 TOLERANCE

- A. Substituted insulation materials shall provide thermal resistance within 10 percent at normal conditions, as materials indicated.

3.4 FLEXIBLE GLASS FIBER DUCTWORK INSULATION SCHEDULE

- A. All ducts shall be insulated on the outside with flexible glass fiber blanket with a minimum installed R-Value of 4.3 and Type FSK facing,

<u>DUCTWORK</u>	<u>THICKNESS</u> Inches	<u>FINISH</u>
Supply Ducts, Indoor in Non-Conditioned Spaces	1-1/2	Vapor Barrier
Return Ducts, Indoor in Non-Conditioned Spaces	1-1/2	Vapor Barrier

3.5 GLASS FIBER DUCT LINER INSULATION SCHEDULE

- A. All internal duct liner shall have minimum installed R-Value of 6.3.

<u>DUCTWORK</u>	<u>THICKNESS</u> Inch	<u>FINISH</u>
All Ducts and Plenums shown lined on Drawings for condensate prevention (Duct dimensions shown on drawings are inside clear dimensions)	1	Erosion resistant (no fibers exposed)

END OF SECTION

SECTION 15855

AIR HANDLING UNITS

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Custom air handling units.

1.2 REFERENCES

- A. AFBMA 9 - Load Ratings and Fatigues Life for Ball Bearings
- B. AFBMA 11 - Load Ratings and Fatigue Life for Roller Bearings
- C. AMCA 99 - Standards Handbook
- D. AMCA 210 - Laboratory Methods of Testing Fans for Rating Purposes
- E. AMCA 300 - Test Code for Sound Rating Air Moving Devices
- F. AMCA 301 - Method of Publishing Sound Ratings for Air Moving Devices
- G. AMCA 500 - Test Methods for Louver, Dampers, and Shutters
- H. ARI 410 - Forced-Circulation Air-Cooling and Air-Heating Coils
- I. ARI 430 - Central Station Air Handling Units
- J. ARI 435 - Application of Central Station Air Handling Units
- K. ARI 610 - Central System Humidifiers
- L. NEMA MG1 - Motors and Generators
- M. NFPA 70 - National Electrical Code
- N. SMACNA - HVAC Duct Construction Standards - Metal and Flexible
- O. UL 900 - Test Performance of Air Filter Units

1.3 SUBMITTALS

- A. Submit under provisions of General Conditions and Division 1 as applicable.
- B. Shop Drawings: Indicate assembly, unit dimensions, weight loading, required clearances, construction details, field connection details, electrical characteristics and connection requirements.
- C. Product Data:
 - 1. Provide literature, which indicates dimensions, weights, capacities, ratings, fan performance, gauges and finishes of materials, electrical characteristics and connection requirements.
 - 2. Provide data on filter media, filter performance data, filter assembly, and filter frames.
 - 3. Provide fan curves with specified operating point clearly plotted.

4. Submit sound power level data for fan unit outlet, inlet and casing radiated at rated capacity and specified pressure.
 5. Submit electrical requirements for power supply including wiring diagrams for interlock and control wiring, clearly indicating factory installed and field installed wiring.
 6. Submit performance and vibration test results of the fan for review prior to any air handling unit shipment to the jobsite.
- D. Operation and Maintenance Data
1. Submit under provisions of General Conditions and Division 1 as applicable.
 2. Maintenance Data: Include instructions for lubrication, filter replacement, motor and drive replacement, spare parts lists and wiring diagrams.
- E. Manufacturer's Installation Instructions.
- 1.4 ACCEPTABLE MANUFACTURERS
- A. Energy Labs equipment is the basis of the design on this project. The contractor shall base his bid on Energy Labs and, at his option, may provide line item additive or deductive alternates for alternate brand items set out below.
- B. Alternate pricing shall include any contractor required costs of architectural, mechanical, structural, acoustical, seismic, electrical changes required to match the performance, fit and characteristics of the base bid equipment. An alternate price does not imply an alternate manufacturer's standard construction is acceptable. Deviations from the base bid specification shall be noted with particularity at the time of bid.
1. Base Bid - Energy Labs
 2. Optional Alternate: Alliance
 3. Optional Alternate: Temtrol
- 1.5 QUALIFICATIONS
- A. Manufacturer: The air handler manufacturer must have fifteen (15) years documented prior successful experience in building products meeting the specifications and on projects of similar size, scope and complexity.
- 1.6 EXTRA MATERIALS
- A. Furnish under provisions of General Conditions and Division 1 as applicable.
- B. Provide one (1) set of fan belts and filters for each unit.
- 1.7 QUALITY ASSURANCE
- A. Conform to all information documented in approved submittal package and construction notes.
- B. All air handling units shall be ETL listed and labeled, as completed assemblies, certifying compliance with UL 1995.
- 1.8 DELIVERY, STORAGE, AND HANDLING
- A. Store in clean dry place and protect from weather and construction traffic. Handle carefully to avoid damage to components, enclosures and finish. All fans must be periodically rotated during storage period per manufacturer recommendation.

PART 2 - PRODUCTS

2.1 AIR HANDLING UNIT

- A. Unit Construction: The following sections describe in detail construction requirements for the unit base, cabinet, access doors, insulation and paint finish. Unit shall be built for outdoor installation.
- B. Unit Base: Each unit shall be constructed on a base fabricated from ASTM A36 welded structural steel channel. Tubular or formed metal channel bases are not acceptable. Channel bases shall be sized as a function of air handling length as follows:

<u>A.H. UNIT LENGTH</u>	<u>MINIMUM CHANNEL SIZE</u>	
UP to 10'	4" x 1-5/8"	(5.4lbs/Lin.Ft.)
10' to 18'	6" x 2"	(8.2lbs/Lin.Ft.)
18' to 30'	8" x 2-1/2"	(11.5lbs/Lin.Ft.)
30' to 50'	12" x 3"	(20.7lbs/Lin.Ft.)

- C. Heavy removable lifting lugs shall be added to the perimeter channel along the longest length of the unit. The unit floor shall be fabricated of 0.125" thick, #3003 aluminum tread plate sheets. The floor shall be supported by structural and minimum 12-gauge formed galvanized steel members. Max spacing of floor support shall be 24" centers. These formed members shall be welded to other members for maximum strength. Floor skin shall be supplied with standing seams design and drive cleats to maintain water and airtight seal. The flooring shall be spot welded to the members below. No penetrations thru the floor skin shall be acceptable. Welds shall be below the floor and spaced no greater than 6" on center.
- D. Fans, coils and major components shall be supported with structural steel members directly below these items.
- E. Housing: The unit housing side and roof panels shall be constructed of 16-gauge galvanized steel, and shall utilize a standing seam modular panel type construction. The panels shall be caulked and attached to each other, to the roof, and to the floor using nuts and bolts. Drive screw attachment is not acceptable. All panels shall be removable. All seams shall be sealed with an acrylic latex sealant prior to assembling the panels and after completion of the assembly. All floor openings shall have 12 gauge galvanized steel-framed flange around the entire perimeter of opening for duct connection. Minimum sound transmission loss (STL) through unit panels shall be as follows:

OCTAVE BAND CENTER FREQUENCY

<u>125</u>	<u>250</u>	<u>500</u>	<u>1K</u>	<u>2K</u>	<u>4K</u>
25	29	36	42	47	48

F. ACCESS DOORS:

1. Hinged, double wall, insulated, man size access doors shall be provided in all sections requiring access for maintenance or service. The doorframe shall be one piece, 14 gauge galvanized steel welded with an integral gutter lip. Access doors shall be fully gasketed with a closed cell, replaceable neoprene gasket. The gasketing material shall be installed to allow for easy removal and replacement. Access door must not leak more than 25 CFM @ 6" static pressure.
2. Door hinges and latches shall be easily adjustable, without the use of shims or special tools, to allow for a tight seal between the door and the doorframe as the gasketing material compresses over time. The door hinge design shall allow for field modification of door swing and doors shall be easily removable. Provide door detail drawing with submittal package.
3. Latches shall utilize phenolic knurled knobs. The latch assembly shall incorporate a built-in safety catch to release cabinet operating pressure prior to opening the door.

4. Doors entering into any section of the air handler that contains rotating fans shall be provided with zinc-plated nuts in lieu of knurled knobs. The nuts shall limit access to personnel with proper tools. Include a 10" x 10" wire reinforced glass view window in each fan access door.
 5. A door switch shall be interlocked with fan starter to stop the fan before access door is opened.
- G. Outdoor units shall have roofs with a minimum of ¼" per foot slope to insure no standing water.
- H. Insulation and Interior Liner: Insulation shall be 2" thick, 3 lbs per cubic foot density, neoprene coated fiberglass to cover all walls and ceilings. This insulation shall meet NFPA-90A smoke and flame spread requirements. All floors shall be insulated from below using minimum 1" thick foam to insure that the entire under surface of the floor is insulated. There shall be no raw edges of insulation exposed to the air stream. Plenum fan sections shall have a 20 gauge perforated galvanized sheet metal liner covering all wall and ceiling surfaces in the blast area of fan. The entire interior of all units shall be lined with minimum 20 gauge bright galvanized steel liner. The interior liner of the fan sections shall be perforated and the remaining shall be solid.
- I. Drain Pans: Drain pans shall be constructed from 16-gauge, 316 stainless steel. Galvanized steel drain pans are not acceptable. The drain pan shall be insulated with 2.0", 1½ # density insulation to prevent condensation under the drain pan. Insulation shall be protected with an 18-gauge galvanized steel liner. Drain pans must be sized such that the entire coil, including headers and return bends, are inside the drain pan. Drain pans must slope in two directions so there is no standing water in drain pan. Stainless steel condensate connection shall be provided on one side of the unit. Coils shall be supported on 10 gauge stainless steel members to prevent immersion of the coil in condensate and allow for complete cleaning of drain pan beneath the coils.
- J. Paint Finish: After final assembly the unit exterior shall be coated with an industrial grade, polyurethane finish. In addition, all fan bases, springs, and structural steel supports shall be coated with the same finish. The paint system shall meet ASTM B117 Salt spray test for a minimum of 5000 hours.

2.2 INTERNAL COMPONENTS

A. Fan Assembly

1. Plenum fans shall be configured as dual Arrangement #4 direct drive supply fans and Arrangement #1 belt drive return fan. There shall be no obstructions (i.e., bearings or bearing supports, etc.,) at the inlet of the fan. Fan wheel shall be aluminum with aluminum extruded airfoil blades. The fan inlet shall be isolated from the cabinet by means of a neoprene-coated flexible connection. Plenum fans shall be provided with spring-style thrust restraints. Arrangement #3 fans are not acceptable.
2. Each fan shall be sized to perform as indicated on the equipment schedule. The wheel diameter shall not be less than that shown on the equipment schedule. The fan shall be constructed to AMCA Standards for the Class Rating as indicated on the Equipment Schedule.
3. Fan Base, Spring Isolation, and Support Framing: Mount fan and motor on an internal, fully welded, rigid steel base. Base shall be free-floating at all four corners on spring type isolators with earthquake restraints. The fan assembly shall be isolated from the cabinet by steel springs with minimum deflection of 2.0" or as indicated on schedules. The spring isolators shall be mounted to structural steel members. All isolators shall be rated for zone 4 seismic requirements. The spring isolators shall be mounted on a waffle pad for vibration isolation.

4. Balancing: The fan shaft shall be sized not to exceed 75% of the first critical speed for maximum RPM of Class specified. The critical speed will refer to the top of the speed range of the fans' AMCA class. The lateral static deflection shall not exceed 0.003" per foot of the length of the shaft. Fans shall be balanced to ISO standard G6.3. A copy of the above balance test data for this project showing calculations for deflection and critical speed of the shaft and wheel assembly shall be submitted to the engineer and a copy forwarded to the Owner.

B. Motors and Drive:

1. Furnish premium-efficiency open drip proof, NEMA frame, ball bearing type motors. Baldor E Motors are approved equal. The Horsepower values as shown on the schedule are minimum allowable.
2. The motor shall be mounted on an adjustable slide rail motor base with two adjusting bolts per side. The fan motors shall be factory wired to an external junction box with flexible conduit of adequate length so that it will not have any affect on the vibration isolation.

C. Coils

1. Chilled water coils shall be of the plate fin extended surface type. Tubes shall be 5/8" outside diameter seamless copper with a 0.020" minimum wall thickness. Each coil shall have individually replaceable return bends of 0.025 wall thickness on both sides of the coil. Coils incorporating a "hairpin" type design are not acceptable. Tubes shall be expanded into the fin collars to provide a permanent mechanical bond.
2. The secondary surface shall be formed of 0.008" copper fins and shall be spaced not closer than 12 fins per inch with integral spacing collars that cover the tube surface. Headers shall be non-ferrous seamless copper, outside the air stream and provided with brazed copper male pipe connections. Drain and vent tubes shall be extended to the exterior of the air handling unit.
3. All coils shall have counter flow construction with connections left or right hand as shown on the drawings. The use of internal restrictive devices to obtain turbulent flow will not be accepted.
4. Cooling coil casings shall be of minimum 16-gauge, 316 stainless steel with double-formed 1-1/4" stacking flanges and 3/4" flanges on the side plates. All other coil casing shall be of 16-gauge galvanized steel. Flanged tube sheets shall have extruded tube holes to prevent raw edges of tube sheets cut into copper tubes because of thermal expansion of tubes in tube holes. Tube holes with raw sheet metal edges are not acceptable. Reinforcing shall be furnished so that the unsupported length is not over 60". All coil assemblies shall be tested under water at 300 psi and rated for 150-psi working pressure. Headers are to be located inside the cabinet casing with only the pipe connections extending through the casing. All sides of coils shall be carefully blanked off with the same materials used for the coil casings, to ensure all air passes through the coil.
5. Intermediate condensate pans are to be furnished on multiple coil units and single coils greater than 48" high. The pans shall be 16Ga. 316 stainless steel and drain to the main drain pan through copper downspouts.
6. All water coils shall be rated in accordance with ARI Standard 410. The air handling unit manufacturer, for the purpose of sole source responsibility, shall manufacture all coils supplied for the air handlers.
7. Hot water coils shall be similar to the chilled water coils.

D. Filters

1. Filter sections shall be fabricated as part of the air-handling unit. Filters shall be arranged for upstream, downstream, or side loading as shown on the drawings. Provide filter-holding frames to accommodate scheduled filters. Filter frames shall be 16 Ga. galvanized steel and shall be fully welded to reduce leakage of air through corners.

2. Factory install at each filter bank a Dwyer Magnehelic "Series 2000 ASF" pressure gauge complete with signal flags, static pressure taps, hardware and fittings. Enclose the gauge in a protective sheet metal box with a hinged inspection door. Paint to match unit.
 3. Air filters shall be high-efficiency, extended media area mini-pleat (LUWA Style), totally rigid and disposable type. Air filters shall be Aerostar FP-85 or Flanders Superflow V minipleat and shall have average efficiency of not less than 85% when tested in accordance with ASHRAE 52-76 test standard. Filter shall be of the quantities and sizes as indicated on the drawings.
- E. Dampers and Louvers: Dampers shall be supplied with low leak extruded aluminum airfoil blades. Blades shall be supplied with rubber edge seals and stainless steel arc end seals. Rubber edge seals shall be backed by the damper blade to assure a positive seal in the closed position. Dampers shall be provided with nylon bearings within extruded openings. Damper leakage shall not exceed 6 CFM/ft² at 5.0" of static pressure. Leakage testing shall be in accordance with AMCA standard 500 figure 5.5. Test results must be from independent testing laboratory. Provide louvers for outside air and exhaust air for units located outdoors. OSA louvers shall be sized for a maximum face velocity of 500 fpm based on gross louver area. Louvers shall have zero water penetration at 600-ft/min air velocity. Maximum louver pressure drop shall be 0.03" in w. g. at 500 ft/min. Provide test results from independent testing laboratory. Test must be conducted in accordance to AMCA Standard 500 figure 5.5. Louver water carry over must be less than 0.01 oz/ft² at 1100 ft/min of free louver area. Test must be conducted by independent testing laboratory per AMCA 500-89 figure 5.6. Hoods in lieu of louvers are not acceptable.
- F. Economizer / Mixing Box: Economizer section shall include dampers for return air, fresh air and exhaust air. Dampers shall be opposed blade type. Dampers shall be sized for not greater than 1000 fpm face velocity based upon gross damper area. Dampers shall meet above specifications. Furnish full height 24" wide access doors for damper and linkage service. Min/max dampers shall be provided for outside air.
- G. Electrical Requirements:
1. All AHU and electrical panel wiring shall be performed in a UL 508 listed shop. Provide single source power panels (SSPP's) that are constructed according to NEC regulations and carry a U.L.508 listing and label. The panel shall include a non-fused main disconnect switch covering all fans in each unit, Motor Starters for constant volume units or VFD's for variable volume units, and any necessary transformers, Hand-Off-Auto switches, relays and pilot lights for complete operation of the fans in the unit. The single source power panels shall be factory wired to all factory furnished devices such as motors and interlocks.
 2. The air handling unit manufacturer, for the purpose of sole source responsibility, shall manufacture all electrical panel assemblies supplied for the air handlers. The air handling unit manufacturer shall be a U.L. 508 listed panel shop.
 3. The main control panel shall have access door(s) for direct access to the controls. The panel shall be NEMA type 3R (rainproof) and shall contain a single externally operated, non-fused disconnect, suitable for copper wire up to and including 3" conduit. The electrical contractor shall bring separate 460/3/60 power to the single source power panel.
 4. All wiring shall be run in EMT conduit, (or flexible when connecting to a motor), raceways are not acceptable.
 5. Provide fluorescent, marine style lights in each access section wired to a common weatherproof switch with 60 minute timer mounted adjacent to the supply fan access door. 120V GFI duplex service receptacles shall be installed and wired with the lighting circuit and located in each fan compartment.
 6. If the unit requires splits, junction boxes shall be furnished on each section to allow the electrical contractor to make final connections in the field. Wiring shall be clearly labeled to allow ease in final interconnections.

H. Variable Frequency Drive:

1. Furnish complete variable frequency drives, (VFD's) as manufactured by Danfoss or equal by Reliance Electric or Toshiba, as specified herein for the air handling unit fans designated on the drawing schedules to be VAV. All standard and optional features shall be included within the VFD enclosure, unless otherwise specified. VFD shall be housed in a metal NEMA 12 enclosure and shall be factory mounted inside a flush NEMA 3R enclosure on the air handling unit. The VFD's UL listing shall allow mounting in plenum or other air handling compartments.
2. The VFD and options shall be tested to ANSI/UL Standard 508. The complete VFD, including all specified options, shall be assembled by the manufacturer, which shall be UL-508 certified for the building and assembly of option panels. Assembly of the option panels by a third-party panel shop is not acceptable. The appropriate UL stickers shall be applied to both the VFD and option panel, in the case where these are not contained in one panel. When these VFD's are to be located in Canada, CSA or C-UL certifications shall apply. Both VFD and option panel shall be manufactured in ISO 9001 certified facilities.
3. The VFD shall have DC link reactors on both the positive and negative rails of the DC bus to minimize power line harmonics. VFD's without DC link reactors shall provide a minimum 3% impedance line reactor.
4. An automatic energy optimization selection feature shall be provided standard in the VFD. This feature shall automatically and continually monitor the motor's speed and load and adjust the applied voltage to maximize energy savings and provide up to an additional 3% to 10% energy savings.
5. VFD shall minimize the audible motor noise through the use of an adjustable carrier frequency. The carrier frequency shall be automatically adjusted to optimize motor and VFD efficiencies while reducing motor noise.
6. The following interface features shall be included:
 - a. Hand/Start, Off/Stop and Auto/Start selector switches shall be provided to start and stop the VFD and determine the speed reference.
 - b. The keypads for all sizes of VFD's shall be identical and interchangeable.
 - c. To set up multiple VFD's, it shall be possible to upload all setup parameters to the VFD's keypad, place that keypad on all other VFD's in turn and download the setup parameters to each VFD. To facilitate setting up VFD's of various sizes, it shall be possible to download from the keypad only size independent parameters.
 - d. The VFD shall include a standard EIA-485 communications port and capabilities to be connected to a Johnson Controls N2 Metasys or Siemens "Apogee" FLN system at no additional cost to the owner. The connection shall be software selectable by the user.
 - e. Additionally an optional communication card allowing use of LonWorks®, shall be available.
 - f. The VFD shall have full Serial Communications with the DDC / BAS (Direct Digital Control / Building Automation System) to allow for reviewing, changing and controlling VFD configuration and parameters. If serial communications is not provided, hardwiring is required to all (8) digital inputs, (3) analog inputs, (2) digital outputs and (2) analog outputs on the VFD, as selected by the owner, engineer and BAS / DDC installing company.
 - g. Two set-point control interface (PID control) shall be standard in the unit. VFD shall be able to look at two feedback signals, compare with two set-points and make various process control decisions.
 - h. If the temperature of the VFD's heat sink rises to 80°C, the VFD shall automatically reduce its carrier frequency to reduce the heat sink temperature. If the temperature of the heat sink continues to rise the VFD shall automatically reduce its output frequency to the motor. As the VFD's heat sink temperature returns to normal, the VFD shall automatically increase the output frequency to the motor and return the carrier frequency to its normal switching speed.

7. The manufacturer shall provide start-up commissioning of the VFD and its optional circuits by a factory certified service technician who is experienced in start-up and repair services. Sales personnel and other agents who are not factory certified shall not be acceptable as commissioning agents. Start-up services shall include checking for verification of proper operation and installation for the VFD, its options and its interface wiring to the building automation system.
 8. The VFD shall be warranted by the manufacturer for a period of 36 months from date of shipment. The warranty shall include parts, labor, travel costs and living expenses incurred by the manufacturer to provide factory authorized on-site service. The warranty shall be provided by the VFD manufacturer.
- I. Air Flow Measuring Stations:
1. The flow measuring station shall be factory mounted. The flow measuring station shall consist of pressure taps pick-ups located on drawings. The ventilation air flow sensor and the economizer air flow sensor will be at the outside air opening at the inlet of the air handler before the respective control dampers. The return air flow sensor will be in the ductwork upstream of the return air damper. The supply airflow sensors will be at the inlet cone of each fan. There shall be no obstruction created on the inlet of the fan by installation of flow measuring device. Flow measuring stations installed in the inlet of fan will obstruct the fan inlet and will decrease fan efficiency and increase sound power levels. Provide a gauge with CFM scale on external side of the fan sections, which indicates the fan volume.
 2. AHU Vendor must demonstrate during commissioning that the minimum required OSA flow conditions are satisfied at full design flow and at minimum flow as shown on drawings.
- J. Minimum Outside Air Monitoring System
1. The monitor/controller shall be capable of direct measurement of airflow through an outside air inlet and produce dual outputs; one representing the measured airflow, and the other to control the inlet damper.
 2. The monitor/controller shall contain an integral multi-line liquid crystal display for use during the configuration and calibration processes, and to display two measured processes (volume, velocity, temperature) during normal operation. All configuration, output scaling, calibration, and controller tuning will be performed digitally in the on-board microprocessor via input pushbuttons.
 3. The monitor/controller shall measure inlet airflow with an accuracy of $\pm 5\%$ of reading over a range of 150-600 FPM, and not have its reading affected by the presence of directional or gusting wind.
 4. Measured airflow shall be density corrected for ambient temperature variances, and atmospheric pressure due to site altitude.
 5. The monitor/controller shall interface with existing building automation systems (BAS), accepting inputs for fan system start, economizer mode operation, and an external controller setpoint, and provide flow deviation alarm outputs.
 6. The monitor/controller shall be constructed of materials that resist corrosion due to the presence of salt or chemicals in the air; all non-painted surfaces shall be constructed of stainless steel. The electronics enclosure shall be NEMA 4.
 7. The monitor/controller shall be manufactured by Ebtron.

PART 3 - EXECUTION

3.1 ENVIRONMENTAL REQUIREMENTS

- A. Do not operate units for any purpose, temporary or permanent, until ductwork is clean, filters are in place, bearings are lubricated, and fan has been test run under observation

3.2 INSTALLATION, START-UP AND WARRANTY

- A. Install in accordance with manufacturer's instructions.
- B. Install in conformance with ARI 435.
- C. Assemble high-pressure units by bolting sections together. Isolate fan section with flexible duct connections.
- D. Warranty and Start-Up Service: Manufacturer shall provide factory start-up service for each air-handling unit. Manufacturer shall provide a one (1) year parts and labor warranty. If any units shipped in sections a factory authorized field technician shall assist the installing contractor in field assembly to insure proper assembly. All necessary sealing and fastening hardware shall ship with the units.

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SECTION 15890

DUCTWORK

PART 1 - GENERAL

1.1 SCOPE

- A. This section includes low pressure ductwork and fittings. Duct system design, as indicated, has been used to select and size air-moving and air-distribution equipment and other components of air system. Changes to layout or configuration of duct system must be specifically approved in writing by the University Representative. Accompany requests for layout modifications with calculations showing that proposed layout will provide original design results without increasing system total pressure.
- B. Duct Pressure and Leakage Testing to be preformed by the Mechanical Contractor. The AABC Test and Balance Contractor shall verify all leakage tests. Mechanical contractor shall submit all test reports.
- C. All mechanical equipment and hardware shall be braced or anchored to resist horizontal force acting in any direction according to 2007 CBC, Section 1632A Using $C_a = 0.44$ and $I_p = 1.15$. Where anchorage details are not shown on the drawings, the installation shall be subject to the approval of the mechanical engineer and the field engineer of the Division of the State Architect. Ductwork and piping shall be in strict accordance with SMACNA Guidelines for Restraint of Mechanical Systems, Including Supplement Dated 2000 for Seismic Level "AA".

1.2 QUALITY ASSURANCE

- A. References: This section contains references to the following documents. They are a part of this section as specified and modified. In case of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

ASTM A36	Structural Steel.
ASTM A90	Weight of Coating on Zinc-Coated (Galvanized) Iron or Steel Articles.
ASTM A480	General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet and Strip.
ASTM A653	General Requirements for Steel Sheet, Zinc- Coated (Galvanized) by the Hot-Dip Process.
ASTM A666	Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
ASTM B209	Standard Specification of Aluminum Alloy Sheet and Plate which references ANSI Standard H-35.2 Dimensional Tolerances for Aluminum Mill Products.
ASTM D9.1	Welding of Sheet Metal.
ASTM C920	Specification for Elastomeric Joint Sealants.
ASTM E84	Standard Test Method for surface burning characteristics.
NADCA	National Air Duct Cleaners Association.
NFPA 90A	Installation of Air Conditioning and Ventilating Systems.
NFPA 90B	Installation of Warm Air Heating and Air Conditioning Systems.
NFPA 91	Exhaust Systems for Air Conveying of Vapors, Gases, Mists, Noncombustible Particulate Solids.

NFPA 96	Installation of Equipment for the Removal of Smoke and Grease-Laden Vapors from Commercial Cooking Equipment.
NFPA 211	Standard for chimney, fireplaces, vents and solid fuel-burning appliances.
NFPA 318	Protection of Cleanrooms.
SMACNA ADLTM	HVAC Air Duct Leakage Test Manual.
SMACNA DCS	HVAC Duct Construction Standards - Metal and Flexible.
UL181	Factory-Made Air Ducts and Connectors.
CMC	California Mechanical Code
UL727	Standard for surface burning characteristics

- B. No variation of duct configuration or sizes permitted except by written permission from the University Representative. Upon written permission size round ducts installed in place of rectangular ducts in accordance with ASHRAE table of equivalent rectangular and round ducts.
- C. Perform Work in accordance with SMACNA - HVAC Duct Construction Standards - Metal and Flexible and other applicable Standards mentioned above.
- D. Ducts shall be located away from hot equipment such as furnaces and un-insulated pipes to avoid excess temperature exposure.
- E. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.
- F. Installer: Company specializing in performing the work of this section with minimum five years documented experience.
- G. Construct ductwork to NFPA 90A and 90B standards. Duct gauges shall conform to CAC Title 24 and CMC unless otherwise specified in this section.
- H. Do not install duct sealants when temperatures are less than those recommended by sealant manufacturers.
- I. Exhaust system shall comply with CMC Section 505 and 506. Hot gas exhaust ductwork shall conform to CMC Section 816, 817 and 818. Both systems shall comply also to NFPA 91.

1.3 SUBMITTALS

- A. Refer to Section 15010 for additional requirements.
- B. Provide:
 - 1. Shop drawings: provide 1/4" = 1' duct layout drawings indicating duct fittings, particulars such as gauges, sizes, welds, and configuration prior to start of work as required by section 15980.
 - 2. Product data: provide data for duct materials and joints.
 - 3. Show details of fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work. Duct layout indicating pressure classifications and sizes on plans. Fittings. Reinforcement and spacing. Seam and joint construction. Penetrations through fire-rated and other partitions. Terminal unit, coil installations. Hangers and supports, including methods for building attachment, vibration isolation, seismic restraints, and duct attachment.
 - 4. Coordination drawings: ductwork plans drawn to scale and coordinating penetrations and ceiling-mounted items. Show other systems installed in same space as ducts. Access doors and panels required to provide access to dampers duct cleanout. Coordination

- with ceiling-mounted items, including lighting fixtures, diffusers, grilles, speakers, sprinkler heads, access panels, and special moldings.
- 5. Welding certificates: copies of certificates indicating welding procedures and personnel comply with requirements in "quality assurance" article.
- 6. Field test reports: indicate and interpret test results for compliance with performance requirements.
- 7. Duct pressure and leakage testing method and procedure.

1.4 PROJECT RECORD DOCUMENTS

- A. Submit under provisions of Section 15010.
- B. Record actual locations of ducts and duct fittings. Record changes in fitting location and type. Show additional fittings used.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Galvanized Steel Ducts:
 - 1. Lock-forming quality conforming to ASTM A653, A653M, G90 (Z275) coating designation.
 - 2. Mill-phosphatized finish for surfaces of ducts exposed to view.
 - 3. Ductwork exposed on roof shall be painted with non-metallic paint. Color shall be white or off-white to match sarnafil roof.
- B. Fasteners:
 - 1. Rivets, bolts, or sheet metal screws shall be cadmium plated.
 - 2. Provide stainless steel fasteners for all stainless steel ductwork.
- C. Sealant:
 - 1. Joint and Seam Sealant: One-part, nonsag, solvent-release-curing, polymerized butyl sealant, formulated with a minimum of 75 percent solids.
 - 2. Flanged Joint Mastics: One-part, acid-curing, silicone, elastomeric joint sealants, complying with ASTM C 920, Type S, Grade NS, Class 25, Use O.
 - 3. Non-hardening, water-resistant, fire resistive, compatible with mating materials; liquid used alone or with heavy mastic.
- D. Hanger Materials:
 - 1. ASTM A36; steel, galvanized; threaded both ends, threaded one end, or continuously threaded.
 - 2. Galvanized, sheet steel or round, threaded steel rod.
 - 3. Hangers Installed in Corrosive Atmospheres (Lab Areas): Electro galvanized, all-thread rod.
 - 4. Straps and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for sheet steel width and thickness and for steel rod diameters.
 - 5. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
 - 6. Trapeze and Riser Supports: Steel shapes complying with ASTM A 36/A 36M. Supports for Galvanized-Steel Ducts: Galvanized steel shapes and plates.
 - 7. Framing shall be carbon steel.
 - 8. Strut Type:
 - a. 1-7/8" strut or larger

- b. Provide roll-formed 3-sided tubular shape, perforated with 9/16" holes at 1-7/8" centers on three sides.
- c. Thickness shall be 12 gauge
- d. Carbon steel finish and hot dip galvanized per ASTM A 123
- e. Hardware such as nuts, bolts and washers shall be hot dip galvanized.

2.2 DUCTWORK FABRICATION

- A. All ductwork shall be constructed to meet SMACNA requirements in the latest edition of SMACNA "HVAC Duct Construction Standards - Metal and Flexible". Unless otherwise indicated, provide duct material, gauges, reinforcing, and sealing for operating pressures indicated. Circular ducts shall be spirally seamed or longitudinally seamed if system pressure is equal to or less than 2 inches water column only.
- B. Transverse Joints: Ductmate, WDCI, or equal proprietary duct connection systems will be accepted for galvanized ductwork. Ductwork constructed using these systems will refer to the manufacturers guidelines for sheet gauge, intermediate reinforcement size and spacing, and joint reinforcements. Duct sizes 18" wide and larger, which have more than 10 square feet of un-braced panel, shall be beaded or cross broken every 12 in. This requirement is applicable to 20 gauge or less thickness and 3 in. wg. or less for system pressure.

TDC/TDF/T-24 shall be constructed as a SMACNA T-24 flange. Use of these joint systems shall be limited as follows:

Duct Size	Operating Pressure
0 - 42"	0 - 2" W.G.

- 1. Longitudinal Seams:
 - 2. Pittsburgh Lock shall be used on all longitudinal seams.
 - 3. All longitudinal seams will be sealed with mastic sealant. Snaplock is not acceptable.
 - 4. All exhaust ducts shall be continuously welded on the longitudinal seams and transverse joints.
 - a. Joint Sealant/Mastic: Shall be flexible, water-based, adhesive sealant designed for use in all pressure duct systems. After curing, it shall be resistant to ultraviolet light and shall prevent the entry of water, air and moisture into the duct system.
 - b. Sealer shall be UL 723 listed and meet NFPA requirements for Class 1 ductwork.
- C. Spiral Seams: Lockseam shall be used on all spiral seams. Snaplock is not acceptable.
- D. Ductboard: Fiberglass ductboard will not be accepted.
- E. The Contractor will be required to replace proprietary duct construction and transverse joining systems that are installed without authorization.
- F. Construct T's, bends, and elbows with radius of not less than 1-1/2 times width of duct on centerline. Where not possible and where rectangular elbows are used, provide extended trailing edge turning vanes. Where acoustical lining is indicated, provide turning vanes of perforated metal with glass fiber insulation.
- G. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream.
- H. Fabricate continuously welded round and oval duct fittings two gauges heavier than duct gauges indicated in SMACNA Standard.

1. Joints: 0" - 20" diameter, interior slip coupling beaded at center, fastened to duct with screws and with sealing compound applied continuously around joint before assembling and after fastening. Wrap joints with 3 inch wide duct tape.
 2. Joint 22" - 72" diameter, use 3 piece, gasketed, flanged joints consisting of 2 internal flanges (with integral mastic sealant) split to accommodate minor differences in duct diameter, and one external closure band designed to compress gasketing between internal flanges. Example: Ductmate Spiralmate or equal.
 3. Joints 74" diameter and up, use companion angle flanged joints only gasketed and bolted. Ductwall to be welded longitudinal seams.
- I. Provide standard 45 degree lateral wye takeoffs unless otherwise indicated. Branches may also have 45 degree entry with a minimum transition of 4" to duct dimensions and a clinch lock or spin-in lock per Fig.2-6, SMACNA HVAC DCS. Fit all connections to avoid visible openings and secure them suitably for the pressure class used.
- J. Welding:
1. Preparation for Welding: Dirt, grease, forming or machining lubricants, or any organic material shall be removed from the areas to be welded by cleaning with a suitable solvent or by vapor degreasing. The oxide coating shall be removed just prior to welding. This may be done by etching or scratch brushing. Suitable edge preparation to assure 100% penetration in butt welds shall be used.
 2. Cutting: Material may be sheared, sawed, cut with a router, or arc cut. All edges which have been cut by the arc process shall be planed to remove edge cracks. Cut edges shall be true and smooth, and free from excessive burrs or ragged breaks. Re-entrant cuts shall be avoided wherever possible. If used, they shall be filleted by drilling prior to cutting. Oxygen cutting of aluminum alloys shall not be permitted.
 3. Welding Procedure: Duct shall be welded with an inert gas shielded arc or resistance welding process. No welding process that requires a welding flux shall be used. Other filler metal alloys may be used provided they meet qualification test requirements, and result in welds with the listed alloy filler. Pre-heating for welding is permissible, provided the temperature does not exceed 400°F for a total of 30 minutes.
 4. Rewelding Defects: Portions of joints that have been rejected on inspection because of defects may be repaired by rewelding only. The defective area shall be removed by chipping or machining. Flame cutting shall not be used before rewelding. The joints shall be inspected to assure that all defective weld metal has been removed and that the joint is accessible so that the welding operator can obtain full penetration through the joint. All welding shall comply to ASTM D9.1.

2.3 MANUFACTURED DUCTWORK AND FITTINGS

- A. Manufacture in accordance with SMACNA DCS, and as indicated. Provide duct material, gauges, reinforcing, and sealing for operating pressures indicated.

2.4 SEALANT MATERIALS

- A. Joint and Seam Sealants, General: The term "sealant" is not limited to materials of adhesive or mastic nature but includes tapes and combinations of open-weave fabric strips and mastics.
1. Joint and Seam Tape: 2 inches wide; glass-fiber fabric reinforced.
 2. Tape Sealing System: Woven-fiber tape impregnated with a gypsum mineral compound and a modified acrylic/silicone activator to react exothermically with tape to form a hard, durable, airtight seal.
 3. Joint and Seam Sealant: One-part, nonsag, solvent-release-curing, polymerized butyl sealant, formulated with a minimum of 75 percent solids.
 4. Flanged Joint Mastics: One-part, acid-curing, silicone, elastomeric joint sealants, complying with ASTM C920, Type S, Grade NS, Class 25, Use O.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. All mechanical equipment and hardware shall be braced or anchored to resist horizontal force acting in any direction according to 2007 CBC, Section 1632A Using $C_a = 0.44$ and $I_p = 1.15$. Where anchorage details are not shown on the drawings, the installation shall be subject to the approval of the mechanical engineer and the field engineer of the Division of the State Architect. Ductwork and piping shall be in strict accordance with SMACNA Guidelines for Restraint of Mechanical Systems, Including Supplement Dated 2000 for Seismic Level "AA".
- B. Install manufactured ductwork and fittings in accordance with manufacturer's instructions. Ducts shall be independently supported from building structure, and not from other equipment or other equipment supports unless specifically shown on drawings or approved by the Engineer.
- C. Install and seal ducts in accordance with SMACNA DCS and SMACNA HVAC Air Duct Leakage Test Manual.
- D. Contractor shall verify all dimensions at the site, making all field measurements and shop drawings necessary for fabrication and erection of sheet metal work. Make allowances for beams, pipes and other obstructions in building construction and for Work of other Sections. Check Drawings showing Work of other trades and consult with the Owner in the event of potential interference.
- E. Duct sizes are inside clear dimensions. For lined ducts, maintain sizes inside lining and refer to Section 15290 for liner requirements.
- F. Provide openings in ductwork where required to accommodate thermometers and controllers. Provide pilot tube openings where required for testing of systems, complete with metal can with spring device or screw to ensure against air leakage. Where openings are provided in insulated ductwork, install insulation material inside a metal ring.
- G. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.
- H. Use crimp joints with or without bead for joining round duct sizes 8 inches and smaller with crimp in direction of air flow.
- I. Use double nuts and lock washers on threaded rod supports.
- J. Fabricate ductwork in a workmanlike manner with airtight joints, presenting smooth surfaces on inside, neatly finished on outside, construct with curves, bends, turning vanes to aid the easy flow of air.
- K. Connect diffusers to low pressure ducts directly per details indicated on the drawings.
- L. Provide seismic transverse and longitudinal bracing for ductwork per Section 15141.
- M. During construction provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering ductwork system.
- N. All exposed ductwork and supports shall be primed and painted. All ductwork shall be considered exposed unless concealed in shafts or ceiling spaces. Color to be selected by the Owner.

- O. Non-Fire-Rated Partition Penetrations: Where ducts pass through interior partitions and exterior walls, and are exposed to view, conceal space between construction opening and duct or duct insulation with sheet metal flanges of same metal thickness as duct. Overlap opening on four sides by at least 1-1/2 inches.
- P. Fire-Rated Partition Penetrations: Where ducts pass through interior partitions and exterior walls, install appropriately rated combination fire/smoke damper, sleeve, and firestopping sealant. Fire and smoke dampers are specified in Division 15 Section "Duct Accessories." Firestopping materials and installation methods are specified in Division 7 Section "Firestopping."
- Q. Upon completion of ductwork, Mechanical Contractor shall wrap the bottoms of all ducts below 12'-0" above finished floor in open areas, with 1" thick Armaflex (or equal) in a manner to prevent head injuries.
- R. All individual branch supply, return, exhaust, etc. ductwork shall be provided with manual volume dampers.
- S. Paint the inside of all ducts with flat black paint extending as far as visible, including backs of grilles and registers.
- T. All exposed ductwork shall be painted. Coordinate with the University and Architect.

3.2 DUCT PRESSURE / LEAKAGE TESTING

- A. Mechanical contractor shall conduct leakage test on the entire ductwork system. Mechanical contractor shall coordinate with Test and Balance Agency, the University and Engineer for witness and certification of all tests. Tests shall be performed prior to installing ductwork insulation. Mechanical contractor shall submit test reports to the Test and Balance Contractor for review prior to final review by the University Representative. Provide flow test of existing ductwork to remain and report conditions that will affect completed system performance. This work must be performed after hours and scheduled with University Representative.
- B. Systems shall be inspected and tested to positive pressures, in accordance with the following:
 - 1. There are no visible mechanical defects.
 - 2. There is no audible leakage at any point when area ambient noise is at normal-occupancy level.
- C. Measured total system leakage shall not exceed 1% of total system cubic feet per minute (cfm) when tested in accordance with "Leak Tests".
- D. Leak Tests: Test apparatus and procedures shall be similar in all respects to those defined in SMACNA HVAC Duct Leakage Test Manual or AABC standards.
 - 1. Filtered blower inlet and automatic safety relief device where necessary shall be provided to protect system.
 - 2. Accuracy of measurement of leakage flow rate shall be certified to be within 1 percent of total system flow.
- E. Test Apparatus shall consist of the following:
 - 1. A source of high pressure air - a portable rotary blower or tank type vacuum cleaner.
 - 2. A flow measuring device usually an orifice assembly consisting of straightening vanes and an orifice plate mounted in a straight tube with properly located pressure taps. Each

orifice assembly shall be accurately calibrated to its own calibration curve. Pressure and flow readings are usually taken with a differential pressure meter.

F. Test Procedures:

1. Test for audible leaks as follows:
 - a. Close off and seal openings in the duct section to be tested. Connect the test apparatus to the duct by means of a flexible duct section.
 - b. Start the blower with its control damper closed (some small blowers popularly used for testing ducts may damage the duct because they can develop pressures up to 25 inches w.g.).
 - c. Gradually open the inlet damper until the duct pressure reaches 0.5 inches w.g. greater than duct pressure class. Test pressure is read on the differential pressure meter.
 - d. Survey joints for audible leaks. Mark each leak and repair after shutting down blower. Do not apply a retest until sealants have set.
2. After all audible leaks have been sealed, the remaining leakage should be measured with the test apparatus orifice section as follows:
 - a. Start blower and open damper until duct pressure reaches 25 percent in excess of design duct operating pressure.
 - b. Read the pressure differential across the orifice on meter No. 2. Leakage rate in cfm is read directly from the calibration curve. If leakage does not occur, the pressure differential will be zero.
 - c. Total allowable leakage should not exceed 5 percent of the total system design air flow rate. When partial sections of the duct system are tested, the summation of the leakage for all sections shall not exceed the total allowable leakage.
 - d. If all audible leaks have been corrected, it is unlikely that the measured leakage will exceed one percent of capacity. If it does, the leaks shall be located by careful listening or feeling along the joint.
 - e. It should be noted that even though a system may pass the measured leakage test, a concentration of leakage at one point may result in a noisy leak that shall be corrected.

G. If specimen fails to meet allotted leakage level, the Contractor shall modify to bring it into compliance and shall retest it until acceptable leakage is demonstrated.

H. Tests and necessary repair shall be completed prior to concealment of ducts.

I. Test Report: A test report shall be provided for each system tested, identified by system or section thereof, and containing leak-test curves for apparatus used and data pertinent to acceptance requirements.

3.3 ADJUSTING AND CLEANING

- A. Cleaning of General Service Ductwork: Remove debris from general-purpose ductwork and accessories, and then blow ductwork and accessories, and then blow ductwork clean with air movement provided by the system fan or blower. Supply ductwork shall be blown clean before final branch connections are made to terminal units, or before terminal grilles, registers, or diffusers are installed.
- B. General Cleaning: Clean up and remove refuse material, crates, and rubbish arising from work of this Section from the premises.

3.4 SCHEDULES

- A. Ductwork Material Schedule

B. Air System Material

General Exhaust
Supply and Return Air

Galvanized Steel
Galvanized Steel

C. Minimum Ductwork Pressure and Seal Classes

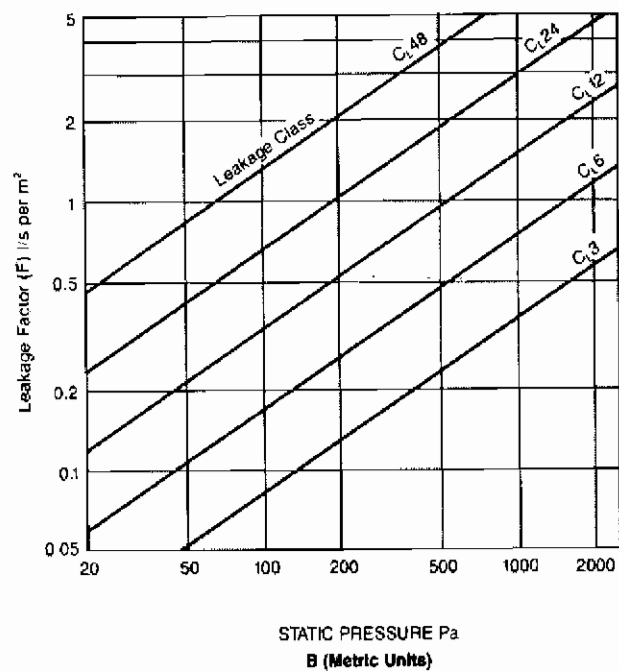
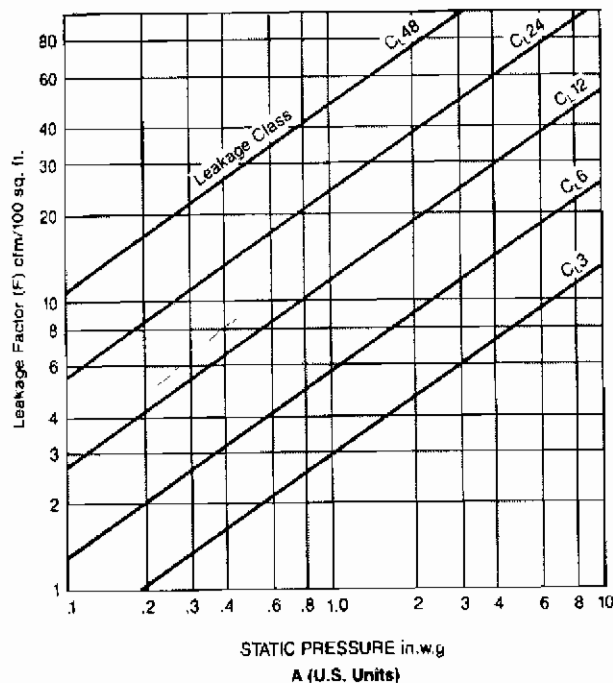
SMACNA SYSTEM	SMACNA PRESSURE CLASS	RECT / ROUND SEAL CLASS	LEAKAGE CLASS
Supply and Return	2 inch W.G.	C	24 / 12
Exhaust	2 inch W.G.	C	24 / 12
Supply and Return	3 inch W.G.	B	12 / 6
Exhaust	3 inch W.G.	B	12 / 6
Supply and Return	4, 6, 10 inch W.G.	A	6 / 3
Exhaust	4, 6, 10 inch W.G.	A	6 / 3

Class A: 4"w.g.and above; all transverse joints, longitudinal seams, and duct wall penetrations.

Class B: 3"w.g.; all transverse joints and longitudinal seams only.

Class C: 2"w.g.; transverse joints only.

Duct Leakage Classifications



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SECTION 15900

DIRECT DIGITAL CONTROL SYSTEMS

PART 1 - GENERAL

1.1 SCOPE OF WORK

- A. The Building Automation system (BAS) Contractor shall furnish and install a fully integrated building automation system, incorporating direct digital control (DDC) for energy management, equipment monitoring and control as herein specified. The system shall include all required computer software and hardware, controllers, sensors, transmission equipment, local panels, conduit, wire, installation, engineering, database and setup, supervision, commissioning, acceptance testing, training, warranty service and, at the owner's option, extended warranty service. System shall be an extension of the existing campus Staefa Talon network including all necessary updates to the main operating workstation at Central Plant control room.
- B. The system shall use LonTalk® as its native protocol. System components shall be certified by LONMARK® and display the LONMARK® logo where applicable. System components that do not have a LONMARK® profile shall be compatible with the LONMARK® standards. For each LonWorks device that does not have LonMark certification, the device supplier must provide DRF and XIF files for the device.
- C. The BAS shall be capable of total integration of the facility infrastructure systems with user access to all system data either locally over a secure intranet within the building or by remote access by a standard Web Browser over the Internet.
- D. The BAS shall be capable of communicating to third party systems such as chillers, boilers, air handling systems, energy metering systems, other energy management systems, access control systems, fire-life safety systems and other building management related devices with open, interoperable communication capabilities.
- E. All materials and equipment used shall be standard components, regularly manufactured for this and/or other systems and not custom designed especially for this project.
- F. For this scope of work the BAS as-built drawings are accessible from existing building graphics.

1.2 RELATED WORK SPECIFIED ELSEWHERE:

- A. Drawings and general provisions of the Contract, including General and supplementary Conditions and Division-1 specification sections, apply to work of this section.
- B. Products furnished or controlled but not installed under this section:
 - 1. Control valves, flow switches, air and water flow sensors, thermowells and pressure taps to be installed under section 15060, 15855, and other division 15 sections.
 - 2. Automatic dampers to be furnished and installed under section 15890.
- C. Coordination with electrical:
 - 1. Installation of all line voltage power wiring by division 16.
 - 2. Each motor starter provided under Division 16, shall be furnished with individual control power transformer to supply 120-volt control power and auxiliary contacts (one N.O. and one N.C.) for use by this section.

1.3 PERFORMANCE

- A. DDC shall be controlled with Direct Digital Control (DDC), according to the point list, sequences of operation and control diagrams shown on the plans and in these specifications. Additional points or software programming not listed or shown, but which are required to meet the Sequence of Operations on the Drawings, shall be provided.

1.4 QUALITY ASSURANCE

- A. The modifications to the existing Staefa Talon system shall be made by Control Works (909. 627. 7155). The authorized subcontractor shall be fully responsible for proper engineering, installation and operation of the direct digital control system including programming, testing, debugging and calibration of each component of the system consistent with the existing campus DDC system. The authorized subcontractor shall employ and provide when necessary a minimum of four (4) factory trained and certified technicians to install and maintain the system.

- B. At the time of bid, all BAS Application Specific Controllers and Programmable Equipment Controllers shall be listed as follows:

1. American Society for testing and materials, ASTM
2. Institute of Electrical and Electronic Engineers, IEEE
3. National Electrical Manufacturers Association, NEMA
4. Underwriters Laboratory, UL 916 and 864 UDTZ
5. FCC Regulation, Part 15, Section 156
6. National Fire Protection Association, NFPA
7. Local building codes

- C. References: This section contains references to the following documents. They are a part of this section as specified and modified. In case of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

ASHRAE 85 Automatic Control Terminology for Heating, Ventilating, Air Conditioning.
ASME MC85.1 Terminology for Automatic Control.
API RP 550-85 Manual on Installation of Refinery Instruments and Control Systems
ISA S5.4-76 Diagrams Instrument Loop.
ISA S5H-79 Process Instrumentation Terminology.
NEMA EMC1 Energy Management Systems Definitions.
NEMA ICS 1-83 General Standards for Industrial Control and Systems.
NEMA ICS 2-83 Industrial Control Devices, Controllers, and Assemblies
CSULB Campus Standards

- D. The Control Contractor shall furnish all electric relays and coordinate with the supplier of variable speed drives for auxiliary contact requirements. All electric control devices shall be of a type to meet current, voltage, and switching requirement of their particular application. Relays shall be provided with 24 VAC coils and contacts shall be rated at 10 amps minimum.
- E. Manufacturer: Single source manufacturer offering a full-line of controls, specializing in manufacturing the products specified in this Section with minimum ten years documented experience. Acceptable manufacturer is Siemens Building Technologies, Staefa - Talon with proven, successful experience with interfacing to existing Campus Staefa Talon architecture.
- F. California State University, Long Beach requires that the control system allow for purely open protocol, intelligent field equipment from multiple HVAC, Lighting control and other equipment manufacturers to communicate to a single front-end computer workstation. The DDC system must interface the communication and data through the existing Siemens Building Technologies, Staefa-Talon workstation software. All functions, displays, controls, etc. must communicate dynamically in real-time through the Staefa-Talon workstation software to the existing DDC central workstation. Any variation or third-party emulation to achieve transparent operation will not be accepted.

- G. It is a requirement of this specification to provide full integration, including equipment interface, software and complete graphics consistent with the existing campus DDC graphics.

1.5 SUBMITTALS

- A. Submit the specified number of sets of documentation in the following phased delivery schedule:
 - 1. Valve schedules
 - 2. Equipment data cut sheets
 - 3. System schematics, including:
 - a. Sequence of operations
 - b. Point names
 - c. Point addresses
 - d. Point to point wiring
 - e. Interface wiring diagrams
 - f. Panel layouts
 - g. System riser diagrams
 - h. Floor plans with equipment, fip, mcc, vav, and lon routing
 - i. Visio® or AutoCAD compatible as-built drawings including floor plans
- B. Upon project completion, submit operation and maintenance manuals, consisting of the following:
 - 1. Index sheet, listing contents in alphabetical order
 - 2. Manufacturer's equipment parts list of all functional components of the system, disk of system schematics, including wiring diagrams
 - 3. Description of sequence of operations
 - 4. As-Built interconnection wiring diagrams
 - 5. User's documentation containing product, system architectural and programming information.
 - 6. Trunk cable schematic showing remote electronic panel locations, and all trunk data
 - 7. List of connected data points, including panels to which they are connected and input device (ionization detector, sensors, etc.)
 - 8. Conduit routing diagrams
 - 9. Copy of the warranty
 - 10. Operating and maintenance cautions and instructions
 - 11. Recommended spare parts list

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURER AND BAS SUBCONTRACTOR

- A. Staefa Talon System as installed by ControlWorks. (909. 627. 7155)

2.2 THE BUILDING AUTOMATION SYSTEM

- A. (BAS) shall be comprised of a network of interoperable, stand-alone digital controllers. The BAS shall incorporate LonWorks™ technology using Free Topology Transceivers (FTT-10), and specific conformance to the LONMARK™ Interoperability Association's v3.0 Physical Layer guidelines in all unitary, terminal and other device controllers. The system shall include:
- B. Network Area Controllers (NAC'S) for distributed system applications, databases and networking functions.

- C. Programmable Equipment Controllers (PEC'S) for control of primary mechanical systems and distributed system applications. Controllers shall be fully programmable to create custom control solutions.
 - D. Application Specific Controllers (ASC'S) for control of VAV terminal units, fan coil terminal units, Unit Vent terminal units, Heat Pump units and other terminal equipment.
 - E. Graphical User Interface (GUI), which includes the hardware and software necessary for a user to interface with the control system and devices.
- 2.3 THE PHYSICAL NETWORK shall use polarity insensitive twisted pair wiring and support star, home run, multi-drop, loop, or a mixture of these wiring topologies. The network shall communicate at a minimum 78Kbps.
- 2.4 ALL COMPONENTS AND CONTROLLERS supplied under this contract shall be true "peer-to-peer" communicating devices. Components or controllers requiring "polling" by a host to pass data shall not be acceptable.
- 2.5 COMMUNICATION AND INTEGRATION OF 3RD PARTY LONMARK® PRODUCTS shall be accomplished without gateways or interface devices. The 3rd party product supplier shall provide DRF and XIF files for each device.
- 2.6 MAXIMUM ACCEPTABLE RESPONSE TIME from any alarm occurrence (at the point of origin) to the point of annunciation shall not exceed 5 seconds for network connected user interfaces. Maximum acceptable response time from any alarm occurrence (at the point of origin) to the point of annunciation shall not exceed 60 seconds for remote or dial-up connected user interfaces.
- 2.7 NETWORK AREA CONTROLLER (NAC)
- A. The Network Area Controller (NAC) shall provide the interface between the field control devices, and provide global supervisory control functions over the control devices connected to the NAC. It shall be capable of executing application control programs to provide:
 - 1. Calendar functions
 - 2. Scheduling
 - 3. Trending
 - 4. Alarm monitoring and routing
 - 5. Time synchronization
 - 6. Integration of LonWorks controller data
 - 7. Network Management functions for all LonWorks based devices
 - B. The NAC shall provide multiple, concurrent user access to the system and support for ODBC or SQL. A database resident on the NAC shall be an ODBC-compliant database or must provide an ODBC data access mechanism to read and write data stored within it.
 - C. The NAC shall support standard Web browser access via the Intranet/Internet. It shall support a minimum of 16 simultaneous users.
 - D. The NAC shall provide alarm recognition, storage; routing, management, and analysis to supplement distributed capabilities of equipment or application specific controllers.
 - 1. The NAC shall be able to route any alarm condition to any defined user location whether connected to a local network or remote via dial-up, telephone connection, or wide-area network.
 - 2. Alarm generation shall be selectable for annunciation type and acknowledgement requirements including but limited to:
 - a. To alarm

- b. Return to normal
 - c. To fault
- 3. Provide for the creation of an unlimited number of alarm classes for the purpose of routing types and or classes of alarms, i.e.: security, HVAC, Fire, etc.
- 4. Provide timed (schedule) routing of alarms by class, object, group, or node.
- 5. Provide alarm generation from binary object "runtime" and /or event counts for equipment maintenance. The user shall be able to reset runtime or event count values with appropriate password control.
- E. Alarms shall be annunciated in any of the following manners as user defined:
 - 1. Screen message text
 - 2. Email of the complete alarm message to multiple recipients. Provide the ability to route and email alarms based on:
 - a. Day of week
 - b. Time of day
 - c. Recipient
 - 3. Pagers via paging services that initiate a page on receipt of email message
 - 4. Graphic with flashing alarm object(s)
 - 5. Printed message, routed directly to a dedicated alarm printer
- F. The following shall be recorded by the NAC for each alarm (at a minimum):
 - 1. Time and date
 - 2. Location (building, floor, zone, office number, etc.)
 - 3. Equipment (air handler #, accessway, etc.)
 - 4. Acknowledge time, date, and user who issued acknowledgement.
 - 5. Number of occurrences since last acknowledgement.
- G. Defined users shall be given proper access to acknowledge any alarm, or specific types or classes of alarms defined by the user.
- H. A log of all alarms shall be maintained by the NAC and/or a server (if configured in the system) and shall be available for review by the user.
- I. Provide a "query" feature to allow review of specific alarms by user defined parameters.
- J. A separate log for system alerts (controller failures, network failures, etc.) shall be provided and available for review by the user.
- K. An Error Log to record invalid property changes or commands shall be provided and available for review by the user.
- L. Data Collection and Storage
 - 1. The NAC shall have the ability to collect data for any property of any object and store this data for future use.
 - 2. The data collection shall be performed by log objects, resident in the NAC that shall have, at a minimum, the following configurable properties:
 - a. Designating the log as interval or deviation.
 - b. For interval logs, the object shall be configured for time of day, day of week and the sample collection interval.
 - c. For deviation logs, the object shall be configured for the deviation of a variable to a fixed value. This value, when reached, will initiate logging of the object.

- d. For all logs, provide the ability to set the maximum number of data stores for the log and to set whether the log will stop collecting when full, or rollover the data on a first-in, first-out basis.
 - e. Each log shall have the ability to have its data cleared on a time-based event or by a user-defined event or action.
- 3. All log data shall be stored in a relational database in the NAC and the data shall be accessed from a server (if the system is so configured) or a standard Web Browser.
- 4. All log data, when accessed from a server, shall be capable of being manipulated using standard SQL statements.
- 5. All log data shall be available to the user in the following data formats:
 - a. HTML
 - b. XML
 - c. Plain Text
 - d. Comma or tab separated values
- 6. Systems that do not provide log data in HTML and XML formats at a minimum shall not be acceptable.
- 7. The NAC shall have the ability to archive its log data either locally (to itself), or remotely to a server or other NAC on the network. Provide the ability to configure the following archiving properties, at a minimum:
 - a. Archive on time of day
 - b. Archive on user-defined number of data stores in the buffer (size)
 - c. Archive when buffer has reached it's user-defined capacity
- M. Provide and maintain an Audit Log that tracks all activities performed on the NAC. Provide the ability to specify a buffer size for the log and the ability to archive log based on time or when the log has reached its user-defined buffer size. Provide the ability to archive the log locally (to the NAC), to another NAC on the network, or to a server. For each log entry, provide the following data:
 - 1. Time and date
 - 2. User ID
 - 3. Change or activity: i.e., Change setpoint, add or delete objects, commands, etc.
- N. The NAC shall have the ability to automatically backup its database. The database shall be backed up based on a user-defined time interval.
 - 1. Copies of the current database and, at the most recently saved database shall be stored in the NAC. The age of the most recently saved database is dependent on the user-defined database save interval.
 - 2. The NAC database shall be stored, at a minimum, in XML format to allow for user viewing and editing, if desired. Other formats are acceptable as well, as long as XML format is supported.

2.8 PROGRAMMABLE EQUIPMENT CONTROLLERS (PEC)

- A. Programmable Equipment Controllers (PEC's) shall be stand-alone, multi-tasking, real-time digital control processors with an embedded network database.
- B. The PEC's shall communicate via native LonTalk protocol and be compatible with the LONMARK® standards. Provide a minimum of 4MB Random Access Memory in each PEC.
- C. The PEC must communicate peer-to-peer with all of the network application specific and programmable controllers sharing alarming, trending, scheduling and totalization information.
- D. PEC's that do not reside exclusively on the LonTalk network and/or cannot provide direct distribution of the system level applications must be configured to co-function with an additional operational back-up PEC.

- E. Programming of the PEC shall be accomplished by using graphical software that incorporates drag and drop capabilities. The PEC software database must be able to execute all of the specified mechanical system controls functions. The programming software shall be able to bundle software logic to simplify control sequencing. All values, which make up the PID output value, shall be readable and modifiable at a workstation or portable service tool. Each input, output, or calculation result shall be capable of being shared/bound with any controller or interface device on the network.
- F. PEC's shall be able to execute custom, job-specific processes defined by the user, to automatically perform calculations and special control routines.
 - 1. A single process shall be able to incorporate measured or calculated data from any and all other PEC's on the network. In addition, a single process shall be able to issue commands to points in any and all other PEC's on the network.
 - 2. Processes shall be able to generate operator messages and advisories to operator I/O devices.
- G. Each PEC shall support firmware upgrades without the need to replace hardware. The upgrades can be accomplished remotely over the LonTalk network and/or by visiting each controller.
- H. Each PEC shall continuously perform self-diagnostics, which include communication diagnosis and diagnosis of all components. The PEC shall provide both local and remote annunciation of any detected component failures, low battery conditions or repeated failure to establish communication.
- I. In the event of the loss of normal power, there shall be an orderly shutdown of all PEC's to prevent the loss of database or operating system software. Non-volatile memory shall be incorporated for all critical controller configuration data and battery backup shall be provided to support the real-time clock and all volatile memory for a minimum of 72 hours.
 - 1. Upon restoration of normal power, the PEC shall automatically resume full operation without manual intervention.
 - 2. All PEC's control programming and databases must be stored in Flash memory, therefore eliminating data loss, downtime and re-load time.
- J. Provide a separate PEC for each AHU or other HVAC system. All system points shall reside on a single controller.
- K. Historical data collection utilities shall be provided to manually or automatically sample and store system data for selected points. Any point, physical or calculated may be designated for trending. Any point, regardless of physical location in the network, may be collected and stored. Two methods of collection shall be allowed either by a pre-defined time interval or upon a pre-defined change of value. Sample intervals of 1 minute to 7 days shall be provided. The PEC shall have a dedicated RAM-based buffer for trend data. All trend data shall be available for transfer to a Workstation without manual intervention.

2.9 APPLICATION SPECIFIC CONTROLLERS (ASC)

- A. Each Application Specific Controller (ASC) shall operate as a stand-alone LonMark® compliant controller capable of performing its specified control responsibilities independent of other controllers in the network. Each ASC shall be a minimum 16-BIT microprocessor based, multi-tasking, multi-user, real time digital control processor.
- B. Each ASC's application must comply with one of the following LONMARK® interoperability profile guidelines:

1. Zone Dampers - Profile 8502

- C. Flash memory re load or updating of an existing control algorithm shall be completed over the network.
 - D. Network access may be accomplished (where shown) at the ASC room sensor or the ASC. System node access shall be available from connecting to the room sensor jack.
 - E. Controllers shall include all inputs and outputs necessary to perform the specified control sequences. Analog and digital outputs shall be industry standard signals such as 0-10V and 3-point floating control allowing for interface to a variety of industry standard modulating actuators. The ASC inputs and outputs shall consist of industry standards types. Inputs shall be electrically isolated from outputs, communications and power. All inputs shall be provided with an auto-calibrate function to eliminate sensing errors.
 - F. All controller sequences and operation shall provide closed loop control of the intended application. Closing control loops over the network is not acceptable.
 - G. The ASC must be mounted remotely from the room sensor. ASC'S, that are wall mounted with integral room sensors, are not acceptable.
 - H. The control program shall reside in the ASC. The application program configuration information shall be stored in non-volatile memory with no battery back up.
 - I. After a power failure the ASC must run the control application using the current setpoints and configuration. Reverting to default or factory setpoints are not acceptable.
- 2.10 GRAPHICAL USER INTERFACE WORKSTATION HARDWARE (DESKTOP)
Not required.
- 2.11 GRAPHICAL USER INTERFACE WORKSTATION HARDWARE (LAPTOP COMPUTER)
Not required.
- 2.12 GRAPHICAL USER INTERFACE SOFTWARE (GUI)
- A. Operator workstations are capable of supporting any LonMark® compliant product. The operator shall not be able to distinguish the DDC points from different manufacturers when commanding, monitoring points or acknowledging alarms. The new controls shall be compatible with the existing campus-wide Building Automation System. The BAS shall be accessible from any of the application specific controllers installed in this project.
 - B. The software provides a multi-tasking type environment that allows the user to run several applications simultaneously. The GUI software runs on a Windows 2000 or NT 32-bit operating system. The operator is able to work in Microsoft Word, Excel, and other Windows based software packages, while concurrently annunciating on-line BAS alarms and monitoring information.
 - C. Real-Time Displays. The GUI, supports the following graphical features and functions:
 - 1. Graphic screens are developed using any drawing package capable of generating a GIF, BMP, or JPG file format. In addition to, or in lieu of a graphic background, the GUI supports the use of scanned pictures.
 - 2. A gallery of HVAC and automation symbols are provided including fans, valves, motors, chillers, AHU systems, standard ductwork diagrams and symbols. The operator has the ability to add custom symbols to the gallery as required.
 - 3. Graphic screens have the capability to contain objects for text, real-time values, animation, color spectrum objects, logs, graphs, HTML or XML document links, schedule objects, hyperlinks to other URL's, and links to other graphic screens.

4. Graphics support layering and each graphic object shall be configurable for assignment to a layer. A minimum of six layers are supported.
 5. Modifying common application objects, such as schedules, calendars, and set points are accomplished in a graphical manner.
 - a. Schedule times are adjusted using a graphical slider, without requiring any keyboard entry from the operator.
 - b. Holidays are set by using a graphical calendar, without requiring any keyboard entry from the operator.
 6. Commands to start and stop binary objects are done by mouse command from the pop-up menu. No entry of text is required.
 7. Adjustments to analog objects, such as set points, is done by mouse command using a graphical slider to adjust the value. No entry of text is required.
- D. System Configuration. The GUI permits the operator to perform the following tasks, with proper password access:
1. Create, delete or modify control strategies.
 2. Add/delete objects to the system.
 3. Tune control loops through the adjustment of control loop parameters.
 4. Enable or disable control strategies.
 5. Generate hard copy records or control strategies on a printer.
 6. Select points to be alarmable and define the alarm state.
 7. Select points to be trended over a period of time and initiate the recording of values automatically.
- E. On-Line Help. Provide a context sensitive, on-line help system to assist the operator in operation and editing of the system. On-line help shall be available for all applications and shall provide the relevant data for that particular screen. Additional help information shall be available through the use of hypertext. All system documentation and help files shall be in HTML format.
- F. Each operator shall be required to log on to that system with a user name and password in order to view, edit, add, or delete data. System security shall be selectable for each operator. The system administrator shall have the ability to set passwords and security levels for all other operators. Each operator password shall be able to restrict the operators' access for viewing and/or changing each system application, full screen editor, and object. Each operator shall automatically be logged off of the system if no keyboard or mouse activity is detected. This auto log-off time shall be set per operator password. All system security data shall be stored in an encrypted format.
- G. System Diagnostics. The system automatically monitors the operation of all workstations, printers, modems, network connections, building management panels, and controllers. The failure of any device is annunciated to the operator.
- H. The system is provided with a dedicated alarm window or console. This window notifies the operator of an alarm condition, and allows the operator to view details of the alarm and acknowledge the alarm. The use of the Alarm Console is enabled or disabled by the system administrator.
1. When the Alarm Console is enabled, a separate alarm notification window supercedes all other windows on the desktop and shall not be capable of being minimized or closed by the operator. This window notifies the operator of new alarms and un-acknowledged alarms.

2.13 WEB BROWSER CLIENTS

- A. The existing system is capable of supporting an unlimited number of clients using a standard Web browser such as Internet Explorer™ or Netscape Navigator™. The new controls shall be compatible with the existing campus-wide Building Automation system.
- B. The Web browser software runs on any operating system and system configuration that is supported by the Web browser. Web page access and control are from system Network Area Controllers, not from the Workstation. This prevents the problem of no access to Web pages if the Workstation is turned off.
- C. The Web browser provides the same view of the system, in terms of graphics, schedules, calendars, logs, etc., and provides the same interface methodology as is provided by the Graphical User Interface. The browser includes background refresh software to all real-time updates without use of a refresh button.
- D. The Web browser client supports at a minimum, the following functions:
 - 1. User log-on identification and password shall be required. If an unauthorized user attempts access, a blank web page shall be displayed. Security using Java authentication and encryption techniques to prevent unauthorized access shall be implemented.
 - 2. Graphical screens developed for the GUI shall be the same screens used for the Web browser client. Any animated graphical objects supported by the GUI shall be supported by the Web browser interface.
 - 3. HTML programming shall not be required to display system graphics or data on a Web page. HTML editing of the Web page shall be allowed if the user desires a specific look or format.
 - 4. Storage of the graphical screens shall be in the Network Area Controller (NAC), without requiring any graphics to be stored on the client machine. Systems that require graphics storage on each client are not acceptable.
 - 5. Real-time values displayed on a Web page shall update automatically without requiring a manual "refresh" of the Web page.
 - 6. User's has administrator-defined access privileges. Depending on the access privileges assigned, the user is able to perform the following:
 - a. Modify common application objects, such as schedules, calendars, and set points in a graphical manner. Schedule times will be adjusted using a graphical slider, without requiring any keyboard entry from the operator. Holidays shall be set by using a graphical calendar, without requiring any keyboard entry from the operator.
 - b. Commands to start and stop binary objects are done by right-clicking the selected object and selecting the appropriate command from the pop-up menu. No entry of text is required.
 - c. View logs and charts
 - d. View and acknowledge alarms
 - 7. The system has the capability to specify a user's (as determined by the log-on user identification) home page. Provide the ability to limit a specific user to just their defined home page. From the home page, links to other views, or pages in the system shall be possible, if allowed by the system administrator.
 - 8. Graphic screens on the Web Browser client support hypertext links to other locations on the Internet or on Intranet sites, by specifying the Uniform Resource Locator (URL) for the desired link.

2.14 LONWORKS NETWORK MANAGEMENT

- A. Controls shall be compatible with existing campus-wide Building Automation System (BAS).

2.15 FIELD DEVICES

- A. Provide modulating magnetic control valves, sensors, transmitters controllers, and other components as required for complete installation. Except as otherwise indicated, provide

Staefa Control System standard control system components as indicated by published product information, designed and constructed as recommended by manufacturer.

B. Temperature Sensors

1. Temperature Sensors: Temperature sensors shall be linear precision elements with ranges appropriate for each specific application. All ASC room sensors shall provide for direct connection and access to the LonTalk network.
2. Space (room) sensors shall be available with setpoint adjustment and override switch. Space sensor shall have a portable service tool jack to allow communication with the LonWorks system. Sensors shall be furnished with electrical box adapters.
3. Duct mounted averaging sensors shall be 4-20ma, with the appropriate range, and utilize a sensing element incorporated in a copper capillary with a minimum length of 20 feet. The sensor shall be installed according to manufacture recommendation and looped and fastened at a minimum of every 36 inches.
4. Sunshields shall be provided for outside air sensors.
5. Immersion sensors shall be 4-20ma with the appropriate range selected for the application (CHW, CW, HW) s furnished with stainless steel or brass as required for the application.

C. Humidity Sensors: Humidity sensors shall be of the solid-state type using a capacitance-sensing element. The sensor shall vary the output voltage with a change in relative humidity. Outside air sensor shall have a minimum range of 10% to 90% $\pm$ 5%. Duct mounted humidity sensors shall have a minimum range of 10% to 90% $\pm$ 5%.

D. Duct and filter Differential Pressure Transmitters: The indicating differential pressure transmitters shall be Veris PXD series, utilizing an advanced ceramic capacitive sensing element, with ranges suitable to the applications. Transmitters shall be furnished with static tips, fittings & tubing.

E. Space Static Pressure Sensors: The wall mounted pressure sensor (one per AHU) shall be Kele RPS and shall vary the output pressure with a change in space pressure. Indicating transmitters shall be Veris PXD series, utilizing an advanced ceramic capacitive sensing element, and have a sensing range shall be -0.2" to +0.2"WC with linearity of 1.5% of full scale and offset of less than 1% of full scale. Sensor shall be capable of withstanding up to 150% of rated pressure without damage.

F. Air Quality/CO2 Sensor: (Siemens QPA series) The Staefa wall mounted air quality/CO2 sensor (one per AHU) shall be capable of simultaneously monitoring various types of Volatile Organic Compounds (VOC'S) and CO2. The sensor shall be capable of monitoring from 100% air quality to 0% air quality and shall produce a linear 0-10 VDC signal. The sensor shall also produce a 0 to 10 VDC signal based on CO2 levels from 0-2000 PPM, $\pm$ 100 PPM.

G. Wet Media Differential Pressure Transmitters shall be Veris PW/PW2 Series wet/wet pressure transducers. The transducer shall be enclosed in a NEMA 4 sealing, provide 4-20 MA outputs over the selected range, include jumper controlled electronic surge dampening for high stability and include a pushbutton zero calibration switch.

H. Water flow meters shall be EMCO ,Sono-track ST-30 Model#ST-30-A-N-250-1-25-12 or approved equal. The meter accuracy shall be 0.5% of reading for any value between 1.6 and 30 fps. The meter shall be furnished complete with NIST certification.

I. Supply Air Fan airflow sensors shall be Fan Evaluator manufactured by Air Monitor Corporation or approved equal. The sensor shall be multi-point, self averaging Pitot traverse station with integral air straightener-equalizer honeycomb cell, capable of continuously measuring fan discharges with an accuracy of 2% or better.

J. Branch ducts air low sensors shall be Kele 160 Series Pitot tubes with A-158 mounting kits or approved equal. They shall be available in 8, 12, 18, 24, 36 & 48 inch lengths with insertion depth

markings stamped on the tube for proper installation. The Pitot tubes shall be of ASME design & accurate even with up to 15 degrees misalignment.

- K. Differential Pressure Transmitters: For air flow sensors installed in the fan discharge of each fan and branch ducts furnish and install a Veris PXD series indicating differential pressure transmitter with a range suitable to the AHU airflow sensor output. (Range selectable)

L. Switches and Thermostats

1. The BAS Contractor shall furnish all electric relays and coordinate with the supplier of magnetic starters for starter coil requirements. All electric control devices shall be of a type to meet current, voltage, and switching requirement of their particular application. Relays shall be provided with 24 VAC coils and contacts shall be rated at 10 amps minimum.
2. Current Operated Switches: Switches shall be Veris H708 for Motor status indications, for constant speed equipment and H904 for variable speed motors, where shown on the control schematics. The switches shall be adjusted to prove motor full running status.

M. Control Valves

1. Base Bid Control Valves shall be Delta P as manufactured by Flow Control Industries of Seattle Washington. See Schedule on Sheet M-2.
2. Alternate Control Valves shall be Siemens Modulating control valves up to 4 inches shall be sized for a 3 to 5 PSI pressure drop. Valves shall be packless, modulating, magnetically actuated, with a control rangeability of 500 to 1. These valves shall have true linear flow characteristics in relationship to valve opening.
3. ½ inch to 4 inch: Valves shall be equipped with hand wheel, or manual position mounted dial adjacent to valve, to allow manual positioning of valve in absence of control power.

N. Damper Actuators

1. Actuators shall be modulating (0-10 VDC) sized as required by the application. The actuator shall use an overload-proof synchronous motor. Actuators shall be available with spring return to the normal position when required. Actuators shall have a position indicator for external indication of damper position. Actuators shall have manual override capability without disconnecting damper linkage.

2.16 ELECTRICAL BULK MATERIALS

- A. Enclosures: Terminal boxes located indoors shall be rated for NEMA 1. Terminal boxes located outdoors shall be rated for NEMA 4X. They shall have protective coatings suitable to the environment in which they are to be installed. All enclosures shall be hinged with lockable doors.
- B. Transformers: Provide step-down transformers where control equipment operates at lower than circuit voltage. Transformers serving shall be fed from the fan motor leads, or fed from the nearest distribution panelboard or motor control center, using circuits provided for the purpose. Transformers, other than transformers in bridge circuits, shall have primaries wound for the voltage available and secondaries wound for the correct control circuit voltage. Size transformers so that 80 percent of the rated capacity equals the connected load. Enclose transformers in a steel cabinet with conduit connections. Provide a disconnect switch on the primary side and a fuse cutout on the secondary side. Transformers shall conform to UL 506.
- C. The Controls Contractor shall furnish all electrical relays and coordinate with the supplier of magnetic starters for the auxiliary contact requirements. All electrical control devices shall be of a type to meet current, voltage, and switching requirement of their particular application. Relays shall be provided with 24 VAC coils and contacts shall be rated at 10 amps minimum.

- D. The Controls Contractor shall furnish conduits for control wiring as required and where not specifically shown on Electrical Drawings. All conduit and finish requirements shall be in accordance with Section 16050, "Basic Materials and Methods".
- E. Wiring:
1. Provide complete electric wiring for temperature control apparatus, including wiring to transformer primaries.
 2. Control circuit conductors which run in same conduit as power circuit conductors shall have same insulation level as power circuit conductors.
 3. Circuits operating at more than 100 volts shall be in accordance with Section 16050, "Basic Materials and Methods".
 4. Circuits operating at 100 volts or less shall be defined as low voltage and shall be run in rigid or flexible conduit, metallic tubing, metal raceways or wireways, armored cable, or multiconductor cable. Use multiconductor cable for concealed accessible locations only. Provide circuit and wiring protection as required by NFPA 70. Aluminum-sheathed cable or aluminum conduit may be used but shall not be buried in concrete.
 5. Provide all exposed wiring in conduit or EMT.
 6. For less than nominal 120VAC service: Cable in control panels for analog loops shall be twisted and shielded two conductor, #16 x 30 stranded with #22 AWG drain wire and aluminum-polyester 100 percent shielding cover for each pair. Cable outside of control panels for analog signal loops shall be single twisted #18 AWG shielded pair. Conductors shall be copper coated with Class B strand. Insulation shall be 30 mils XPPE rated at 300 volts. Each conductor shall be color coded. Each cable shall have polyethylene jacket.
 7. Wire for low voltage DC and electronic circuits carrying less than 0.5 ampere, cable of two or more conductors, shall be not smaller than No. 18 AWG stranded copper (shielded).
 8. Shield cables carrying analog signals and install in separate conduit from AC power circuits.
 9. Terminate cables in solder or screw type terminal strips. Do not tap cables at intermediate points.
 10. Color code or number wires, whether individual or in cables, for identification.
 11. Cables terminating in screw type terminal strips shall have pressure type connectors conforming to UL 486A. Wire in physical contact with compression screw is not acceptable.
- F. Power line Surge Protection: Power circuits for each controller shall be individually electrically isolated to protect against transients, spikes and power surges. Optical isolation shall be provided either as an integral component of the controller or provided as a separate interface device between the controller and field wiring. Fuses are not permitted.
- G. Sensor and Control Wiring Surge Protection: Control and sensor circuits for each controller shall be individually electrically isolated to protect against transients, spikes, and power surges. Each local controller input system and output system shall individually optically isolated from other inputs and outputs on other local controllers' field wiring. Optical isolation shall be provided either as an integral component of the controller or provided as a separate interface device between the controller and field wiring. Fuses are not permitted for surge protection.

PART 3 - EXECUTION

3.1 PROJECT MANAGEMENT

- A. Provide a project manager who will be on site whenever required and shall, as a part of his duties, be responsible for the following activities:

1. Coordination between the contractor and all other trades, owner, local authorities and the design team.
2. Scheduling of manpower, material delivery, equipment installation and checkout.
3. Maintenance of construction records such as project scheduling and manpower planning and AutoCAD or Visio for project co-ordination and as-built drawings.
4. Coordination/Single point of contact

3.2 INSTALLATION METHODS

- A. Install systems and materials in accordance with manufacturer's instructions, rough-in drawings and equipment details. Install electrical components and use electrical products complying with requirements of applicable Division-16 sections of these specifications.
- B. The term "control wiring" is defined to include providing of wire, conduit, and miscellaneous materials as required for mounting and connecting electric or electronic control devices.
- C. All exposed wiring, low and line voltage subject to mechanical damage, shall be run in conduit. Line and low voltage wiring shall be run in separate conduits. Concealed but accessible wiring, except in mechanical rooms and areas where other conduit and piping are exposed shall run in UL plenum rated cable as approved by local codes unless expressly restricted by requirements in Division 16 specification.
- D. All Controllers, Relays, Transducers, etc., required for stand-alone control shall be housed in a NEMA 1 enclosure with a lockable door.

3.3 SYSTEM ACCEPTANCE

- A. General: The system installation shall be complete and tested for proper operation prior to requesting systems acceptance. All tests shall be observed by the Owner's authorized representative. A letter, certifying that all controls are installed and the software programs have been completely exercised for proper equipment operation shall be submitted to the Architect requesting systems acceptance. Final acceptance testing shall commence at a mutually agreeable time within ten (10) calendar days after receipt of written request. The warranty period will NOT start until the project has been accepted in accordance with the Contract General Conditions.
- B. Field Equipment Test Procedures: BAS panels shall be demonstrated via a functional end-to-end test. Such that:
 1. All output channels shall be commanded (on/off, stop/start, adjust, etc.) and their operation verified.
 2. All analog input channels shall be verified for proper operation.
 3. All digital input channels shall be verified by changing the state of the field device and observing the appropriate change of displayed value.
 4. If a point should fail testing, perform necessary repair action and retest failed point and all interlocked points.
 5. Automatic control operation shall be verified by introducing an error into the system and observing the proper corrective system response.
 6. Selected time and setpoint schedules shall be verified by changing the schedule and observing the correct response on the controlled outputs.
- C. As-Built Documentation: After a successful acceptance demonstration, the Contractor shall submit as-built drawings of the completed project for final approval. After receiving final approval, supply "6" complete 11x17 as-built drawing sets, together with AutoCAD or Visio diskettes to the owner.
- D. Operation and Maintenance Manuals: Submit three copies of operation and maintenance manuals. Include the following

1. Manufacturer's catalog data and specifications on sensors, transmitters, controllers, control valves, damper actuators, gauges, indicators, terminals, and any miscellaneous components used in the system.
2. An operator's manual that will include detailed instructions for all operations of the system.
3. An operator's reference table listing the addresses of all connected input points and output points. Settings shall be shown where applicable.
4. A programmer's manual that will include all information necessary to perform programming functions.
5. Flow charts of the control software programs utilized in the DDC system.
6. Flow charts of the custom software programs utilized in the DDC system as approved.
7. Complete program listing file and parameter listing file for all programs.
8. A copy of the warranty.
9. Operating and maintenance cautions and instructions.

3.4 TRAINING

- A. Contractor shall provide to the engineer a training class outline prior to any scheduled training.
- B. Factory trained control engineers and technicians shall provide training sessions for the Owner's personnel.
- C. The BAS contractor shall conduct two (2) eight-hour training courses for the designated owners' personnel in the maintenance and operation of the control system. One class shall be given upon system acceptance and the other approximately six months into the warranty.
- D. The course shall include instruction on specific systems and instructions for operating the installed system to include as a minimum:
 1. HVAC system overview.
 2. Operation of Control System
 3. Function of each Component
 4. System Operating Procedures
 5. Programming Procedures
 6. Maintenance Procedures

3.5 WARRANTY

- A. The BAS shall be warranted to be free from defects in both material and workmanship for a period of one (1) year of normal use and service. The warranty period shall commence upon project acceptance in accordance with the Contract General Conditions.

3.6 SEQUENCE OF OPERATION

A. GENERAL

1. All HVAC Systems shall be controlled with Direct Digital Control (DDC) according to the control points on the control schematics shown on the drawings and in the specifications, and shall be stand-alone. Additional points or software programming not shown but which are required to meet the approved sequence of operation shall be provided. Refer to the sequence of operation in specification section 15985.

END OF SECTION

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SECTION 16000

COMMON ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of contract work, including general and supplementary conditions, apply to work of this section.
- B. Section includes basic electrical requirements specifically applicable to Division 16 sections.
- C. Electrical General Requirements specifically applicable to Division 16 Sections, in addition to Division 1 - General Requirements. Work includes but is not necessarily limited to the following:
- D. Definitions, guarantees, submittals, clean-up, "As-Builts" and all other applicable requirements of Division 0 and Division 1 apply to the work of this section.
- E. Examine all other sections for work related to those sections which are required to be included as work under this section.
- F. Coordinate all work in this Division with related trades.
- G. Make detailed arrangements with the University telecommunication company for telephone service to the building.

1.2 GENERAL DESCRIPTION

- A. This Section of the Specifications outlines the provisions of the contract work to be performed under this Division. This section applies to and forms a part of each Section of the Specifications in Division 16 and all work performed under the electrical and communications contracts.
- B. Provide all labor, equipment and material (unless otherwise noted), tools, and services required for the complete installation of electrical equipment as shown on the drawings and described in this specification. Perform all labor in a workmanlike manner to the satisfaction of the University. Staff the project with sufficient skilled workmen, including a fully qualified superintendent, to complete the work in the time allotted. The superintendent must be qualified to supervise all aspects of the work under this Division. Certification of qualifications will be submitted upon request from the University. The work includes, but is not limited to the following.
 - 1. Providing all conduit, conduit fittings, junction or pull boxes, and other miscellaneous electrical fittings and supports as required.
 - 2. Providing all panels disconnects switchboards, circuit breakers, and hardware as required.
 - 3. Providing all switches, receptacles, cover plates, and special connecting devices as required.
 - 4. Providing all transformers and related equipment as required.
 - 5. Providing all wiring, connecting and splicing devices, and terminals as required.
 - 6. Providing all lighting fixtures and related devices and hardware.
 - 7. Incidental related work and material.

1.3 CODES, PERMITS AND FEES

- A. Comply with all applicable laws, ordinances, rules, regulations, codes or rulings of governmental units having jurisdiction, as well as standards of the National Fire Protection Association and serving utility requirements.
- B. Obtain and pay for permits, fees, inspections, meters, utility connections and extensions and the like associated with work in each Section of this Division.
- C. Installation procedures, methods and conditions: Comply with the latest requirements of the Federal Occupational Safety and Health Act (OSHA).

1.4 EXAMINATION OF PREMISES

- A. Examine the Construction Drawings and premises prior to bidding. No allowances will be made for not being knowledgeable of existing conditions.

1.5 APPLICABLE PUBLICATIONS

The following standard publications of the latest editions and supplements thereto form a part of these Specifications. All electrical work must, at a minimum, be in accordance with the latest edition of these standards, unless otherwise noted.

- A. NFPA 70 - National Electrical Code.
- B. NFPA 37 - Stationary Combustion Engines & Gas Turbines.
- C. NFPA 76A - Essential Electrical systems.
- D. NFPA 101 - Life Safety code.
- E. City of Long Beach Local Codes and Amendments.
- F. National Fire Protection Association Standards (NFPA).
- G. Underwriters' Laboratories, Inc. (UL).
- H. Certified Ballast Manufacturers Association (CBM).
- I. National Electrical Manufacturers Association (NEMA).
- J. Radio, Electronics and TV Manufacturers Association.
- K. Institute of Electrical and Electronic Engineers (IEEE).
- L. American Society for Testing and Materials (ASTM).
- M. National Board of Fire Underwriters (NBFU).
- N. National Board of Standards (NBS).
- O. American National Standards Institute (ANSI).
- P. Insulated Power Cable Engineers Association (IPCEA).
- Q. Electrical Testing Laboratories (ETL).

R. State of California Administrative Codes, Title 8 and Title 24.

S. Americans with Disabilities Act of 1990 (ADA).

1.6 DEFINITIONS

A. Approved: Meeting all legal requirements and satisfactory to the University.

B. Directed: Instructed by the University's authorized representatives.

C. Indicated: Shown or noted on the Drawings or called for in the Specifications.

D. Permitted: Allowed by the legal authorities.

E. Prohibited: Not allowed by the legal authorities.

F. Provide: Furnish, install and connect.

G. Required: Called for by the legal authorities or necessary for the proper functioning of the equipment or system.

H. Concealed: Shall mean that the installation will not be visible when all permanent or removable elements of the construction are in place.

I. Exposed: Shall mean that the installation is visible when all permanent or removable elements of the construction are in place.

J. Unfinished Space: A room or space that is ordinarily accessible only to building maintenance personnel, a room noted on the "Finish Schedule" with exposed and unpainted construction for walls, floor or ceilings, or specifically mentioned as "unfinished."

K. Finished Spaces: Any space ordinarily visible to the visiting public, including exterior areas.

L. Work or Electrical Work: Includes products, labor, equipment, tools, appliances, transportation, and all related items, directly or indirectly required to complete the specified and indicated electrical installation.

M. Code: Shall mean any and all regulations and requirements of regulatory bodies, public and private, having jurisdiction over the work.

N. Product: Used in Division 16 means all material, equipment, machinery, and/or appliances directly or indirectly required to complete the specified and/or indicated electrical work.

O. Standard Product: Shall mean a manufactured product, illustrated and/or described in catalogs or brochures, which are in general distribution prior to the date of issue of construction documents for bidding.

1.7 MATERIALS

A. Provide all new electrical materials and equipment of the type and quality specified, listed by UL and bearing their label where standards have been established, in compliance with the applicable standards of NEC (NFPA 70), NFPA, ANSI, IEEE, IPCEA and NEMA. Replace or repair all non-conforming, damaged or defective items at no extra cost to the University

- B. Mount materials provided under the contract for which the UL label is not normally available in separate enclosures and wire to the labeled units in an acceptable manner. Obtain approval from the local authorities for this procedure prior to starting any work.
- C. University Furnished Products
 - 1. Unless otherwise noted, all items shall be furnished by the Contractor for a complete and operational installation.
 - 2. All items required for a complete and operational installation shall be furnished and installed by the Contractor.

1.8 APPROVAL OF MATERIALS AND EQUIPMENT

Refer to General and Supplementary Conditions for description of alternate material and equipment provided under this Division.

1.9 DISCREPANCIES

- A. Where a conflict in requirements occurs between the specifications and drawings, or in the specifications or on the drawings, and a resolution is not obtained from the Design Consultant before the bidding date, the more expensive alternate will become the contractual requirements.
- B. Omissions from the drawings or specifications or the misdescription of details of work which are manifestly necessary to carry out the intent of the drawings and specifications, or which are customarily performed, shall not relieve the Contractor from performing such omitted or misdescribed details of the work but they shall be performed as if fully and correctly set forth and described in the drawings and specifications.
- C. The Contractor shall check all drawings furnished him immediately upon their receipt and shall promptly notify the Architect of any discrepancies. Figures marked on drawings shall in general be followed in preference to scale measurements. Large scale drawings shall in general govern small scale drawings. The Contractor shall compare all drawings and verify the figures before laying out the work and will be responsible for any errors, which might have been avoided thereby.

1.10 CHANGES

- A. The Contractor shall be responsible to make and obtain approval for all necessary adjustments in circuiting as required to accommodate the relocations of equipment and/or devices which are affected by any approved authorized changes. All changes shall be clearly indicated on the "As-Built" drawings.

1.11 SHOP DRAWINGS

- A. Submit shop drawings and all data in accordance with General and Supplementary Conditions for all equipment provided under this Division.
- B. The purpose of shop drawing submittals by the Contractor is to ensure that the Contractor understands the design concept; he demonstrates his understanding by indicating which equipment and material he intends to furnish and install and by detailing the fabrication and installation methods he intends to use. If deviations, discrepancies or conflicts between shop drawings and Specifications are discovered, either prior to or after shop drawing submittals are processed, submittals will be rejected and re-submittal per project specifications will be required.

- C. Submit manufacturer's data and dimension sheets giving all pertinent physical and engineering data including weights, cross sections and maintenance instructions. List standard items of equipment such as receptacles, switches, plates, and related items which are cataloged items, by manufacturer.
- D. Index all submittals and reference to these Specifications. All submittals are to be signed by the Contractor and state that the material complies with the Drawings and Specifications prior to submitting to the University.
- E. Proposed Products List: Include Products specified in the following Sections:
 - 1. Section 16050 - Basic Materials and Methods
 - 2. Section 16170 - Grounding and Bonding
 - 3. Section 16195 - Electrical Identification
 - 4. Section 16122 - Medium Voltage Cable
 - 5. Section 16321 - Padmount Transformer
 - 6. Section 16429 - Distribution Board
 - 7. Section 16526 - Sports Field Lighting
- F. The Contractor shall be responsible for all equipment ordered and/or installed prior to receipt of shop drawings returned from the Architect bearing the electrical engineer's stamp of "Reviewed". All corrections or modifications to the equipment as noted on the shop drawings shall be performed and equipment removed from the job site at the request of the Architect without additional compensation.
- G. Shop Drawings: Drawings shall be a minimum of 8.5 inches by 11 inches in size with a minimum scale of 1/8-inch per foot, except as specified otherwise. Include wiring diagrams and installation details of equipment indicating proposed location, layout and arrangement, control panels, accessories, piping, duct work, and other items that must be shown to assure a coordinated installation. In wiring diagrams, identify circuit terminals and indicate the internal wiring for each item of equipment and the interconnection between each item of equipment. Indicate adequate clearance for operation, maintenance, and replacement of operating equipment devices. If equipment is disapproved, revise drawings to show acceptable equipment and resubmit.
- H. Manufacturer's Data: For each manufactured item, provide current manufacturer's descriptive literature of cataloged products, equipment drawings, diagrams, performance and characteristic curves if applicable, and catalog cuts.
- I. Standard Compliance: When materials or equipment provided by the Contractor must conform to the standards of organizations such as American National Standards Institute (ANSI) or Underwriters' Laboratories (UL), submit proof of such conformance to the Architect for approval. If an organization uses a label or listing to indicate compliance with a particular standard, the label or listing will be acceptable evidence, unless otherwise specified. In lieu of the label or listing, submit a certificate from an independent testing organization, which is competent to perform acceptance testing and is approved by the University. The certificate shall state that the item has been tested in accordance with the specified organization's test methods and that the item conforms to the specified organization's standard.
- J. Certified Test Reports: Before delivery of materials and equipment, certified copies of all test reports specified in individual sections shall be submitted for approval.
- K. Certificates of Compliance or Conformance: Submit manufacturer's certifications as required on products, materials, finish, and equipment indicated in the technical sections. Certifications shall be documents prepared specifically for this contract. Pre-printed certifications and copies

of previously submitted documents will not be acceptable. The manufacturer's certifications shall name the appropriate products, equipment, or materials and the publication specified as controlling the quality of that item. Certification shall not contain statements to imply that the item does not meet requirements specified, such as "as good as"; or "achieve the same end use and results as materials formulated in accordance with the referenced publications"; or "equal or exceed the service and performance of the specified material." Certifications shall simply state that the item conforms to the requirements specified. Certificates shall be printed on the manufacturer's letterhead and shall be signed by the manufacturer's official authorized to sign certificates of compliance or conformance.

1.12 PRODUCT ALTERNATES OR SUBSTITUTIONS

- A. Where a manufacturer's product is specified, the intent is to establish definite quality, construction and performance characteristics. The manufacturer's latest published catalog data for the product shall become part of this specification as though stated herein to the extent that such data establishes quality desired, testing procedures, safety features, life expectancy, performance characteristics and, in the case of finish material, the general appearance. Substitute products, where permitted, will be required to equal or exceed these various requirements as established by the specified product manufacturer's literature.

1.13 EQUIPMENT PURCHASES

- A. Arrange for purchase and delivery of all materials and equipment within 7 days after approval of submittal. Order all materials and equipment in ample quantities for delivery at the proper time. If items are not on the project in time to expedite completion, the University may purchase said equipment and materials and deduct the cost from the Contract Sum.
- B. Provide all materials of similar class or service by one manufacturer.

1.14 COOPERATIVE WORK

- A. Correct without charge all work requiring alteration due to lack of proper supervision or failure to make proper provision in time. Correct without charge all damage to adjacent work caused by the alteration.
- B. Cooperative work includes:
 - 1. General supervision and responsibility for proper location and size of work related to this Division, but provided under other Sections of these Specifications.
 - 2. Installation of sleeves, inserts and anchor bolts for work under each Section in this Division.

1.15 VERIFICATION OF DIMENSIONS

- A. Scaled and figured dimensions are approximate only. Before proceeding with work, carefully check and verify dimensions, and similar items, and be responsible for properly fitting equipment and materials together and to the structure in spaces provided.
- B. Drawings are diagrammatic, and many offsets, bends, pull boxes, special fittings, and exact locations are not indicated. Carefully study Drawings and premises in order to determine best methods, exact locations, routes, building obstructions, and related means, and install apparatus and equipment in available locations. Install apparatus and equipment in manner and locations to avoid obstructions, preserve headroom, and keep openings and passageways clear.

1.16 ENCLOSING OF WORK NOT INSPECTED

- A. Cover no work until inspected, tested and approved. Where work is covered before inspection and/or tested, it will be uncovered and when inspected, tested and approved, restore all work to original/proper condition as determined by the University.

1.17 ACCESSIBILITY

- A. Install all control devices or other specialties requiring reading, adjustment, inspection, repairs, removal or replacement conveniently and accessibly throughout the project.
- B. Provide all required access doors or panels in walls and ceilings as part of the work under this division.
- C. Provide doors which pierce a fire separation with the same fire rating as the separation.
- D. Refer to "Finish Schedule" for types of walls and ceiling in each area and Architectural Drawings for rated wall construction.
- E. Coordinate work of the various Sections to locate specialties requiring accessibility with others to avoid unnecessary duplication of access doors. Obtain approval from University of all locations prior to proceeding with work.

1.18 IDENTIFICATION OF EQUIPMENT

Label, tag, stamp, or otherwise identify all electrical equipment in accordance with the following schedule:

- A. Nameplates: In general, clearly indicate on the installed nameplates as herein called for, its use, area served, circuit identification, voltage and any other useful data. Fasten nameplates to the device with a minimum of two sheet-metal screws or two rivets. Nameplate sizes may vary; the following is the minimum acceptable by the University.
- B. Panelboards:
 - 1. Panel Identification: Provide laminated plastic nameplates for all panels, switchboards, disconnecting means, relays, and equipment enclosures. Nameplates (unless otherwise noted) shall be black on white (2.5) inches long, (1) inch wide, and (1/8) inch thick. Surface shall be matte finish. Corners shall be square. Lettering shall be block style a minimum of (1/4) inch high and centered. Identify emergency panels with white on red nameplates, of the same size but with (3/8) inch lettering.
 - 2. Circuit Directory: A two-column, typewritten card set under glass or glass equivalent. Identify each circuit by the room number and/or area which it serves. Permanently install circuit breaker identification provided with equipment. If not provided, identification shall be as listed in item (1) above or as determined by the University.
- C. Miscellaneous Electrical Equipment: Identify individually mounted starters, transformers, pull boxes, junction boxes, and related items as required by the use of such equipment with plates as for panelboards. All junction boxes shall be marked so as to indicate panel of origin, voltage, and circuit numbers within the box.
- D. All Auxiliary Systems, Including Communications: Label to indicate function, routing, and termination point or panelboard. Also label any circuits providing power to this equipment and the panel of origin.

1.19 CONSTRUCTION OF FACILITIES

- A. General: Under this Section of the Specifications, execute all work in a manner to provide safe and lawful ingress and egress to the University's establishment, and keep such facilities clear of materials or equipment as directed by University.
- B. Furnish and maintain from the beginning to completion, all lawful and necessary guards, railing, fences, canopies, lights, warning signs, and similar items. Take all necessary precautions required by city and state laws and OSHA to avoid injury or damage to any persons and property.

1.20 GUARANTEE

- A. Guarantee all material, equipment and workmanship for all Sections under this Division in writing to be free from defects of material and workmanship for one (1) year from date of final acceptance. Replace without charge all material or equipment proving defective during this period. The guarantee includes performance of equipment under all conditions of load, and installing any additional items of control and/or protective devices as required.

1.21 WIRING OF EQUIPMENT FURNISHED UNDER OTHER SECTIONS

- A. Included all electrical wiring including power wiring and control wiring (except as specified under Automatic Temperature Control), including all raceways, wiring, outlet and junction boxes, and labor for installation of the wiring and equipment in this Section of the Specifications.

1.22 EQUIPMENT ROUGH-IN

- A. Rough-in all equipment, fixtures, and related items, as designated on the Drawings and as specified herein. The Drawings indicate only the approximate location of rough-ins. Determine the exact rough-in locations from large-scale certified drawings. Obtain all certified rough-in information before progressing with any work for rough-in connections.
- B. Be responsible for providing all outlets and services of proper size at the required locations.
- C. Anticipate and provide for minor changes in the Contract Drawings under this Division to comply with rough-in drawings.

1.23 EQUIPMENT FINAL CONNECTIONS

Provide all final connections for the following:

- A. All equipment furnished under this Division.
- B. Electrical equipment furnished under other Sections of the Specifications (except as otherwise designated).

1.24 INSERTS, ANCHORS, MOUNTING SLEEVES

Provide inserts and anchors:

- A. For support of work under this Division.
- B. Which are adjustable concrete hanger inserts installed in new concrete work as manufactured by Grinnell or approved equal.

- C. In locations approved by University.
- D. Which are expandable lead type anchors installed in existing concrete with minimum surface damage, as manufactured by Ackerman-Johnson, Pierce, Diamond or Hilti, or approved equal.
- E. Which are toggle bolts, or "molly" anchors, where installed in concrete block walls.
- F. Complete with 3/16-inch or heavier steel backup plate where used to support heavy items. Conceal through-bolts or backup plates from view, except as otherwise indicated.
- G. For mounting of equipment that is of such size as to be freestanding and that equipment which cannot conveniently be located on walls, such as motor starters, and similar items. Rigidly support such equipment on a framework of galvanized steel angle, Unistrut or as approved.
- H. And all sleeves as required for the installation of all work under all Sections of this Division. Sleeves through floors, roof and walls.

1.25 RUSTPROOFING

- A. Apply rust-proofing to all ferrous metals as follows:
 1. Hot-dipped galvanized after forming of angle iron, bolts, anchors, and similar items.
 2. Hot-dipped galvanized after fabrication for junction boxes and pull boxes cast in concrete.

1.26 GENERAL WIRING

- A. Drawings, in general, indicate location of motor starting equipment. Determine exact locations of motors and other devices in field. Provide an electrical feed and appropriate circuit protective device for all equipment. Where size or ampacity is omitted from the drawings, approval must be obtained from the University before installation. Verify panel schedules and layout, maintaining number of spare branches indicated.
- B. Provide conductors for branch circuit lighting, receptacle power and miscellaneous systems. Minimum size wire shall be number twelve (12) AWG. All conductors shall be stranded copper type THHN/THWN unless otherwise noted. Romex cable is not permitted. Every precaution shall be taken to insure that cable of any kind, type, or size will not be dragged along or over the ground, concrete, asphalt or other abrasive surfaces. Any questionable situations shall be reviewed and/or approved by the University before installation.
- C. Verify location and mounting height of all receptacles, wall mounted fixtures, switches, and other equipment before roughing in. See Drawings for pertinent information. Refer questionable cases to the University.
- D. Toggle switches used for room lighting shall be specification grade and rated 20 amps, 277 volts unless otherwise specified. If no proper clamping terminals are provided, the wire (stranded) shall be terminated with the use of an insulated crimp on type terminal designed for the wire size being used. Only one wire will be used per terminal. Loop feed is not permitted, all wires will be pigtailed.
- E. Receptacles shall be specification grade and rated 20 amps, 120 volts unless otherwise specified. If no proper clamping terminals are provided, the wire (stranded) shall be terminated with the use of an insulated crimp on type terminal designed for the wire size being used. Only one wire will be used per terminal. Loop feed is not permitted, all wires will be pigtailed.

- F. Where located on opposite sides of a wall, do not place outlet boxes back-to-back. Provide outlet boxes in Dorm room community walls with a twenty four (24) inch minimum separation unless otherwise approved by the University. If wall is insulated, separation may be reduced to sixteen (16) inches.
- G. Complete rough-in requirements of all equipment to be wired under the contract are not indicated. Coordinate with respective trades furnishing equipment or with the University, as the case may be, for complete and accurate requirements to result in a neat, workmanlike installation.
- H. For installation of power for computer systems, there shall be a separate neutral and ground for each phase and no more than six (6) receptacles on each twenty (20) amp circuit breaker. These circuits shall be identified as dedicated for computers only. Orange receptacles indicating isolated ground shall be provided.

1.27 COLOR CODING

- A. Color shall be green for grounding conductors and white for neutrals; except where neutrals of more than one system are installed in the same raceway or junction box, other neutrals shall be white with a colored (not green) stripe. Ungrounded conductors shall be as follows:

Phasing is Top to Bottom and Left to Right A, B, C.

Voltage--- 208/120

- (A) Phase---- Black
- (B) Phase---- Red
- (C) Phase---- Blue
- (N) Phase---- White

Voltage--- 480/277

- (A) Phase---- Brown
- (B) Phase---- Orange
- (C) Phase---- Yellow
- (N) Phase---- Gray

- B. Switch legs can be any color not already specified. However, switch legs and travelers on a 208/120 volt system, when not installed in the same raceway as a 480/277 volt system, can be yellow or orange.

1.28 CONDUIT

- A. General: Install conduits in accordance with NECA "Standard of Installation", and the NEC. Conduit systems shall be installed complete before installation of wire. Conduits shall be electrically continuous and grounded in accordance with the NEC and/or University Standards. Exposed conduits shall be galvanized rigid steel to a minimum of eight (8) feet above finished floor or grade.
- B. Galvanized Rigid Conduit: Shall be cut square, do not use pipe cutter, de-burr cut ends. Conduits one inch in size and larger, shall have a plastic insulating bushing or if required, a grounding type bushing, when terminating in panelboards, switchboards, control cabinets, light standards, underground pullboxes, transformers, any location with concentric knockouts and where ever required by existing codes, or determined by the University representative. When installed underground, this conduit shall be wrapped with scotch #50 pipe wrap or equivalent. Wrapping shall be half lapped to provide a double layer. In all cases, conduit shall be drawn tight by means of the proper fittings. Refer to NEC Article 346 for other pertinent information.

- C. **Electrical Metallic Tubing:** Shall be cut square, do not use pipe cutter, de-burr cut ends. Conduits one inch in size and larger, shall have a plastic insulating bushing or if required, a grounding type bushing, when terminating in panelboards, switchboards, control cabinets, light fixtures, pullboxes, transformers, any location with concentric knockouts, and where ever required by existing codes. Underground installation is not permitted. Refer to NEC Article 348 for other pertinent information.
- D. **Flexible Metal Conduit:** Shall be cut square. Screw-in type (jake) fittings shall be used, when coupling or terminating conduit, to ensure continuous continuity. Conduits over six feet in length shall have a ground wire, properly sized, installed the entire length of the run. This conduit shall not be used in damp or wet locations for any purpose. Refer to NEC Article 350 for other pertinent information.
- E. **Liquidtight Flexible Metal Conduit:** Shall be cut square. This conduit shall be used as described in NEC Article 351. However, liquidtight flexible nonmetallic conduit shall not be used for power runs or motor connections.
- F. **Underground Conduits:** Minimum size conduit shall be (3/4) inch. There shall be not less than three inches clearance from the conduit to each side of the trench. The bottom of trenches shall be graded smooth. Where rock, soft spots, and/or sharp edged materials are encountered, the bottom shall be excavated for an additional three inches, filled with sand, and tamped level with the original bottom. Conduits shall be not less than twenty four (24) inches below grade at any location. Empty conduits shall be provided with a pull string of at least two hundred (200) pounds breaking strength. Leave three feet of string at each end of the run, and/or pullbox.
 - 1. Metallic conduit shall be wrapped with scotch #50 wrap or equivalent. All elbows that transition from horizontal to vertical shall be galvanized rigid steel and wrapped with scotch #50 wrap or equivalent. All risers shall be galvanized rigid steel and wrapped with scotch #50 wrap, or equivalent, to a point at least six inches above finished grade, floor, pedestal, etc.
 - 2. PVC conduit shall be schedule 40 or greater and installed in accordance with NEC Article 347 and University standards. Conduits two inches and larger shall have a twelve (12) inch long mandrel, with a diameter (1/4) inch less than the inside diameter of the conduit, drawn through them before installation of wire. All conduits shall be swabbed and cleared of all particles of earth, sand, gravel or other obstructions before installation of wire. After installation of wire, all conduits shall be sealed at pullboxes and termination points. Conduits crossing roadways shall be galvanized rigid steel and wrapped as indicated before.
 - 3. Install pullboxes in runs exceeding two hundred (200) feet of straight conduit or having more than the equivalent of three ninety (90) degree bends. Each ninety (90) degree bend shall be considered the equivalent of fifty (50) feet of straight run. Pullboxes are to be installed within three feet of each pole mounted fixture unless otherwise noted or agreed to by the University. Pullboxes are to be installed flush with curb height or one inch above finished grade which ever applies. Pullboxes shall be precast concrete and installed so as to have a minimum of six inches of gravel base for the box to set on. Conduits shall extend to the mid-point of the box (both horizontally and vertically). Minimum size pullbox shall be eighteen (18) inches long by Thirteen (13) inches wide by twelve (12) inches deep. (18 x 13 x 12). Christy box #N9 with #N9T cover or approved equal.
 - 4. Risers terminating in the base of a pole mounted fixture, shall have a grounding bushing, be not less than two inches below nor higher than flush with the bottom of the handhole opening, and be centered. Wiring shall extend a minimum of twelve (12) inches through the handhole opening. All splices shall be thoroughly taped to keep out moisture

1.29 SEPARATE CONDUIT SYSTEMS

- A. Contain each system in a separate conduit system. This includes each power system each lighting system, each signal system of whatever nature, telephone, emergency system, sound system, control system, fire alarm system, and similar systems.

1.30 CLEAN-UP

- A. In addition to clean-up specified under other Sections, thoroughly clean all parts of the equipment. Where exposed parts are to be painted, thoroughly clean off all spattered construction materials and remove all oil and grease spots. Wipe the surface carefully and scrape out all cracks and corners.
- B. Use steel brushes on exposed metal work to carefully remove rust, and similar imperfections and leave smooth and clean.
- C. During the progress of the work, keep the premises clean and free of debris.

1.31 PAINTING

- A. Paint all unfinished metal with one coat of rust-inhibiting primer. (Galvanized and factory painted equipment are considered as having a sub-base finish.)
- B. Finished painting is specified under Section 09900.

1.32 CONNECTIONS TO SERVICE

- A. Provide all connections to electrical services furnished under other Divisions, except as otherwise specifically designated. Provide all necessary connections, and related work required to properly connect all services and equipment as shown on the Drawings or described herein.

1.33 PROJECT CLOSE-OUT

- A. Prior to completion of project, compile a complete equipment maintenance manual for all equipment supplied under Sections of this Division, as described below.

1.34 EQUIPMENT LISTS AND MAINTENANCE MANUALS

- A. Prior to completion of job, compile a complete equipment list and maintenance manual including the following items for every piece of material equipment supplied under this Section of the Specifications.
 - 1. Name, model and manufacturer.
 - 2. Complete parts drawings and list.
 - 3. Local supply for parts and replacement and telephone number.
 - 4. All tags, inspection slips, instruction packages, and similar items, removed from equipment as shipped from the factory, properly identified as to the piece of equipment it was taken from.
- B. Furnish maintenance manuals for each applicable Section of the Specifications. Suitably bind with hard covers and include all available manufacturers' operation and maintenance instructions, together with record drawings and lists specified and all other diagrams and instructions necessary to properly operate and maintain the equipment. Submit the equipment lists and maintenance manuals to University for approval in conformance with General and Supplementary Conditions. Include the name, address and phone number of the General Contractor and all subcontractors involved in any of the work specified herein.

1.35 TESTING

- A. Upon completion of the electrical work, test the entire installation and demonstrate it to be operating satisfactorily.
- B. Test wiring for continuity, short circuits and/or accidental grounds. Keep all systems entirely free from grounds, short circuits, and all defects.
- C. Have motors operating in proper rotation and control devices functioning properly. Check all motor controllers to determine that properly sized overload devices are installed. Check all electrical equipment for proper operation.
- D. Perform tests and adjustments prior to acceptance of the electrical installation by the University, and provide a certificate of inspection and acceptance of the electrical installation by local inspection authorities.
- E. Correct or replace promptly, all equipment or wiring provided, which tests prove to be defective or operating improperly, at no additional cost to the University.
- F. Furnish written report of test data to the University.

1.37 EQUIPMENT SUPPORTS AND RESTRAINTS

- A. Design and construct all prefabricated equipment in such a manner that all portions, elements, sub-assemblies and/or parts of said equipment and the equipment as a whole, including their attachments, will resist a horizontal and vertical load equal to the operating weights of those parts multiplied by the following factors:

1.37.2	Type of Equipment	Horizontal CP	Vertical CP
1.	Rigid and rigidly supported conduit and equipment such as lighting, fixtures, motors transformers, and panels.	0.50	0.33
2.	Communication equipment, emergency stand-by equipment such as battery operated equipment, and fire alarm panels and devices.	1.00	0.67

- B. Load is to be applied at the center of gravity of the part and to be in any direction horizontally and vertically. Design stresses shall be in accordance with the applicable sections of Title 17 and 24, California Administrative Code and the 1991 Edition of the Uniform Building code. Anchorage, support and/or attachment of said prefabricated equipment to the structure shall be in accordance with the details found in the Drawings and Specifications or approved shop drawings.
- C. The Drawings shall show completely the work to be done, but approved by the University and/or the University shall not be construed as waiving any of the requirements of the Contract and particularly shall not be construed as relieving the Contractor of full responsibility for fitting his equipment in the spaces provided and to the work of the various trades.
- D. Provide all materials and equipment as specified and no deviation will be allowed without specific approval of the University.

- E. Review of shop drawings will be for general compliance with the contract documents and no responsibility will be assumed by the reviewer for correctness of dimensions or details. Review of shop drawings shall not relieve the Contractor of the responsibility for full compliance with all contract documents. Shop drawings shall indicate proof of U.L. or other recognized Testing laboratory approvals for all materials.

END OF SECTION

SECTION 16010

ELECTRICAL GENERAL REQUIREMENTS

PART 1 - GENERAL

1.1 SCOPE

Electrical General Requirements specifically applicable to Division 16 Sections, in addition to Division 1 - General Requirements. Work includes but is not necessarily limited to the following:

- A. Definitions, guarantees, submittals, clean-up, "As-Builts" and all other applicable requirements of Division 0 and Division 1 apply to the work of this section.
- B. Examine all other sections for work related to those sections which are required to be included as work under this section.
- C. Coordinate all work in this Division with related trades.
- D. Make detailed arrangements with the University telecommunication company for telephone service to the building.
- E. Furnish and install the following:
 - 1. Incidental items not indicated on the drawings nor mentioned in the Specifications that belong to the work described, or are required to provide complete systems, as though called out here in every detail.
 - 2. All construction power and lighting and all power for testing of equipment and systems through final acceptance tests.
 - 3. All equipment and facilities required to provide temporary and permanent services.
 - 4. Electrical distribution systems, including feeders, pullboxes, distribution transformers, panelboards, branch circuit wiring, and circuit control and disconnect devices.
 - 5. All electrical work for the mechanical systems, except as specified herein to be furnished or installed as part of other sections of the specifications.
 - 6. All distribution material for and connection of the mechanical equipment, as required by the specific equipment furnished so that a complete and operable system results.
 - 7. All lighting fixtures, including lamps.
 - 8. Conduits, outlets and cabinets or terminal boards for the Telecommunication systems.
 - 9. Work related to the mechanical trade as listed below shall be included in this Division of the work. Refer to control drawings and mechanical drawings for exact requirements of work in this scope. Furnish and install the following:
 - 10. All conduit, outlets, line voltage wiring, and control devices required for the specified operation of the equipment.
 - 11. Furnishing and installation of all hangers, anchors, sleeves, chases and supports, for all electrical materials and equipment.
 - 12. Connect all motors and electrical line voltage control equipment.
 - 13. Cleaning, patching, repairing and painting.

1.2 APPLICABLE PUBLICATIONS

The following publications form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

- A. American National Standards Institute, Inc. (ANSI) Publications
- B. State of California Administrative Codes

- C. National Electrical Manufacturers Association (NEMA) Publication
- D. National Fire Protection Association (NFPA) Publications
- E. Underwriters Laboratories, Inc. (UL) Publications

1.3 WORK SEQUENCE

- A. Install work in phases to accommodate University's occupancy requirements. During the construction period, coordinate electrical schedule and operations with University and other trades. Refer to Division 1 - General Requirements.

1.4 DEFINITIONS

- A. The words "work" or "electrical work" herein include products, labor, equipment, tools, appliances, transportation and all related items, directly or indirectly required to complete the specified and indicated electrical installation.
- B. The word "concealed" shall mean that the installation will not be visible when all permanent or removable elements of the construction are in place. The word "exposed" shall mean that the installation is visible when all permanent or removable elements of the construction are in place.
- C. The word "code" shall mean any and all regulations and requirements of regulatory bodies, public and private, having jurisdiction over the work involved.
- D. The word "product" used in Division 16 means all material, equipment, machinery, and/or appliances directly or indirectly required to complete the specified and/or indicated electrical work.
- E. The words "standard product" shall mean a manufactured product, illustrated and/or described in catalogs or brochures, which are in general distribution prior to the date of issue of construction documents or bidding. Products will generally be identified by means of a specific catalog number and manufacturer's name.
- F. The word "provide" shall mean furnish and install and where applicable shall also mean connect, complete installation and test.
- G. The words "powered equipment", as used in Division 16, shall mean a complex product converting and electrical energy source to:
 - 1. Heat energy.
 - 2. Mechanical power.
 - 3. Direct current.
 - 4. Electrical energy differing in frequency.
- H. Refer to Division 1, general Requirements, for additional definitions of words and phrases used to describe Division 16, Electrical Work.

1.5 UNIVERSITY FURNISHED PRODUCTS

Unless noted otherwise, all items shall be furnished by the Contractor for a complete and operational installation.

- A. All items required for a complete and operational installation shall be furnished and installed by the Contractor.

1.6 DISCREPANCIES

- A. Where a conflict in requirements occurs between the specifications and drawings, or in the specifications or on the drawings, and a resolution is not obtained from the Design Consultant before the bidding date, the more expensive alternate will become the contractual requirements.
- B. Omissions from the drawings or specifications or the misdescription of details of work which are manifestly necessary to carry out the intent of the drawings and specifications, or which are customarily performed, shall not relieve the Contractor from performing such omitted or misdescribed details of the work but they shall be performed as if fully and correctly set forth and described in the drawings and specifications.
- C. The Contractor shall check all drawings furnished him immediately upon their receipt and shall promptly notify the Architect of any discrepancies. Figures marked on drawings shall in general be followed in preference to scale measurements. Large scale drawings shall in general govern small scale drawings. The Contractor shall compare all drawings and verify the figures before laying out the work and will be responsible for any errors which might have been avoided thereby.

1.7 CHANGES

- A. The Contractor shall be responsible to make and obtain approval for all necessary adjustments in circuiting as required to accommodate the relocations of equipment and/or devices which are affected by any approved authorized changes. All changes shall be clearly indicated on the "As-Built" drawings.

1.8 SUBMITTALS

- A. Submit shop drawings, manufacturer's data certificates for equipment, materials and finish, and pertinent details for each system where specified in each individual section, and obtain approval before procurement, fabrication, or delivery of the items to the job site. Partial submittals are not acceptable and will be returned without review. Include the manufacturer's name, trade name, catalog model or number, nameplate data, size, layout dimensions, capacity, project specification and paragraph reference, applicable technical society publication references, and other information necessary to establish contract compliance of each item the Contractor proposes to furnish. Photographs of existing installations and data submitted in lieu of catalog data are not acceptable and will be returned without approval. Contractor shall be responsible for reviewing and certifying submittals as conforming to the drawings and specifications prior to submittal and shall verify conformance of equipment as delivered with final shop submittals, specifications and plans. Contractor shall report to Architect any deviations prior to initiation of construction. Contractor is responsible for promptly reporting to University any news of late equipment delivery which is likely or certain to delay installation.

- B. Submit under provisions of Section 01300.

- C. Proposed Products List: Include Products specified in the following Sections:

- 1. Section 16050 - Basic Materials and Methods
- 2. Section 16170 - Grounding and Bonding
- 3. Section 16195 - Electrical Identification
- 4. Section 16122 - Medium Voltage Cable
- 5. Section 16321 - Padmount Transformer
- 6. Section 16429 - Distribution Board
- 7. Section 16526 - Sports Field Lighting

- D. Submit shop drawings and product data grouped and referenced by the technical Section numbers.

- E. The Contractor shall be responsible for all equipment ordered and/or installed prior to receipt of shop drawings returned from the Architect bearing the electrical engineer's stamp of

"Reviewed". All corrections or modifications to the equipment as noted on the shop drawings shall be performed and equipment removed from the job site at the request of the Architect without additional compensation.

- F. Shop Drawings: Drawings shall be a minimum of 8.5 inches by 11 inches in size with a minimum scale of 1/8-inch per foot, except as specified otherwise. Include wiring diagrams and installation details of equipment indicating proposed location, layout and arrangement, control panels, accessories, piping, duct work, and other items that must be shown to assure a coordinated installation. In wiring diagrams, identify circuit terminals and indicate the internal wiring for each item of equipment and the interconnection between each item of equipment. Indicate adequate clearance for operation, maintenance, and replacement of operating equipment devices. If equipment is disapproved, revise drawings to show acceptable equipment and resubmit.
- G. Manufacturer's Data: For each manufactured item, provide current manufacturer's descriptive literature of cataloged products, equipment drawings, diagrams, performance and characteristic curves if applicable, and catalog cuts.
- H. Standard Compliance: When materials or equipment provided by the Contractor must conform to the standards of organizations such as American National Standards Institute (ANSI) or Underwriters' Laboratories (UL), submit proof of such conformance to the Architect for approval. If an organization uses a label or listing to indicate compliance with a particular standard, the label or listing will be acceptable evidence, unless otherwise specified. In lieu of the label or listing, submit a certificate from an independent testing organization, which is competent to perform acceptance testing and is approved by the University. The certificate shall state that the item has been tested in accordance with the specified organization's test methods and that the item conforms to the specified organization's standard.
- I. Certified Test Reports: Before delivery of materials and equipment, certified copies of all test reports specified in individual sections shall be submitted for approval.
- J. Certificates of Compliance or Conformance: Submit manufacturer's certifications as required on products, materials, finish, and equipment indicated in the technical sections. Certifications shall be documents prepared specifically for this contract. Pre-printed certifications and copies of previously submitted documents will not be acceptable. The manufacturer's certifications shall name the appropriate products, equipment, or materials and the publication specified as controlling the quality of that item. Certification shall not contain statements to imply that the item does not meet requirements specified, such as "as good as"; or "achieve the same end use and results as materials formulated in accordance with the referenced publications"; or "equal or exceed the service and performance of the specified material." Certifications shall simply state that the item conforms to the requirements specified. Certificates shall be printed on the manufacturer's letterhead and shall be signed by the manufacturer's official authorized to sign certificates of compliance or conformance.

1.9 REGULATORY REQUIREMENTS

- A. Electrical: Conform to NFPA 70, ANSI C2, CAC Title 24, NFPA 101 and all other state and local codes.
- B. The requirements of authorities shall be the minimum acceptable requirements for the work and nothing described in these Specifications or indicated on the drawings shall be construed to permit work not conforming to the most stringent of the applicable codes and regulations. When drawings or specifications call for materials or construction of better quality of larger size than required by codes, laws, rules and regulations, the drawings and specifications shall take precedence.
- C. Equipment not complying with applicable codes shall be removed and replaced with approved equipment at Contractor's expense. UL listing labels, where applicable, shall be installed prior to shipment from factory.

- D. Obtain permits, and request inspections from authority having jurisdiction.

1.10 PRODUCT ALTERNATES OR SUBSTITUTIONS

- A. Where a manufacturer's product is specified, the intent is to establish definite quality, construction and performance characteristics. The manufacturer's latest published catalog data for the product shall become part of this specification as though stated herein to the extent that such data establishes quality desired, testing procedures, safety features, life expectancy, performance characteristics and, in the case of finish material, the general appearance. Substitute products, where permitted, will be required to equal or exceed these various requirements as established by the specified product manufacturer's literature.

1.11 GUARANTEE

- A. Except as may be specified under other sections in the Specifications, guarantee all equipment furnished under the Specifications for a period of one year from date of acceptance against defective workmanship and material and improper installation. Upon notification of failure, correct deficiency immediately and without cost to the University.
- B. Standard warranty of manufacturer shall apply for replacement of parts after expiration of the above period. Manufacturer shall furnish replacement parts to the University or their service agency as directed. Furnish manufacturer's warranties in accordance with Division 0 of this Specification.

1.12 PROJECT/SITE CONDITIONS

- A. Install work in locations shown on drawings, unless prevented by project conditions.
- B. Prepare drawings showing proposed rearrangement of work to meet project conditions, including changes to work specified in other Sections. Obtain permission of University before proceeding.

1.13 OPERATION AND MAINTENANCE MANUAL

Submit as required for systems and equipment indicated in the technical sections. Furnish six copies, bound in hardback binders or an approved equivalent. Furnish one complete manual prior to performance of systems or equipment tests, and furnish the remaining manuals prior to contract completion. Inscribe the following identification on the cover; the words "OPERATION AND MAINTENANCE MANUAL," the name and location of the system, equipment, building, name of Contractor, and contract number. Include in the manual the names, addresses, and telephone numbers of each subcontractor installing the system or equipment and the local representatives for the system or equipment. Include a table of contents and assemble the manual to conform to the table of contents, with the tab sheets placed before instructions covering the subject. The instructions shall be legible and easily read, with large sheets of drawings folded in. The manual shall include:

- A. Internal and interconnecting wiring and control diagrams with data to explain detailed operation and control of the system or equipment.
- B. A control sequence describing startup, operation, and shutdown.
- C. Description of the function of each principal item of equipment.
- D. Installation and maintenance instructions.
- E. Safety precautions.
- F. Diagrams and illustrations.

- G. Testing methods and test equipment required.
- H. Performance data.
- I. Parts list. The list shall indicate sources of supply, recommended spare parts, and name of servicing organization.
- J. Appendix: List qualified permanent servicing organizations for support of the equipment, including addresses and certified qualifications.

1.14 POSTED OPERATING INSTRUCTIONS

Furnish approved operating instructions for systems and equipment 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 instructions exposed to the weather. Operating instructions shall not fade when exposed to sunlight and shall be secured to prevent easy removal or peeling.

1.15 INSTRUCTION TO UNIVERSITY PERSONNEL

Where indicated in the technical sections, furnish the services of competent instructors to give full instruction to University personnel in the adjustment, operation, and maintenance of systems and equipment, including pertinent safety requirements as required. Each instructor shall be thoroughly familiar with all parts of the installation and shall be trained in operating theory as well as practical operation and maintenance work. Coordinate schedule of instructional class with University during the first regular work week after the equipment or system has been accepted and turned over to University for regular operation.

1.16 CATALOGED PRODUCTS/SERVICE AVAILABILITY

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, manufacturer's 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 6000 hours, exclusive of the manufacturer's factory or laboratory tests, is furnished. The equipment items shall be supported by service organizations which are reasonably 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.

1.17 MANUFACTURER'S RECOMMENDATIONS

Where installation procedures or any part thereof are required to be in accordance with manufacturer's recommendations, furnish printed copies of the recommendations prior to installation. Installation of the item shall not proceed until recommendations are received. Failure to furnish recommendations shall be cause for rejection of the equipment or material.

1.18 DELIVERY AND STORAGE

Handle, store, and protect equipment and materials in accordance with the manufacturer's recommendations and with the requirements of NFPA 70B P, Appendix I, titled "Equipment Storage and Maintenance During Construction." Replace damaged or defective items with new items.

1.19 ELECTRICAL REQUIREMENTS

Furnish internal wiring for components of packaged equipment as an integral part of the equipment. Power wiring and conduit shall conform to the requirements of Section 16050 "Basic Materials and Methods."

PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

3.1 Obtain and pay for all permits and inspections, including any independent testing required to verify standard compliance, and deliver certificates for same to University. All work shall conform to the requirements of NFPA 70, Title 24, California Code of Regulations (CCR) & UBC 1988.

3.2 WORK RESPONSIBILITIES

- A. The drawings indicate diagrammatically the desired locations or arrangement of conduit runs, outlets, equipment, etc., and are to be followed as closely as possible. Proper judgment must be exercised in executing the work so as to secure the best possible installation in the available space and to overcome local difficulties due to space limitations or interference with structural conditions. The contractor is responsible for the correct placing of his work and the proper location and connection of his work in relation to the work of other trades. Advise appropriate trade as to locations of access panels.
- B. Locations shown on architectural ceiling plan or on wall elevations shall take precedence over electrical plan locations but where a major conflict is evident, notify the Architect for instructions.
- C. In the event changes in the indicated locations or arrangements are necessary, due to developed conditions in the building construction or rearrangement of furnishings or equipment, such changes shall be made without extra cost, providing the change is ordered before the conduit runs, etc. and work directly connected to same is installed and no extra materials are required.
- D. Where equipment is furnished by others, verify dimensions and the correct locations of this equipment before proceeding with the roughing-in of connections.
- E. Lighting fixtures in mechanical spaces and elevator machine room are shown in their approximate locations only. Do not install light outlets or fixtures until mechanical piping and duct work is installed; then lights shall be installed in locations best suited for equipment arrangement or as directed by the Architect.
- F. All scaled and figured dimensions are approximate of typical equipment of the class indicated. Before proceeding with any work, carefully check and verify all dimensions, sizes, etc. with the shop drawings to see that the equipment will fit into the spaces provided without violation of applicable codes.
- G. Should any changes to the work indicated on the drawings or described in the specifications be necessary in order to comply with the above requirements, notify the Architect

immediately and cease work on all parts of the contract which are affected until approval for any required modifications to the construction has been obtained from the Architect.

- H. Be responsible for any cooperative work which must be altered due to lack of proper supervision or failure to make proper provisions in time. Such changes shall be under direction of the Architect and shall be made to his satisfaction.
- I. Perform all work with competent and skilled personnel.
- J. All work, including aesthetic as well as electrical and mechanical aspects of the work, shall be of the highest quality consistent with the best practices of the trade.
- K. Replace or repair, without additional compensation, and any work which, in the opinion of the Architect, does not comply with these requirements.

3.3 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 touch up, to match finish on other equipment in adjacent spaces or to meet safety criteria.
- C. When not already covered under the painting section of the specifications, all electrical work exposed to view shall be painted in accordance with the painting section of the specifications to match surroundings. Work to be painted shall include conduit, hangars, outlet boxes, pull boxes, surface raceway and similar items.

END OF SECTION

SECTION 16050

BASIC MATERIALS AND METHODS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Conduit
- B. Fittings and Conduit Bodies
- C. Surface Raceways
- D. 600 Volt Wires
- E. Boxes
- F. Wiring Devices
- G. Cabinets and Enclosures
- H. Lighting

1.2 RELATED SECTIONS

- A. Section 16010 - Electrical General Requirements, applies to this section, with the additions and modifications specified herein.
- B. Section 16170 - Grounding and Bonding.
- C. Section 16195 - Electrical Identification.

1.3 APPLICABLE PUBLICATIONS

The following publications form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

- A. American National Standards Institute, Inc. (ANSI) Publications
 - 1. C80.1-95 Rigid Steel Conduit, Zinc Coated
 - 2. C80.3-95 Electrical Metallic Tubing, Zinc Coated
 - 3. C80.5-95 Specification for Rigid Aluminum Conduit
 - 4. FB 1-97 Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and Cable Assemblies
 - 5. OS 1-84 Sheet-Steel Outlet Boxes, Device Boxes, Covers and Box Supports
 - 6. OS 2-86 Nonmetallic Outlet Boxes, Device Boxes, Covers and Box Supports
- B. National Electrical Manufacturers Association (NEMA) Publications:
 - 1. ABI-93 Molded Case Circuit Breakers
 - 2. ICS6-93 Industrial Controls and Systems Enclosures
 - 3. KS 1-96 Enclosed Switches

4. TC 2-90 Electrical Plastic Tubing (EPT) and Conduit (EPC-40) and (EPC-80)
 5. WD 1-83 General Requirements for Wiring Devices
 6. WD 6-88 Wiring Device Dimensional Requirements
- C. National Fire Protection Association (NFPA) Publication:
1. 70-93 National Electrical Code (NEC)
- D. Underwriters Laboratories, Inc. (U.L.) Publications:
1. 1-93 Standard for Flexible Metal Conduit
 2. 6-93 Rigid Metallic Conduit
 3. 50-95 Cabinet and Boxes
 4. 83-91 Thermoplastic Insulated Wires
 5. 198E-88 Class R Fuses
 6. 360-96 Liquid-tight Flexible Steel Conduit
 7. 486A-91 Wire Connectors and Soldering Lugs, for use with Copper Conductors
 8. 498-96 Attachment Plugs and Receptacles
 9. 508-93 Industrial Control Equipment
 10. 510-94 Insulating Tape
 11. 514A-91 Metallic Outlet Boxes
 12. 514B-89 Fittings for Conduit and Outlet Box
 13. 0651-95 Schedule for 40 & 80 Rigid PVC Conduit
 14. 797-93 Electrical Metallic Tubing
 15. 1242-96 Standard for Intermediate Metal Conduit
- E. State of California Administrative Codes:
1. Title 24, Part 1, 2008 Energy Conservation Standards

1.4 SUBMITTALS

- A. Submit under provisions of Section 01300 and 16010.
- B. Product Data: Provide for:
1. Conduit (all types)
 2. 600 Volt Wires
 3. Light Fixtures
 4. Lighting Controls
 5. Cabinets and Enclosures
- C. Test Reports: Provide for:
1. Insulation resistance tests of low voltage conductors.
 2. Operational tests.

1.5 PROJECT RECORD DOCUMENTS

- A. Submit under provisions of Section 01700.
- B. Accurately record actual routing of conduits.
- C. Accurately record actual locations pull and junction boxes.
- D. Accurately record actual location of each new light fixture.

1.6 REGULATORY REQUIREMENTS

- A. Conform to requirements of ANSI/NFPA 70 and with all state adopted amendments, except where requirements herein are more stringent.
- B. Furnish products listed and classified by Underwriters Laboratories, Inc. or a testing firm acceptable to authority having jurisdiction as suitable for purpose specified and shown.

1.7 QUALITY ASSURANCE

In each standard referenced to herein, consider the advisory provisions to be mandatory, as though the word "shall" has been substituted for "should" wherever it appears. Interpret references in these standards to "authority having jurisdiction," or other words of similar meaning, to mean University.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect, and handle Products to site under provisions of Section 16010.
- B. Protect conduit from corrosion and entrance of debris by storing above grade. Provide appropriate covering.

1.9 PROJECT CONDITIONS

- A. The drawings are diagrammatic and shall not be scaled for exact locations: Field conditions and non-interference with other utilities and trades, shall determine exact locations.
- B. Verify routing and termination locations of conduit prior to rough-in.
- C. Conduit routing is shown on Drawings in approximate locations unless dimensioned. Route as required to complete wiring system.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT

Materials and equipment shall conform to the respective specifications and standards and to the specifications herein. Electrical ratings shall be as indicated. Except where specifically indicated otherwise, provide only new materials having all legally required approvals and/or labels. Items of a similar nature shall be of the same type and manufacturer.

2.2 CONDUIT

- A. Rigid Steel Conduit (Zinc-coated): ANSI C80.1, UL 6, hot-dip galvanized, threaded type.
- B. Intermediate Metal Conduit: UL 1242, zinc coated steel only.
- C. Electrical Metallic Tubing: UL 797, ANSI C80.3.
- D. Rigid Aluminum Conduit: ANSI C80.5, UL 6.
- E. Rigid Plastic Conduit: NEMA TC-2, UL 651, PVC Schedule 40, Carlon or approved equal.
- F. Flexible Metal Conduit: UL 1.
- G. Liquidtight Flexible Metallic Conduit: UL 360, Interlocked steel construction with a polyurethane jacket, Electri-Flex Liqueflex® type CEA or approved equal.

2.3 FITTINGS

- A. Fittings for Rigid Metallic Conduit and Intermediate Metallic Conduit: UL 514B, threaded-type.
- B. Fittings for EMT: Compression type. Split couplings unacceptable.
- C. Fittings for Flexible Metal Conduit: ANSI/NEMA FB 1.
- D. Expansion/Deflection Fittings: Provide fitting capable of a straight line expansion movement of 2" in either direction and a movement of 3/4" from the normal in all other directions, OZ Gedney Type AX DX. Provide complete with grounding and bonding jumpers.

2.4 SURFACE RACEWAYS

NEMA WD 6. Sheet metal channel with fitted cover suitable for use as surface metal raceway and complete with required accessories. Provide as indicated on the drawings.

2.5 CONDUCTORS

Conductors shall bear the date of manufacture imprinted on the insulation with other identification. Wire and cable manufactured more than 6 months before delivery to the job site shall not be used.

- A. 600 Volt Wires and Cables: UL 83. Conductors shall be stranded copper. Insulation shall be type THHN/THWN unless otherwise noted. Underground conductors shall be type XHHW/THW unless otherwise noted.
- B. Color Coding: Color shall be green for grounding conductors and white for neutrals; except where neutrals of more than one system are installed in same raceway or box, other neutral shall be white with colored (not green) stripe. Color of ungrounded conductors in different voltage systems shall be as follows:

208Y/120 volt, 3Ø:

- 1. Phase A - black
- 2. Phase B - red
- 3. Phase C - blue.

480Y/277 volt, 3Ø:

- 1. Phase A - brown
- 2. Phase B - orange
- 3. Phase C - yellow.

- C. Minimum size for branch circuits shall be No. 12 AWG, unless otherwise noted.

2.6 OUTLET BOXES

- A. Sheet Metal Outlet Boxes: ANSI/NEMA OS 1, galvanized steel.
 - 1. Luminaire and Equipment Supporting Boxes: Rated for weight of equipment supported; include 1/2 inch male fixture studs where required.
 - 2. Concrete Ceiling Boxes: Concrete type.
- B. Nonmetallic Outlet Boxes: ANSI/NEMA OS 2.
- C. Cast Boxes: NEMA FB 1, Type FD, cast fer alloy. Provide gasketed cover and threaded hubs by box manufacturer.

2.7 SWITCHES: NEMA WD 1

- A. General purpose wall switches shall be heavy-duty, 20A, 277V AC, general use snap switch with ivory handle. Provide single pole, 2-pole, 3-way, 4-way, momentary contact, weatherproof, lock or other type switches indicated. Acceptable manufacturers: Hubbell, Pass & Seymour, Sierra or approved equal.
- B. Timer switches shall be solid state type with adjustable time range from 10 minutes to 12 hours. The control shall be tamperproof with out-of-site programming dial with warning flicker. The control shall be rated to switch up to 1300 watts of incandescent or 1000 watts of fluorescent loads. Acceptable manufacturer: Paragon Electric Company or approved equal.
- C. AC Manual Motor Starting Switches: UL 508. Acceptable manufacturers: Hubbell, Pass & Seymour, Sierra or approved equal.

2.8 DEVICE PLATES

- A. Provide UL listed, one-piece device plates for all wiring devices, for telephone and computer outlets and for outlet boxes used as junction or pull boxes. For metal outlets and fittings, plates shall be of zinc-coated sheet steel or cast metal having round or beveled edges. Plates installed in wet locations shall be gasketed and UL listed for "wet locations."
- B. Provide 3/16" high block letters, black enamel filled machine engraving for new device plates under any of the following conditions listed below. Use designations indicated or select words to best describe purpose of each device.
 - 1. All receptacle device plates.
 - 2. Plates containing more than three switch devices.
 - 3. Plates for switches controlling loads, where such loads are not visible from the switch location.
 - 4. Selector switches.
 - 5. Manual motor starting switches.
 - 6. Special outlets where indicated.
 - 7. Control switches.

2.9 CABINETS: UL 50.

- A. Cabinets for same type of use shall be the product of a single manufacturer.
- B. Construct of cold-rolled drawing quality steel, with metal gages and construction methods conforming to National Electrical Code requirements, and Underwriters Laboratories' standards. Provide 12 gauge G-90 grade galvanized steel minimum, unless otherwise noted.
- C. Finish doors, trims, and back boxes for surface-mounted cabinets in finished areas by applying a rust-resistant treatment, prime coat, and a final coat of manufacturers standard enamel or lacquer finish. Galvanize all other sheet metal components of cabinets including back boxes for flush cabinets, excepting non-ferrous metal parts, or steel parts provided with cadmium plating or equivalent protective plating.
- D. Equip doors with concealed or semi-concealed hinges and with flush or semi-flush spring catch type flush cylinder locks. Key cabinet doors of similar use alike, and provide two keys with each lock.
- E. Equip cabinets for use with telephone, alarm or signal systems with a 0.5" thick plywood backboard. Equip cabinets with terminal strips where so specified. Equip cabinets with nameplates.

- F. Surface cabinets shall be furnished without knockouts. Punch or drill required openings during installation. Equip flush back boxes with manufacturer's standard pattern of knockouts.
- G. Equip cabinet doors exceeding 40" in height with vertical bolt three point locking mechanisms.
- H. Acceptable manufacturers: Products from (or approved equal) to the following manufacturers are acceptable.
 - 1. Cabinets for general use: Hoffman Engineering Co., Square D, or Columbia Manufacturing Co.
 - 2. Cabinets for systems and/or products, use cabinets furnished by manufacturer with system or product. Where system or product cabinets do not comply with these Specifications, submit cabinet shop drawings, indicating deviations, and obtain approval for their use.

2.10 JUNCTION BOXES AND PULL BOXES: UL 50

- A. Provide pull and junction boxes of Code gauge steel sized as indicated or required. Provide 16 gauge steel minimum, unless otherwise noted. Indoor enclosures shall conform to NEMA ICS 6 for the type 1, unless otherwise noted.
- B. Size junction and pull boxes to not less than minimum Code requirements. Increase size above Code requirements where necessary to provide space for pulling, racking or splicing enclosed conductors, or where specified or indicated dimensions exceed Code requirements.
- C. Fabricate sheet metal junction and pull boxes of galvanized, Code gage, sheet steel. Include angle iron framing where required for rigidity. Boxes shall not deflect or deform visibly when covers are removed after conduit and conductors are installed, and any deflection occurring shall not prevent the easy installation and removal of cover attachment screws.
- D. Do not use single covers for junction and pull boxes having cover length or width dimension exceeding three feet unless so specified, indicated, or approved. Sectionalize covers that exceed three feet in either dimension into two or more sections.
- E. For interior junction and pull boxes located in concrete floors, and 24" square or smaller, use cast iron boxes with integral cast tapped conduit hubs, and having recessed cover flush in the box trim placing all elements of the face of the box flush in the plane of the surrounding floor. Equip boxes with watertight covers where so indicated.
- F. Equip surface sheet metal junction and pull boxes with covers aligning with the sides of the boxes and equip flush boxes with covers extending 3/4" all around the perimeter of the back box. Provide sufficient cover attachment screws to ensure that box covers will contact the surface of the box for the entire perimeter of the enclosure. Use 316 stainless steel fasteners to attach covers to boxes.
- G. Use brass screws to attach junction and pull box covers to interior floor boxes or to boxes located where moisture may be present.
- H. Acceptable manufacturers:
 - 1. Sheet steel junction and pull boxes: Columbia Electric Co., Hoffman Engineering Co., Pico Metal Products Co.

2.11 WIRE CONNECTORS AND TERMINALS: For use with copper conductors. UL 486A.

2.12 INSULATING TAPES: UL 510.

NAMEPLATES: Provide as specified in Section 16195, "Electrical Identification."

LIGHTING: Provide all required hardware to install University furnished fixtures and specified fixtures.

PART 3 - EXECUTION

3.1 **INSTALLATION:** Electrical installation shall conform to requirements of NFPA 70, state and local codes, and to requirements specified herein.

3.2 LOCATIONS

- A. The drawings indicate diagrammatically the desired locations and arrangements of the components of the electrical work. Follow the drawings as closely as possible, but use judgement and coordinate with other trades to secure the best possible installation in the available space and under the developed conditions.
- B. Before installing any equipment, conduit, or locating any outlet, examine the complete set of documents, including shop drawings and specifications, and verify all dimensions and space requirements. Make such minor adjustments as may be necessary to fit the building structure and accommodate the work of other trades. Install all electrical work to preserve legal headroom, access, work space, clearances and to keep openings and passage ways clear. Arrange for additional space if required for the servicing, maintenance, and replacement of the electrical equipment.
- C. Control devices shall not be mounted more than 6'-6" above the floor.
- D. Prior to installation, the University reserves the right to relocate any outlet or device within six feet of the location indicated on the plans and at no additional cost to the University.
- E. No additional compensation will be allowed for omissions, inadequate space, misunderstandings or rejected work caused by neglect of these requirements.

3.3 CONDUIT

- A. Rigid steel conduit may be used in all locations. Rigid steel conduit shall not be installed below grade in direct contact with earth, it shall be encased in 3" concrete envelope or painted with two coats of black asphalt paint.
- B. Intermediate metal conduit (IMC) may be used in lieu of rigid steel conduit where permitted by Code.
- C. Aluminum Conduit: Do not install underground or encase in concrete. Do not use brass or bronze fittings. Aluminum conduit may be substituted for rigid steel or IMC in dry locations.
- D. Electrical metallic tubing (EMT) may be installed in indoor dry locations only, it shall not be installed lower than four feet above the finished floor. Restrictions applicable to EMT:
 - 1. Do not use in feeder circuits.
 - 2. Do not install below grade.
 - 3. Do not encase in concrete.
 - 4. Do not use in areas subject to severe physical damage (including, but not limited to, mechanical equipment rooms and electrical equipment rooms).
 - 5. Do not use in hazardous areas.
 - 6. Do not use outdoors.
- E. Use flexible metallic conduit in short lengths for final connections to lighting fixtures in accessible ceilings, motors, transformers and other vibration type equipment, or with the approval of the Architect, where absolutely necessary due to structural conditions. Use

liquidtight flexible metal conduit where flexible conduit is exposed to weather, oil or moisture. Provide green ground conductor in all flexible conduit.

- F. Install conduit in accordance with NECA "Standard of Installation." The electrical drawings are diagrammatic and do not show all offsets, bends, fittings, junction boxes, pull boxes and expansion fittings required to meet field conditions. Determine actual material and hardware requirements and verify all dimensions by field inspection.
- G. Arrange supports to prevent misalignment during wiring installation.
- H. Support conduit using coated steel or malleable iron straps, lay-in adjustable hangers, clevis hangers, and split hangers.
- I. Group related conduits; support using conduit rack. Construct rack using steel channel provide space on each for 25 percent additional conduits.
- J. Arrange conduit to maintain headroom and present neat appearance.
- K. Route exposed conduit parallel and perpendicular to walls.
- L. Maintain adequate clearance between conduit and piping.
- M. Maintain 12 inch clearance between conduit and surfaces with temperatures exceeding 104 degrees.
- N. Cut conduit square using saw or pipecutter; de-burr cut ends.
- O. Bring conduit to shoulder of fittings; fasten securely.
- P. Provide pull fittings in all overhead conduit runs exceeding 200 feet of straight conduit, or having more than the equivalent of three 90 degree bends. Each 90 degree bend shall be considered the equivalent of 50 feet of straight run. Use conduit bodies to make sharp changes in direction, as around beams. Use hydraulic one-shot bender to fabricate or factory elbows for bends in metal conduit larger than 2 inch size.
- Q. Where conduit passes from one type of construction to another, or where there is a possibility of dissimilar movements, an expansion/deflection device or a suitable loop of sealtight flexible conduit shall be installed. Looped sealtight flexible conduit shall consist of 18" minimum length of looped conduit with a junction box at one or both ends, wherever conduit crosses building seismic joints.
- R. Avoid moisture traps; provide junction box with drain fitting at low points in conduit system.
- S. Provide 1/8" diameter polyethylene pull line in each new empty conduit except sleeves and nipples.
- T. Conduit which penetrates fire walls, fire partitions, or floors shall be metallic on both sides of fire walls, fire partitions, or floors for minimum distance of 6 inches. Restore fire rating integrity at conduit penetration. All holes created to extend electrical systems through fire rated floors and walls shall be sealed by the electrical contractor with an intumescent material capable of expanding up to 8 to 10 times when exposed to temperatures beginning at 250°F. It shall be UL Classified and have I.C.B.O., B.O.C.A.I. and S.B.C.C.I. (NRB 243) approved ratings to three hours per ASTM E-814 (UL 1479).
- U. Acceptable Manufacturers: 3M, Carborundum, Hevi-Duty/Nelson, or approved equal.
- V. Where conductors of No. 4 AWG or larger are to be installed in a conduit, or where any conductors are to be deflected more than 30 degrees when leaving a conduit, terminate the conduit with an insulating bushing.

W. Ground and bond conduit under provisions of Section 16170.

3.4 600 VOLT CONDUCTORS

A. Splices:

1. Splices in conductors #8 AWG and smaller shall be made with "Scotchlok" insulated connectors or equal of proper size for conductors being spliced.
2. Splices in conductors #6 AWG and larger shall be made with pressure type solderless connectors. The splice area shall be taped to provide equal or greater insulation than the original. Tape run-back over the original insulation shall extend 3 to 5 overall diameters of the insulated wire.

B. Conductors and terminal lugs shall be used for terminating stranded conductors #6 AWG and larger and shall be T&B, IlSCO, or approved equal solderless connectors.

C. Wire in panels, cabinets, pull boxes and wiring gutters shall be neatly grouped, strapped together with T&B Model Tyrap cable strap or laced with #12 stranded lacing twine and fanned out to the terminals.

D. Neutral conductor shall be continuous in outlet boxes and shall not be broken by addition or removal of devices.

E. Wiring methods in return air plenum spaces shall comply with NEC 300-22.

3.5 FITTINGS

A. Use threaded fittings for rigid metal conduit and compression fittings for tubing.

B. Use cement-on fittings for plastic conduit and tapered drive-on fittings for fiber conduit.

C. Fittings for flexible conduit shall be of the threadless hinged clamp type. Do not use fittings threaded internally into the flexible conduit ends.

D. Use fittings made of the same material as the raceway except:

1. Malleable iron and steel are interchangeable.
2. Die cast fittings may be used for flexible steel conduit and for factory manufactured offsets.
3. Use aluminum fittings only with aluminum conduit.
4. Use plastic insulated bushings for conduit sizes larger than 1".
5. Use insulated throat connectors for electrical metallic tubing.

3.6 CABINETS

A. Set cabinets at heights indicated or specified. In the absence of such information, set cabinets at not to exceed 6'-6" from finish floor to top of cabinet.

B. Align tops of cabinets in sight of each other at a uniform height.

C. Install cabinets and other enclosure products in plumb with the building construction. Install flush enclosures so that the trim will rest against the surrounding surface material around the entire perimeter of the enclosure.

D. Do not locate cabinets (or other electrical enclosures) where room doors will touch enclosure face when room door is opened 180°. Locate cabinets (and other enclosures) so that enclosure door can be opened through a minimum 180° arc, except that the arc may be reduced to 130° for enclosures mounted to wireways. Do not install surface mounted cabinets in finished areas, unless so indicated. Where conflicting data is indicated, verify mounting requirements prior to ordering cabinets.

3.7 WIRING DEVICES

- A. Use products of a single manufacturer for each type of wiring device. Different manufacturers may be used for different type devices, if the requirements of the specification are fulfilled.
- B. Substitute key operations for toggle where locking switches are indicated. Provide not less than two keys for each such switch, except not more than ten keys of the same pattern for the total project. Use only keys that are compatible with key system established for site.
- C. Prior to installation of switch outlets, examine architectural plans and verify locations. Place switches in the wall at the latch side of the door.
- D. Coordinate the electrical work with the work of other trades to ensure that wiring device flush outlets are positioned with box openings aligned with the face of the surrounding finish material. Pay special attention to installations in cabinet work, and in connection with specialty building equipment requiring very exact electrical rough-in.

3.8 BOXES, OUTLETS AND SUPPORTS:

Provide boxes in wiring or raceway systems wherever required for pulling of wires, making connections, and mounting of devices or fixtures. Boxes for metallic raceways shall be cast-metal, hub-type when located in wet locations, when surface mounted on outside of exterior surfaces, when installed exposed up to 7 feet above interior floors, when installed under raised floor or when installed in hazardous areas. Boxes in other areas shall be sheet steel. Each box shall have volume required by NFPA 70 for number of conductors enclosed in the box. Provide gaskets for cast-metal boxes installed in wet locations.

3.9 JUNCTION AND PULL BOXES

- A. Wherever possible use outlet boxes for junction and pull boxes.
- B. Locate interior junction and pull boxes in machine rooms, equipment rooms, storage rooms, electrical rooms and similar utility spaces unless otherwise indicated or approved. Where junction or pull boxes must be used in finished areas, use flush boxes only equipped with prime finished sheet metal plates. Fasten plates to boxes with countersunk flat head screws. Provide plates with 3/4" trim all around.
- C. Do not use sectionalized boxes except where indicated. Do not mix feeder and branch circuit conductors in a common pull or junction box.
- D. Where several feeders pass through common pull box, tag feeders to indicate circuit number and panel designation.

3.10 OPENINGS, CHASES AND SLEEVES

- A. Provide openings, chases, cutting, patching, sleeves and other products, necessary to permit the electrical raceways and cables to pass through the structure.
- B. Establish locations for openings, chases and sleeves sufficiently in advance of construction to avoid cutting and patching. Perform any required cutting and patching for electrical work and obtain approval for cutting from Architect prior to work being done.
- C. Repair damages to finished work and surfaces caused by cutting, to the satisfaction of University.
- D. Install sleeves wherever raceways of any type pass through walls or floors above grade, except that sleeves are not required for drywall construction or laid up masonry construction used for interior partitions and not fire rated.

- E. Use pipe or sheet steel sleeves for interior dry locations.
- F. Install sleeves with both ends flush with wall surfaces and with upper ends 3" above floor surfaces. Install bottom end of floor sleeves flush with slabs if not concealed by ceiling system. Use steel pipe sleeves through floors.
- G. Core drill existing concrete walls or slabs to pass new runs of conduit or tubing. Seal core drilled openings as described for sleeves.

3.11 MOUNTING HEIGHTS:

Mount disconnecting switches so height of operating handle at its highest position is maximum 78 inches above floor or platform. When installing switch next to existing switch, match mounting height of existing switch.

3.12 FIELD TESTS:

As an exception to requirements that may be stated elsewhere in the contract, the University shall be given minimum 5 working days notice prior to each test. The Contractor shall provide all test equipment and personnel and submit written copies of all test results.

- A. Distribution Conductors, 600 Volt Class: Test all conductors #10 AWG and larger to verify that no short circuits or accidental grounds exist. Tests shall be made using an instrument which applies a voltage of approximately 500 volts and providing a direct reading of resistance in ohms. Insulation resistance, corrected to 60°F, shall not be less than the following values:

250-750 kcmil	50 megohms
4-4/0 AWG	50 megohms
10-6 AWG	100 megohms

Record resistance readings, temperature and weather conditions on the test form.

- B. Operational Tests: Demonstrate the operation of each switch, relay and other item of electrical control with the system fully energized and operating. Each shall be demonstrated three times. Any faulty or defective Contractor furnished materials and workmanship found during the tests shall be replaced or corrected by the Contractor at no additional cost to the University.

END OF SECTION

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SECTION 16060

ELECTRICAL DEMOLITION

PART 1 – GENERAL

1.1 SECTION INCLUDES

- A. Removal of existing 15KV cables, switchgears, interior and exterior transformers, electrical conduits /conductors, communication cables/conduits and all other associated accessories as noted on drawings.
- B. Contractor shall provide electrical demolition required for work noted on drawings.
- C. The Contractor shall dispose demolished electrical equipment as directed by the College.

1.2 RELATED SECTIONS

- A. Section 02230 - Site Clearing.

1.3 APPLICABLE PUBLICATIONS: The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

- A. Environmental Protection Agency (EPA) Regulations:
 - 1. 40 CFR 261 Regulations Identifying Hazardous Waste
 - 2. 40 CFR 262 Regulations for Hazardous Waste Generators
 - 3. 40 CFR 263 Regulations for Hazardous Waste Transporters
 - 4. Hazardous Waste Facilities
- B. U.S. Department of Labor, Occupational Safety and Health Administration (OSHA) Regulation:
 - 1. 29 CFR 1910.94 Subpart G, Occupational Health and Environmental Control
- C. Department of Transportation (DOT):
 - 1. 49 CFR 178 Regulations for Shipping Container Specifications

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT

- A. Materials and equipment for patching and extending work: As specified in individual Sections.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify field measurements and circuiting arrangements are as shown on Drawings.
- B. Verify that abandoned wiring and equipment serve only abandoned facilities.

- C. Demolition drawings are based on casual field observation and existing record documents. Report discrepancies to Engineer before disturbing existing installation.
- D. Beginning of demolition means installer accepts existing conditions.

3.2 PREPARATION

- A. Disconnect electrical systems in walls, floors, and ceilings scheduled for removal.
- B. Coordinate electrical outages with the Campus.
- C. Provide temporary wiring and connections to maintain existing systems in-service during construction. When work must be performed on energized equipment or circuits, use personnel experienced in such operations.

3.3 DEMOLITION AND EXTENSION OF EXISTING ELECTRICAL WORK.

- A. Projects consisting of multiple phase work, refer to architectural drawings and single line diagram for sequence of work.
- A. Demolish and extend existing electrical work under provisions of this Section and as indicated on the drawings.
- B. Remove, relocate, and extend existing installations to accommodate new construction.
- C. Remove abandoned wiring to source of supply unless otherwise indicated.
- D. Remove exposed abandoned conduit. Cut conduit flush with walls and floors, and patch surfaces.
- E. Disconnect and remove abandoned distribution equipment.
- F. Repair adjacent construction and finishes damaged during demolition and extension work.
- G. Maintain access to existing electrical installations which remain active. Modify installation or provide access panel as appropriate.
- H. Extend existing installations using materials and methods as specified in Section 16050, "Basic Materials and Methods."

3.4 CLEANING AND REPAIR

- A. Clean and repair existing materials and equipment which remain or are to be reused.

END OF SECTION

SECTION 16110

CONDUITS AND RACEWAYS

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

- A. All wiring shall be installed in concealed conduit unless indicated otherwise in these specifications. Surface raceways shall be used in exposed locations in finished areas where conduits cannot be concealed. All surface installation will require College approval.
- B. Separate conduit shall be used for the following wiring:
 - 1. Emergency Power System Wiring.
 - 2. Stand By Power System Wiring.
 - 3. Fire Alarm System.
 - 4. Public Address System.
 - 5. Security System.
 - 6. Intercom System.
 - 7. Telephone/Data Outlets (See Telecom/Data Section).

1.2 STANDARDS

- A. American National Standards Institute, Inc. (ANSI) Publications:
 - 1. C80.1-95 Rigid Steel Conduit, Zinc Coated (GCR)
 - 2. C80.3-95 Electrical Metallic Tubing, Zinc Coated (EMT)
 - 3. C80.5-90 Specification for Rigid Aluminum Conduit
 - 4. FB 1-97 Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and Cable Assemblies
 - 5. OS 1-84 Sheet-Steel Outlet Boxes, Device Boxes, Covers and Box Supports
 - 6. OS 2-86 Nonmetallic Outlet Boxes, Device Boxes, Covers and Box Supports
- B. National Electrical Manufacturers Association (NEMA) Publications:
 - 1. TC 2-90 Electrical Plastic Tubing (EPT) and Conduit (EPC-40 and EPC-80)
 - 2. RN 1 PVC Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metallic Conduit Tubing
- C. National Fire Protection Association (NFPA) Publication:
 - 1. 2010 California Electrical Code (CEC)
- D. State of California Administrative Codes:
 - 1. Title 24, Part 3, CCR, 2010 California Electrical Code
- E. Underwriters Laboratories, Inc. (U.L.) Publications:
 - 1. 1-93 Standard for Flexible Metal Conduit
 - 2. 6-93 Rigid Metallic Conduit
 - 3. 50-95 Cabinet and Boxes

4. 360-96 Liquid-tight Flexible Steel Conduit
5. 514A-91 Metallic Outlet Boxes
6. 514B-89 Fittings for Conduit and Outlet Box
7. 651-95 Schedule for 40 & 80 Rigid PVC Conduit
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9. 870-91 Wireways, Auxiliary Gutters, and Associated Fittings
10. 1242-96 Standard for Intermediate Metal Conduit
11. 1660-94 Liquid-Tight Flexible Nonmetallic Conduit

1.3 SUBMITTALS

- A. Manufacturer's Catalog Sheets.
- B. Metal Gauges, Size and Finish.
- C. Fittings.
- D. List of Conduit types indicating where each type will be used.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Rigid Steel Conduit: Provide standard weight steel that is hot-dipped galvanized, and sherardized both inside and out after threading, with threaded connectors and couplings. Electro galvanizing is not permitted. Intermediate Metal Conduit, IMC, will not be permitted.
- B. Rigid Steel Conduit Fittings: Fitting shall be zinc coated, ferrous metal and threaded type in accordance with ANSI C80.4.
- C. Electric Metallic Tubing (EMT): Provide tubing of high grade cold rolled steel electrically welded with exterior protective coating of hot galvanized zinc, applied by the electro galvanized process. Interior of surface coated with aluminum lacquer or enamel. Manufactured by Allied Tube and Conduit, Triangle, Republic, Torrance Tubing, Western, Wheatland or equal.
- D. EMT Fittings: Fitting shall be watertight, gland ring compression type (no set screw type), wrench tightened connectors and coupling. Indenture and Die Cast will not be acceptable. Manufactured by O-Z Gedney, Raco, Appleton, or Steel City.
- E. Aluminum Conduit: No aluminum conduits.
- F. Flexible Steel Conduit: Provide conduit manufactured from single strip, standard weight steel hot-dipped galvanized on all four sides prior to conduit fabrication or aluminum strips.
- G. Flexible Conduit Connectors and Couplings: Provide die cast fittings of the type that screw into the inside of the conduit with threaded edges at 90 degrees to the fitting body to insure a force fit. Binding screw type will not be acceptable. Manufactured by O-Z Gedney, T&B, Steel City or equal.
- H. Flexible Liquidtight Steel Conduit: Liquid-tight conduit shall be manufactured from single strip standard weight steel, hot dipped galvanized on all four sides prior to conduit fabrication, and shall be provided with an extruded polyvinyl chloride cover. Liquidtight conduit and fittings shall provide positive ground continuity. Include a separate ground conductor for each circuit. Manufacturer "Sealtite Flexible" Type "UA," "Flex-Seal Type "XL," or equal.

- I. Flexible Liquidtight Fittings: Fittings shall be malleable iron, zinc plated, with locknut and o ring seal and slim diameter with small turning radius. Manufactured by O-Z Gedney-4Q series, T&B-5200 series or Appleton Flexible Fittings-ST series.
- J. Rigid Plastic Conduit: Provide heavy wall, virgin polyvinyl chloride Schedule 40 and Schedule 80 with solvent welded joints, conforming to Underwriters Laboratories, Inc. (UL 651) and ANSI C33.91 requirements, listed for exposed and direct burial application.
- K. Rigid PVC Fittings: fittings and cement shall be provided by same manufacturer. All joint shall be solvent welded in accordance with the manufacturer's recommendations.
- L. No conduit shall be smaller than 3/4-inch unless noted otherwise.
- M. Sleeves shall be zinc coated galvanized steel pipe or 16 gauge galvanized sheet metal.
- N. Sealant: Fire rated equal to wall or ceiling penetrated. Silicon foam Dow-Corning #2001, 3M, "Pensil #851," or approved equal. Sealant compound for exterior wall shall be moisture-resistant material made by 3M, GE, Dow-Corning or equal.
- O. Anchors not cast into concrete shall be expansion shield type, Phillips "Red Head," Hilti, or equal.
- P. Conduit seals shall be Crouse-Hinds Type "EYS" or EZS," Appleton Type "ESUF" or "ESUM," or approved equal, with sealing compound as recommended by the manufacturer for hazardous or refrigerated areas.
- Q. Expansion couplings shall be OZ Type "AX" or "DX," Crouse-Hinds Type "XJ" or "SD" or equal, complete with bonding jumper.
- R. Conduit unions shall be "Erickson" couplings manufactured by Thomas and Betts, Type 4-Series manufactured by O-Z/Gedney or equal.

2.2 MINIMUM SIZE:

- A. Metal Conduit: 3/4 inch except 1/2 inch may be used for switch legs
- B. Non metallic conduit: 1 inch.

2.3 RIGID STEEL CONDUIT AND FITTINGS:

- A. Provide standard weight steel that is hot dipped galvanized including threads, with protective coating on inside and outside. Fittings shall be compression type steel insulated. Electro galvanizing is not permitted.

2.4 ELECTRIC METALLIC TUBING (EMT) AND FITTINGS:

- A. Provide tubing of high grade steel with exterior coating of zinc, applied by electro galvanized process and enamel coating on inside. Fittings shall be watertight compression type, wrench tightened connectors and couplings.

2.5 FLEXIBLE STEEL CONDUIT AND FITTINGS:

- A. Provide conduit formed from continuous length of spirally wound interlocked zinc-coated strip steel. Flexible aluminum and light weight steel conduit will not be permitted. Fittings shall be die cast type that screw into the inside of the conduit with threaded edges at 90 degrees to the fitting

body to ensure a force fit. Maximum length shall be 6'.

2.6 FLEXIBLE LIQUID TIGHT STEEL CONDUIT AND FITTINGS:

- A. Conduit shall be manufactured from single strip, flexible continuous interlocked, and double-wrapped steel; galvanized inside and outside; and shall be provided with an extruded polyvinyl chloride cover. Fittings shall provide positive ground continuity. Maximum length shall be 6'.

2.7 CONDUIT SLEEVES:

- A. Sleeves shall be zinc coated galvanized steel pipe or 18 gauge galvanized sheet steel.

2.8 RIGID PLASTIC CONDUIT AND FITTINGS:

- A. Provide heavy wall, virgin polyvinyl chloride (PVC) schedule 40 with self extinguishing additive conforming to UL requirements.

PART 3 - EXECUTION

- A. Size of conduit shall be as indicated on the drawings but not less than that required by California Electrical Code.

B. Rigid Steel Conduit:

- 1. Use permitted for following applications only:
 - a. All outdoor locations including locations exposed to outside air.
 - b. Feeders.
 - c. Electrical and mechanical equipment rooms.
 - d. Indoor exposed locations where subject to mechanical damage and installed within 8 feet above finished floor.
 - e. Recessed in concrete walls and columns.
 - f. All other locations permitted by code.

C. Electric Metallic Tubing (EMT):

- 1. Use permitted for following applications only:
 - a. For all sizes up to 4 inches maximum.
 - b. In dry locations as in stud-wall partitions and in suspended ceiling spaces only. Do not use outdoors.

D. Flexible Metal Conduit:

- 1. Use permitted for following applications only:
 - a. Final connections to vibrating or noise-generating equipment including transformers.
 - b. Final connections to light fixtures in lay-in type accessible ceiling construction.

E. Liquid Tight Flexible Conduit:

- 1. Use permitted for following applications only:
 - a. For final connections to vibrating or noise-generating equipment in damp and wet

locations in mechanical rooms.

- b. For other power and control equipment requiring adjustments or removal for service in damp and wet locations.

F. Rigid Plastic Conduit PVC Schedule 40:

1. Use permitted for underground wiring only.
2. Make all fittings in plastic conduit watertight with solvent-weld cement recommended by conduit manufacturer and specifically manufactured for the purpose. Use a spring mandrel as required to assure full inside diameter at all bends.
3. Minimum size shall be 1 inch.

G. Conduit Placement:

1. Support conduits 1-inch and larger with pipe clamps either suspended from structural slabs with a rod at least 3/8-inch diameter with adjustable pipe ring, or mounted on wall from channel supports. Attach to concrete with drilled anchors. Where two or more conduits 1-1/2-inch and larger are suspended from ceiling, use trapeze type hanger suspended from rods.
2. Where rigid metal conduits and electrical metallic tubing are supported from Building members, supports shall be installed as follows:

Conduit Sizes:

3/4" to 1-1/4"

Within 18" of each outlet inclusive: and on either side of couplings and fittings and at a spacing not to exceed 8 feet;

1-1/2" and larger:

Within 3 feet of each junction or pullbox and terminal cabinet and at a spacing not to exceed 8 feet.

3. When rigid conduits are supported from trapezes, the supports shall be spaced not more than 8 feet apart.
 4. Conduit trapezes shall consist of suitable Unistrut or Kindorf fittings, or equal, in accordance with the manufacturer's printed recommendation.
- H. Provide independent support for all conduit rising from floor for motor connection if over 18 inches above floor. Do not support to motor, to ductwork or mechanical equipment.
- I. Keep bends and offsets in conduit runs to an absolute minimum. Replace all deformed, flattened or kinked conduit, at Contractor's expense.
- J. Ream the ends of all conduits. Conduits shall not be installed in the slab.
- K. Paint fire alarm conduits with a 1-inch wide red band every 5 feet of run. Separate conduits to be provided for fire alarm system.
- L. Install conduit seals on all conduit entering or leaving low temperature area (65 degrees Fahrenheit or less) hazardous areas, refrigerated rooms and clean rooms.
- M. Seal all conduit from exterior outlets at first interior junction box to prevent moisture from entering the building through the conduit.
- N. All exposed conduits shall be installed parallel to and perpendicular to the building structure.

O. Vertical Supports:

1. Supports shall be provided in strict compliance with National Electrical Code.

P. Where bends or risers from underground PVC Schedule 40 conduit terminate above grade or floor or in areas where subject to physical damage during or after construction, use rigid steel factory ells. If additional riser or nipple is required, they also shall be rigid steel. The rigid steel ells and risers shall be taped with Slipknot #100 pipe wrapping tape, or equal (no known equal).

Q. Pull Wires. Provide a 1/8" size polypropylene pull wire in all empty conduits, including those for signal and telephone systems. Pull cords in telephone/data service conduits (4" and larger) shall be 3/16" size. Identify conduits at exposed ends with tags. Tags shall identify location of other end of conduit. The pull wires shall be left with more than 5 feet in length at both ends for future use.

R. Joints and Connections. Cut conduit squarely and ream ends to remove burrs. Close open ends of conduits, unless in a closed box or cabinet, with approved conduit caps or closures as soon as installed and keep closed until ready to pull in conductors.

S. Steel conduit must be clear from contact with building reinforcing steel or other conductors in the building. Each conduit should run no more than two 90 degree bends. If more than two 90 degree bends are necessary, insert an accessible pull-box in the run. Terminate underground conduit inside the building, 2" above the floor below a backboard, or flush with the inside of a cabinet. Terminate overhead conduit 2 feet below floor slab, or flush with the inside of a cabinet.

T. Where conduits pass through exterior concrete or masonry walls below grade, or through floor slab on fill below grade, make entrance watertight. Install pipe sleeves in concrete with 1/2" minimum clearance around conduit and caulk with oakum and mastic, or use gland type conduit entrance seal.

U. Underground conduits, which terminate inside building below grade, or which slope so that water might flow into building, shall be sealed at termination after installation of conductors. Install plugs or caps on all spare (empty) conduits.

V. Do not install conduits in any isolated floor slab. Where it is necessary to cross such area, install conduit below isolated slab, in supporting structural slab or below it. Stub-ups to equipment located on isolated slab shall be through openings at least 1/2" larger in diameter than outside diameter of conduit. Fill space between conduit and opening in slab with mastic.

W. Expansion Joints

1. Where embedded conduits cross building expansion or seismic joints, provide sliding conduit expansion joints with bonding strap and clamps.
2. Where exposed conduits or conduits in furred spaces cross building expansion or seismic joints, use offset flexible conduit or sliding conduit expansion joint.

X. Terminate conduits of 1" size and larger with insulated bushings with grounding lugs where required, O.Z. Type Bldg., or equal (no known equal).

Y. Bends and sweeps for conduits used for telephone systems shall be long radius and factory made with the radius marked on them.

Z. Flashings. Where conduits extend through roof, provide flashings as required by Division 7.

AA. Penetration in Fire Rated Structures: Provide 3M or Dow Corning No. 3-6548, RTV Silicone

form for making fire rated seals around penetrations through floors, walls, elevator shafts as minimum or mechanical fire stop fittings with UL listed fire rating or equal to wall or floor ratings, whichever is larger.

- BB. A separate conduit shall be installed for each homerun indicated on the Drawings.
- CC. Encase all nonmetallic feeder conduit installed underground in a 3-inch concrete envelope. Extend concrete envelopes a minimum of 3 inches beyond all external sides of all outermost conduits. Space the external surfaces of all conduit within a bank, a minimum of 3 inches apart, except that all sound, telephone, and data communication circuits contained within nonmetallic conduit shall have a minimum separation of 12 inches from any light or power circuits that parallel them within a bank. All underground conduits and duct banks containing high voltage feeders shall be encased in red concrete. Concrete shall be pre-mixed at the factory. Sprinkling red oxide in field is not acceptable. All underground conduits to be installed a minimum 36" below grade. Use manufactured concrete or plastic spacers to insure required concrete coverage. Concrete shall be minimum 2500 psi.
- DD. Provide a plastic warning tape in the backfill over the ductlines and approximately 12 inches below grade. Tape shall be run continuously along the entire length of the underground utility lines. Tape shall be polyethylene plastic manufactured specifically for warning and identification of all buried utility lines. Tape shall be of the type provided in rolls, 6-inches minimum width, color coded for electric lines (red) and for communication lines (orange), with warning and identification imprinted in bold black letters continuously and repeatedly over entire tape length. Warning and identification shall be "CAUTION - BURIED ELECTRIC (or COMMUNICATION) LINE BELOW", or similar wording. Code and letter coloring shall be permanent, unaffected by moisture and other substances contained in trench backfill material.
- EE. During construction, partially completed duct lines shall be protected from the entrance of debris such as mud, sand and dirt by means of suitable conduit plugs. As each section of a duct line is completed from manhole to vault, a testing mandrel not less than 12 inches long with a diameter 1/4-inch less than the size of the conduit, shall be drawn through each conduit, after which a brush having the diameter of the duct, and having stiff bristles shall be drawn through until the conduit is clear of all particles of earth, sand, gravel and other foreign materials. Conduit plugs shall then be immediately installed.
- FF. Maintain minimum 6-inch clearance between conduit and piping. Maintain 12-inch clearance between conduit and heat sources such as flues, steampipes, hot water pipes, and heating appliances.
- GG. Tag all empty conduits at each accessible end with a permanent tag identifying the purpose of the conduit and the location of the other end. In wet, corrosive outdoor or underground locations, use brass, bronze, or copper 16 gauge tags or lead tags secured to conduit ends with #16 or larger galvanized wire. Inscribe on the tags, with steel punch dies, clear and complete identifying information.
- HH. Provide expansion and deflection fittings where two rigidly supported conduits may move in relation to each other at expansion joint crossings.
- II. From each panel which is flush mounted in a wall, stub from top of the panel, a minimum of 4-3/4-inch conduits to the nearest ceiling space or other accessible location and cap for future use.
- JJ. Conduits which are installed above dry type suspended ceilings shall not be secured to ceiling support wires. Support such conduit independent of ceiling suspension systems.

- KK. Underground duct-banks shall have continuous slope downward toward manholes and away from buildings with a pitch of not less than 4 inches in 100 feet. Changes in direction of runs exceeding a total of 10 degrees, either vertical or horizontal, shall be accomplished by longsweep bends having a minimum radius of curvature of 25 feet, except that manufactured bends may be used at ends of short runs of 100 feet or less, and then only at or close to the end of run.
- LL. Exposed conduit larger than 1 inch shall be suspended with pipe hangers. Hangers and racks shall be attached to concrete with insets, set at the time the concrete is poured, and to steel members with beam clamps or matching bolts.
- MM. Conduit 1-inch and smaller, in metal and stud partitions, shall be tied to the furring channels with No. 12 gauge galvanized tie wire space not more than 5 feet apart. Conduits above metal channel lath and plaster ceilings for other services and lighting home runs shall be supported independently to the slab.
- NN. Wherever conduits pass through concrete walls, suspended slabs or metal deck floors, furnish and install sleeves of ample size to permit installation of conduit. Sleeves shall be installed prior to pouring of concrete and shall have ends flush with the wall or extend 2 inches above floor surfaces. Verify location with the University's Representative.
- OO. Except as otherwise indicated on the Drawings, bends in conduit 2 inches or larger shall have a radius of curvature of the inner edge, equal to not less than ten (10) times the internal diameter of the conduit. Any deviations from this radius shall be approved by the University's Representative. Wire or cable bends in junction or pull boxes shall be made with a long radius. Bends for 600-volt cable shall have a radius of not less than five (5) times the diameter of the cable. Nesting of conduits shall be made when two or more conduits are run in parallel. High voltage feeder conduit runs (above 600 volts), telephone and closed-circuit television conduit runs shall not have more than two 90-degree long radius bends. All other conduit runs (below 600 volts) shall not have more than three 90-degree long radius bends between pull boxes, junction boxes or terminal cabinets.
- PP. Conduit shall not be run closer than 6 inches on the top of light fixtures and cable trays. Do not install conduit on the sides of the cable tray or within 6 inches below the tray.
- QQ. All control apparatus, outlet boxes, junction and pull boxes, and other similar equipment shall be installed and maintained in accessible positions and locations.
- RR. Conduits in furred spaces shall be routed to clear access openings.
- SS. Where steel conduits enter a concrete floor below a surface mounted panelboard, they shall be encased in a concrete curb of sufficient height to match the height of the finished base file.
- TT. Holes for conduits through existing concrete walls or floors shall be made by the "core-drill" method. Core drilling time shall be coordinated with University's Representative to avoid noise problem.
- UU. Upon completing the installation of any run of conduit, the runs shall be tested to see that they are free from all obstructions and have a smooth interior. Each end of each conduit run shall be plugged with "pennies" and bushings and left plugged until ready to pull circuit wires.
- VV. A 6-inch square by 2 foot deep concrete block with an embedded brass nameplate shall be installed over the ends of all spare conduits stubbed out of the Building, indicating the origin of the conduits. Verify location with University's Representative prior to rough-in.

- WW. Telephone and signal conduits placed in the same trench with power service conduit must be separated by no less than 12" of well packed earth or 3" of concrete.
- XX. Underground conduits for branch circuits without concrete encasement shall have 6-inch thick envelope of sand all around. Conduit installed in unpaved or planted areas shall have 6 inches of sand below and 2-inch thick cap of lean concrete on top.
- YY. Avoid installing conduits underneath the building.
- ZZ. The ends of all underground conduits entering pullboxes, manholes, etc. shall terminate in end bells and shall be capped or sealed with an approved compound, Crouse Hinds "Chico A", or equal (no known equal) after installation of wire. Cap empty conduit stubouts at both ends. In landscaped areas, terminate in a waterproof J-box. Junction boxes located above grade in the landscaped areas shall have factory made gaskets, stainless steel screws and factory painting.
- AAA. Limit to a minimum the routing of conduits within the planting areas of parking lot dividers. Do not run conduit within the planting area parallel to the long dimension of the divider. Coordinate the routing of service conduits to lighting standards and landscape lighting fixtures to avoid conflict with trees and major shrubs.
- BBB. Underground conduits containing wiring for irrigation system shall not be permitted inside the high voltage (600V & above) manholes or pullboxes.
- CCC. Branch circuit conduits from the panelboard to the loads shall be installed on the same floor above the accessible ceiling.
- DDD. A green ground conductor shall be run in all conduits.

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SECTION 16140

WIRING DEVICES

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Provide wiring devices as specified.

1.2 SUBMITTALS

- A. Provide the following submittals:
 - 1. Submittals.
 - a. Submit shop drawings and product data indicating Federal Specification No., amperage and voltage rating, materials, color and manufacturer's catalog sheet of each device and their NEMA number.
 - b. Submit shop drawings and product data indicating materials and thickness or gage of materials, color and manufacturer's catalog sheet of each device.
 - c. Submit two samples of each type device and cover plate.
 - d. Indicate application conditions and limitations of use stipulated by product testing agency specification under regulatory requirement.

1.3 REFERENCES

- A. References include the following:
 - 1. NEMA WD 1 - General Purpose Wiring Devices.
 - 2. NEMA WD 2 - Semiconductor Dimmers for Incandescent Lamps.
 - 3. NEMA WD 6 - Wiring Device Configurations.
 - 4. Federal Specification WS-896-E and WC-596-F
 - 5. Materials and/or installation shall meet or exceed the above referenced standards.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. All devices shall conform to National Electrical Manufacturer's Association (NEMA) standards and shall be Underwriters' Laboratories, Inc., (UL) listed and labeled and shall be "Specification Grade," meeting the requirements of Federal Specification WC-596-F for receptacle, and meeting the requirements of Federal Specification WS-896-E, for switches.
- B. Switches:
 - 1. Wall switches shall be specification grade, fully enclosed, quiet-type tumbler switches rated 20 amperes, 120/277-volt, AC rated, bakelite or composition, back and side wired, bumper pad, full rating for inductive or non-inductive loads and incandescent or fluorescent lighting loads.
 - 2. Single Pole Switches: Hubbell #1221, Arrow #1991, Pass & Seymour 20AC1 or equal
 - 3. Three-way Quiet Switches: Hubbell #1223, Arrow #1993, Pass & Seymour 20AC3 or equal.
 - 4. Wall switch and pilot lights shall be flush mounted combination wall type with switch and pilot light equipped with a 6-watt, 125-volt candelabra base lamp. The pilot light shall have a green jewel with brass rim flush mounted in the wall plate.
 - 5. All switches shall be of the same manufacture.
 - 6. Normal switch color is white. Switches controlling circuits connected to emergency power source shall be red.

7. All switches shall have terminal screws to take up to #10 AWG conductors.
- C. Manual Wallbox Dimmers:
1. Fluorescent dimmers shall be 120 (or 277) volts as required for circuit wiring. Rating shall be based on quantity of lamps controlled, Lutron "NTHF-40" (277V).
 2. Incandescent dimmers shall be thin-profile 120 volts and up to 1500 watts rating. Lutron "Nova T" series, "NTV-1000 or NTV-1500".
 3. Wallbox dimmers shall be slider type with built-in switch and radio/T.V. interference filter. Dimmers shall be solid-state type.
- D. Sensor Switch (Motion Sensor):
1. Wall sensor switch shall be dual-technology, two wire connection (no neutral), 120/277V compatible with electronics ballast and working with 60 watt load. Model # 01-141 Novitas, or approved equal.
 2. Ceiling sensor switch shall be dual-technology type. Cover 28" x 28" for corner mounting and 32" x 60" for center mounting, by Novitas, or approved equal.
 3. Ceiling sensor control unit (switch pack) shall be 120/277V and installed in J-box next to lighting circuit, J-box Model #13-012 Novitas, or approved equal.
- E. Receptacles:
1. Single and duplex convenience receptacles shall be U-grounded type, 125 volts, side and back wired with binding screws only with double wipe contacts and spring steel back up clips. Rating 20 amperes, 125V with straight blade grounding type. Model #5362 of Hubbell, Pass & Seymour Arrow Hart or equal.
 2. Receptacles shall be red on emergency circuits, orange on isolated ground system or white for the rest.
 3. The grounding contact shall be one piece and internally connected to the frame with ground terminal for external ground.
 4. Special receptacles shall be as indicated on plans by NEMA configuration.
 5. Ground fault receptacles shall be 20 amperes, 125 volt, duplex, three wire grounding with pilot light and test and reset buttons. Suitable for feed-through wiring, color to be selected, Hubbell 5362 GF Series, Pass & Seymour 2091 SIL Series or equal.
 6. Isolated ground type receptacles shall be IG 5362 Hubbell, Pass & Seymour or Arrow Hart and shall conform to UL Standard #498 and NEC/NFPA requirements, ANSI #C73.
 7. Poke-thru receptacle shall be flush, 5/8" thick, die-cast aluminum, for power and communication UL listed and classified for 2 hours fire rated Evolution series by Wiremold or equal.
 8. Wiring devices in exposed weatherproof boxes shall be the devices specified in this section, and shall be installed in "FS" or "FD" series condulets with weatherproof cast metal covers, and gaskets as required.
 9. All receptacles shall be of the same manufacturer.
 10. Each receptacle installed outdoors, within 72" of sinks, in wet or damp areas, on roof, outdoors, below grade (pit), janitor, closets, and bathrooms, shall have automatic 5 mA, individual ground fault (GFI) protection.
 11. Floor Outlets: Where floor outlets are shown, boxes shall be Walkerduct #800 CI Series, Steel City Series #78, Hubbell #B-2537, or equal. Where 120, 208 or 240 volts are used, standard NEMA receptacles, suitable for the service, shall be used.
- F. Plates:
1. Provide plates for all switches, receptacles, junction boxes, telephone and other outlets.
 2. Provide engraved or etched plates for all lock switches, pilot switches, switches from which equipment or circuit controlled cannot be readily seen, three or more switches under a common plate and for switches as indicated.
 3. Stainless steel plates shall be American Iron and Steel Institute (AISI) Type 302, with beveled edges, 0.040" thick with satin smooth finish. "Smoothie," Hubbell #97071 Series or equal.
 4. Plastic cover plate shall be ivory / white, high impact thermoplastic, high strength, scratch-resistant, smooth and self-extinguishing, Hubbell "PI" Series, Pass & Seymour RP Series or equal.

5. Where outlets are indicated to be weatherproof, provide an AISI Type 302 stainless with double hinged covers, Pass & Seymour #WPD-8 or equal.
6. Galvanized steel plates shall be square or rectangular and hot dipped galvanized or sherardized, beveled edges and 0.040" thick. Galvanized steel plates shall be used in utility area.
7. Provide plates equipped with close fitting openings for the exact device to be used. Provide plates for telephone outlets equipped with bushed openings.
8. Refer to Section 16141 for labeling of plates.
9. Cover plates on pressed steel outlet boxes in furred areas, attics, etc., or exposed in mechanical equipment rooms shall be of the same material as the outlet box.
10. Cover plates in locations concealed from public view shall have the circuit numbers and source feed point hand labeled with marking black pen (permanent marker). See Section 16141 for labeling.
11. Provide stainless steel cover plates in the kitchen and adjacent to stainless steel panels, unless noted otherwise.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Mount switches 42" above finished floor and vertically in all locations unless indicated otherwise.
- B. All convenience and telephone outlets mounted 18" above the floor shall be installed vertically. Install receptacle with the grounding terminal up. All receptacles mounted more than 18 inches above the floor over the bench top shall be installed horizontally with the grounding terminal to the left.
- C. California Electrical Code (CEC) sized (#12 minimum) bonding jumper shall connect grounded outlet box to receptacle grounding terminal on all flush mounted units.
- D. Align and plumb all devices and plates. Plates shall fit flat against wall and tight against device surface without strain on plate.
- E. Each class of device shall be furnished by one manufacturer for total project. Mixing devices of different suppliers will not be permitted.
- F. Ganged switches on 277volt circuits shall have a barrier between each switch.
- G. Manual dimmers shall be installed in individual outlet boxes. Do not install in ganged boxes with other devices.

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SECTION 16170

GROUNDING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Grounding materials.
 - 2. Electric service grounding electrode.
 - 3. Feeder and branch circuit grounding.
 - 4. Raceway and enclosure grounding.
 - 5. Equipment grounding.
 - 6. Receptacle grounding.
- B. Related Sections:
 - 1. Section 16050, Basic Material and Methods
 - 2. Section 16402, Underground Electrical

1.2 SYSTEM DESCRIPTION

- A. Provide grounding and bonding of electrical service, circuits, equipment, signal and communications systems.
- B. Performance Requirements: Supplement the grounded neutral of the secondary distribution system with an equipment grounding system to properly safeguard the equipment and personnel. Install equipment grounding such that all metallic structures, enclosures, raceways, junction boxes, outlet boxes, cabinets, machine frames, portable equipment and other conductive items in close proximity with electrical circuits operate continuously at ground potential and provide a low impedance path for possible ground fault currents.

1.3 SUBMITTALS

- A. Provide Shop drawings and product data for the grounding material.

1.4 REGULATORY REQUIREMENTS

- A. Conform to requirements of the CEC, latest adopted version with amendments by local AHJ
- B. Furnish products listed by UL or other testing firm acceptable to AHJ.

1.5 SEQUENCING AND SCHEDULING

- A. Building Ground Electrode: Coordinate placement of ground rods and grounding electrode conductor in base of building footing prior to placement of concrete. Coordinate bonding of rebar with rebar installer prior to rough-in.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Ground Rods: Copperclad steel, 3/4 inch diameter, 10 feet long, tapered point, chamfered top. Manufacturers: Weaver, Thomas & Betts, Talley, or approved.

- B. Grounding Connectors: Hydraulic compression tool applied connectors or exothermic welding process connectors or powder actuated compression tool applied connectors. Mechanical type of connectors are not acceptable. Manufacturers: Burndy Hyground Compression System, Erico/Cadweld, Amp Ampact Grounding System or approved.
- C. Pipe Grounding Clamp: Mechanical ground connector with cable parallel or perpendicular to pipe. Burndy GAR Series, O-Z Gedney, Thomas & Betts or approved.
- D. Telecommunications Grounding Bar: 1/4-inch thick by 4-inch high by 20-inch long copper ground bar with insulators. Manufacturers: Erico/Cadweld or approved.
- E. Grounding Electrode Conductor: Bare copper stranded conductor.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Concrete Encased Ground Electrode:
 1. From the service equipment ground bus install grounding electrode conductor to footing foundation rebar.
 2. Bond the grounding electrode conductor to three independent steel rebars. Each rebars minimum length is 20 feet.
 3. Protect grounding electrode conductor extension from footing/foundation to service equipment with rigid PVC conduit. Do not use metal conduit for grounding electrode conductor protection.
- B. Ground Rod Electrode:
 1. Install 60 feet of No. 4/0 stranded bare copper conductor in base of perimeter footing.
 2. Layout conductor to provide maximum exposure to earth in the perimeter footing. Do not fold conductor.
 3. Bond to driven ground rods at 20 feet O.C.
 4. Tap at center ground rod and extend ground electrode conductor to service ground bus. Install ground electrode conductor extension in rigid PVC conduit for physical protection.
- C. Water Service Grounding: Bond building ground electrode and water service pipe to service ground bus. Connect to water pipe on utility side of isolating fittings or meters, bond across water meters.
- D. Raceways:
 1. Ground all metallic raceway systems. Bond to ground terminal with code size jumper except where code size or larger grounding conductor is included with circuit, use grounding bushing with lay-in lug.
 2. Connect all metal raceways, which terminate within an enclosure but without mechanical connection to the enclosure, by grounding bushings and ground wire to the grounding bus.
 3. Where equipment supply conductors are in flexible metallic conduit, install stranded copper equipment grounding conductor from outlet box to equipment frame.
 4. Install equipment grounding conductor, code size minimum unless noted otherwise, in all nonmetallic and metallic raceway systems.
- E. Feeders and Branch Conduits:
 1. Install continuous insulated equipment copper ground conductors within the following circuits; feeders, circuits for computer systems and other circuits as indicated on design Drawings.

2. Where installed in a continuous solid metallic raceway system and larger sizes are not detailed, provide insulated equipment ground conductors for feeders and branch circuits sized in accordance with Table 250-122.
 3. Install isolated ground conductors for electrically sensitive equipment. Install isolated grounding conductors isolated from the equipment ground system except at the common ground connection at the service equipment. Provide isolated ground bus in panelboards isolated from the equipment ground system.
- F. Boxes, Cabinets, Enclosures and Panelboards:
1. Bond grounding conductors to enclosure with specified conductors and lugs. Install lugs only on thoroughly cleaned contact surfaces.
 2. Bond all sections of service equipment enclosure to service ground bus.
- G. Motors, Equipment and Appliances: Install code size equipment grounding conductor from outlet box to (motor) equipment frame or manufacturer's designated ground terminal.
- H. Receptacles: Connect ground terminal of receptacle to equipment ground system by No. 14 conductor bolted to outlet box except isolated grounds where noted. Self grounding nature of receptacle devices does not eliminate conductor bolted to outlet box.
- I. Telecommunications Backboard: provide telecommunications grounding bar at each telecommunications backboard. Bond the grounding bar to service grounding bar in the main service equipment with a 6AWG copper equipment grounding conductor.
- J. Separately Derived Systems: Ground each separately derived system.

END OF SECTION

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SECTION 16180

EQUIPMENT WIRING SYSTEMS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Electrical connections to equipment specified under other sections.
- B. Examine Contract Drawings and other Divisions of these Specifications to ascertain the extent of powered equipment covered by the Drawings and Specifications and the methods by which each item of equipment will be furnished, delivered to the site, and installed and the amount of electrical work required for each item of powered equipment.

1.2 RELATED SECTIONS

- A. Section 01010 - Summary of Work
- B. Electrical work for powered equipment specified in other Divisions of these Specifications.
- C. Section 16010 - Electrical General Requirements, applies to this section, with the additions and modifications specified herein.
- D. Section 16050 - Basic Materials and Methods.

1.3 APPLICABLE PUBLICATIONS

The following publications form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

- A. National Electrical Manufacturers Association (NEMA) Publications:
 - 1. WD 1-83 General Purpose Wiring Devices
 - 2. WD 6-88 Wiring Device Configurations
- B. National Fire Protection Association (NFPA) Publication:
 - 1. 70-08 National Electrical Code (NEC)

1.4 SUBMITTALS

- A. Submit under provisions of Section 01300 and 16010.
- B. Powered equipment suppliers shall furnish, in addition to the manufacturer's data specified in other Sections, the following:
 - 1. Wiring diagrams.
 - 2. Operating Sequences.
 - 3. Installation layouts.
 - 4. Electrical load, voltage and phase data.
 - 5. UL Listing.

1.5 GENERAL REQUIREMENTS

- A. Flexible conduit may be used for lab, shop and similar fixed connections to equipment from adjacent outlets.

- B. Provide the products, and execute the work for this Section in accordance with the product and execution requirements, where applicable, as set forth in the other Sections of Division 16, to provide a complete electrical system.

1.6 REGULATORY REQUIREMENTS

- A. Conform to requirements of ANSI/NFPA 70.
- B. Furnish products listed and classified by Underwriters Laboratories, Inc. or testing firm acceptable to authority having jurisdiction as suitable for purpose specified and shown.

1.7 COORDINATION

- A. Coordinate work under provisions of Section 01040.
- B. Obtain and review shop drawings, product data, and manufacturer's instructions for equipment furnished under other sections.
- C. Determine connection locations and requirements.
- D. Sequence rough-in of electrical connections to coordinate with installation schedule for equipment.
- E. Sequence electrical connections to coordinate with start-up schedule for equipment.

1.8 ELECTRICAL WORK FOR POWERED EQUIPMENT

- A. Disconnect switches in general shall be furnished and installed as electrical work where indicated or required, except where integrally mounted on "package units" provided by other trades.
- B. Provide all starters, combination and magnetic, in motor control centers and individually located, except "chiller" starters and starters in "package units". Starters for three phase equipment shall be combination type. Magnetic starters shall be used for all single phase equipment requiring remote control.
- C. Provide manual starters for 120 volt single phase motors except starters supplied with package units.
- D. Provide all power wiring to all powered equipment installed on this project and included in any section of the Contract Specifications, except as specified in Section 15950, "Controls and Instrumentation". Power wiring shall be defined as conductors, conduit, enclosures and connections and related electrical work to supply powered equipment and including electrical power to supply point for powered equipment control systems.
- E. Do not order motor controllers or motor control centers until requirements for auxiliary contacts and final motor sizes are verified.

1.9 SUBSTITUTIONS

When powered equipment other than that originally specified or indicated is approved for use at the Contractor's request, then the Contractor shall be responsible for any costs incurred by other trades, including revisions to the electrical work such as electrical power supply, wiring, disconnects, circuit breakers, etc.

PART 2 - PRODUCTS

2.1 CORDS AND CAPS

California State University, Long Beach
Bob Cole Conservatory of Music – Phase 2

EQUIPMENT WIRING SYSTEMS
16180-2

- A. Attachment Plug Construction: Conform to NEMA WD 1.
- B. Configuration: NEMA WD 6; match receptacle configuration at outlet provided for equipment.
- C. Cord Construction: ANSI/NFPA 70, Type SO multiconductor flexible cord with identified equipment grounding conductor, suitable for use in damp locations.
- D. Size: Suitable for connected load of equipment, length of cord, and rating of branch circuit overcurrent protection.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify conditions under provisions of Section 01040.
- B. Verify that equipment is ready for electrical connection, wiring, and energization.

3.2 ELECTRICAL CONNECTIONS

- A. Make electrical connections in accordance with equipment manufacturer's instructions.
- B. Make conduit connections to equipment using flexible conduit. Use liquidtight flexible conduit with watertight connectors in damp or wet locations.
- C. Make wiring connections using wire and cable with insulation suitable for temperatures encountered in heat producing equipment.
- D. Provide receptacle outlet where connection with attachment plug is indicated. Provide cord and cap where field-supplied attachment plug is indicated.
- E. Provide suitable strain-relief clamps and fittings for cord connections at outlet boxes and equipment connection boxes.
- F. Install disconnect switches, controllers, control stations, and control devices as indicated.
- G. Modify equipment control wiring with terminal block jumpers as indicated.
- H. Provide interconnecting conduit and wiring between devices and equipment where indicated.

- 3.3 EQUIPMENT SCHEDULES:** Refer to Architectural, Mechanical and Plumbing drawings for equipment schedules. Provide all power wiring to all powered equipment installed on the construction project and included in any section of the Specifications, except line voltage wiring as specified in Section 15950, "Controls and Instrumentation."

END OF SECTION

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SECTION 16195

ELECTRICAL IDENTIFICATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Nameplates and labels.
- B. Wire and cable markers.
- C. Conduit markers.

1.2 APPLICABLE PUBLICATIONS:

The following publications form a part of this specification. The publications are referred to in the text by the basic designation only.

- A. American National Standards Institute, Inc. (ANSI) Publications:
 - 1. C2 2007 National Electrical Safety Code
 - 2. Z35.1-72 Accident Prevention Signs
- B. State of California Administrative Code:
 - 1. Title 8, Industrial Relations
- C. National Fire Protection Association (NFPA) Publication:
 - 1. 70-08 National Electrical Code (NEC)

1.3 SUBMITTALS

- A. Submit under provisions of Section 16010.
- B. Product Data: Provide data for nameplates, labels, conduit and wire markers.

1.4 REGULATORY REQUIREMENTS

- A. Conform to requirements of ANSI/NFPA 70.

PART 2 - PRODUCTS

2.1 NAMEPLATES

- A. Provide laminated plastic nameplates for all electrical equipment and devices including, but not limited to, the following:
 - 1. Enclosures for switchgear, transformers, switchboards, motor control, panels, pull boxes, cabinets and motors.
 - 2. Enclosures for all separately enclosed devices including but not limited to disconnect switches, circuit breakers, contactors, time switches, control stations and relays.
 - 3. Wall switches not within sight of outlet controlled.
 - 4. Special systems such as but not limited to telephone, warning and signal systems. Identification shall be at each equipment rack, terminal cabinet, control panel, annunciator, and pull box.

5. Devices mounted within and part of an equipment including circuit breakers, switches, control devices, control transformers, relays, indication devices and instruments.
 6. Receptacles and lighting switches: Panelboard I.D. and circuit number.
- B. Nameplate designations shall clearly state:
1. Manufacturer's nameplate including equipment design rating of current, voltage, KVA, HP, bus bracing rating, or as applicable.
 2. Equipment nameplate designating system usage and purpose, system nominal voltage, equipment rating for KVA, amperes, HP and RPM as applicable.
 3. Contactors: Voltage, continuous current, horsepower or interrupting current, and whether "mechanically-held" or "electrically-held".
 4. Motors: Rated voltage, full load amperes, frequency, phases, speed, horsepower, code letter rating, time rating, type of winding, class and temperature.
 5. Controllers: Voltage, current, horsepower, and trip setting of motor running overcurrent protection.
 6. Receptacles and lighting switches (wiring devices): Panel designation and circuit number.
- C. Nameplates shall be melamine plastic, 0.125-inch thick, white with black center core. Surface shall be matte finish. Corners shall be square. Accurately align lettering into the black core. Minimum size of nameplates shall be 1. inch by 2.5 inches. Lettering shall be normal block style unless otherwise noted.
- D. Letter Size:
1. Use 0.25 inch letters for identifying individual equipment and loads.
 2. Use 0.50 inch for identifying grouped equipment and loads.
- 2.2 WIRE MARKERS
- A. Description: Tape or tubing type wire markers, 3M ScotchCode or approved equal.
- B. Legend:
1. Power and Lighting Circuits: Branch circuit or feeder number indicated on drawings.
 2. Control Circuits: Control wire number indicated on schematic or interconnection diagrams on shop drawings.
- 2.3 UNDERGROUND WARNING TAPE: Provide per the requirements of Section 16050, "Basic Materials and Methods".
- 2.4 ENGRAVED DEVICE PLATES: Provide per the requirements of Section 16050, "Basic Materials and Methods".

PART 3 - EXECUTION

3.1 PREPARATION

- A. Degrease and clean surfaces to receive nameplates and labels.
- B. Coordinate installation of nameplates, markers and warning signs with the sequence of painting. Refer to Section 09900, "Painting."

3.2 NAMEPLATES

- A. Provide laminated plastic nameplates for all electrical equipment and devices including, but not limited to, the following:

1. Enclosures for switchgear, medium voltage controllers, transformers, low voltage switchgear, motor control centers, variable frequency drives, panels, panelboards, busway, pull boxes, junction boxes, cabinets and electronic circuit monitors.
 2. Enclosures for all separately enclosed devices including but not limited to disconnect switches, circuit breakers, contactors, time switches, control stations and relays.
 3. Special systems such as but not limited to telephone, warning and signal systems. Identification shall be at each equipment rack, terminal cabinet, control panel, annunciator, and pull box.
 4. Devices mounted within and part of an equipment including circuit breakers, switches, control devices, control transformers, relays, indication devices and instruments.
- B. Mounting: Provide number, location, and letter designation of nameplates as indicated. Install nameplate parallel to equipment lines. Fasten nameplates to enclosures with a minimum of two sheet-metal screws or two rivets. Fasten nameplates to device plates with suitable adhesive. Secure nameplate to inside surface of door on panelboard that is recessed in finished locations.
- 3.3 WIRE MARKERS: Provide markers for each conductor at panelboard gutters, pull boxes, junction boxes, outlet boxes, and each load connection.

END OF SECTION

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SECTION 16402

UNDERGROUND ELECTRICAL WORK

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. PVC conduit
- B. Moisture Sealing Material

1.2 APPLICABLE PUBLICATIONS: The publications listed below form a part of this Specification to the extent referenced. The publications are referred to in the text by the basic designation only.

- A. American National Standards Institute, Inc. (ANSI) Publication:
 - 1. C2-07 National Electrical Safety Code
- B. State of California Administrative Codes:
 - 1. Title 24, Part 3, CCR, 2008 California Electrical Code
- C. American Society for Testing and Materials (ASTM) Publications:
 - 1. A48-03(2008) Gray Iron Castings
 - 2. A123-09 Zinc (Hot-Galvanized) Coatings on Products Fabricated from Rolled, Pressed, and Forged Steel Shapes, Plates, Bars, and Strips
 - 3. A153-09 Zinc Coating (Hot Dip) on Iron and Steel Hardware
 - 4. A569/A569M-91a Steel, Sheet and Strip, Carbon (0.15 Maximum Percent), Hot-Rolled, Commercial Quality
 - 5. C478M-09 Specification for Pre-cast Reinforced Concrete Manhole Sections
- D. National Electrical Manufacturer's Association (NEMA) Publications:
 - 1. TC 3-04 PVC Fittings for Use with Rigid PVC Conduit and Tubing
 - 2. TC 7-05 Duct for Underground Installation, PVC and ABS Plastic Communications
- E. National Fire Protection Association (NFPA) Publication:
 - 1. 70-08 National Electrical Code (NEC)
- F. State of California Administrative Code:
 - 1. Title 24, Part 3, CCR, 2008 California Electrical Code
- G. Underwriter's Laboratories Inc. (U.L.) Publications:
 - 1. 651-05 Schedule 40 Rigid PVC Conduit

1.3 RELATED SECTIONS

- A. Section 16010 - Electrical General Requirements, applies to this section, with the additions and modifications specified herein.
- B. Section 16170 - Grounding and Bonding.
- C. Section 16195 - Electrical Identification.

1.4 SUBMITTALS: The following information shall be submitted for approval:

- A. Product Data: Provide for:

1. Conduit/Duct (all types)
 2. Precast Pullboxes
- B. Shop drawings: Provide for:
1. Precast Pullboxes: Indicate dimensions, reinforcement, size and locations of openings, and accessory locations for precast manholes.
- 1.5 QUALITY ASSURANCE: In each standard referenced to herein, consider the advisory provisions to be mandatory, as though the word "shall" has been substituted for "should" wherever it appears. Interpret references in these standards to "authority having jurisdiction," or other words of similar meaning, to mean District.
- 1.6 DELIVERY, STORAGE, AND HANDLING
- A. Deliver, store, protect, and handle Products to site under provisions of Sections 01600 and 16010. Inspect for damage.
 - B. Store and protect in accordance with manufacturer's instructions.
- 1.7 PROJECT CONDITIONS
- A. The drawings are diagrammatic and shall not be scaled for exact locations. The location of existing underground utilities are based on District record drawings and casual field observations. The Contractor shall use reasonable care in excavating for the installation of new underground ducts and shall be responsible for damage to existing underground utilities. Field conditions and non-interference with other utilities and trades, shall determine exact locations of new underground electrical ducts.
 - B. Conduit routing is shown on Drawings in approximate locations unless dimensioned. Route as required to complete wiring system.
- 1.8 PROJECT RECORD DOCUMENTS
- A. Submit under provisions of Section 01700.
 - B. Accurately record actual locations of exact routing of ductbank indicating plan location and depths every 50 linear feet. Measure conduit locations from permanently fixed readily discernible landmarks such as building corners, columns, manhole centerline, etc.
 - C. Accurately record actual locations of each manhole.

PART 2 - PRODUCTS

- 2.1 MATERIALS AND EQUIPMENT: All materials and equipment shall be new and of high quality to give long life and reliable operation. All equipment shall be modern in design and shall not have been in prior service except as required by factory tests. Materials and equipment shall conform to the respective specifications and standards and to the specifications herein. Electrical ratings shall be as indicated.
- 2.2 CONDUIT:
- A. Rigid Plastic Conduit: NEMA TC2; Schedule 40 PVC.
- 2.3 FITTINGS AND OUTLET BOXES:
- A. PVC Fittings and Conduit Bodies: NEMA TC3.

- 2.4 **PULL WIRE:** Pull wire shall be nylon having a minimum tensile strength of 200 lbs in each empty duct. Minimum 48 inches of slack shall be left at each end of pull wires. Rod and clean all existing ducts to be used. Plug spares for future use.
- 2.5 **CABLE SUPPORTS:** Provide a means of supporting all cables running through electrical manholes. This shall be in the form of vertical channels cinch anchored to the manhole wall. A cantilevered support fastened to the channels shall be used to support the cable and splices. Cable racks, including rack arms and insulators, shall be adequate to accommodate the cable. A porcelain clamp shall be used to insulate and protect cables from supports. All cables smaller than 0.75" diameter shall be provided with some supplementary means of support such as cable tray or conduit. All exposed metal parts and fasteners shall be fabricated of stainless steel or double hot-dip galvanized steel.

PART 3 - EXECUTION

- 3.1 **INSTALLATION:** Underground cable installation shall conform to NFPA 70, Cal. P.U.C. G.O.128, and all other state and local codes.
- A. **Duct Line:** Duct lines shall have a continuous slope downward toward manholes and away from buildings with a pitch of not less than 4 inches in 100 feet. Except at conduit risers, changes in direction of runs exceeding a total of 10 degrees, either vertical or horizontal, shall be accomplished by long sweep bends having a minimum radius of curvature of 25 feet. Sweep bends may be made up of one or more curved or straight sections or combinations thereof. Manufactured bends shall have a minimum radius of 36 inches for ducts of 3 inches in diameter and larger.
1. Join nonmetallic duct using adhesive as recommended by manufacturer. Wipe nonmetallic duct dry and clean before joining. Apply full even coat of adhesive to entire area inserted in fitting. Allow joint to cure for 20 minutes, minimum.
 2. Use suitable separators or chairs of high impact polystyrene installed not greater than 4 feet on center.
 3. The joints of the conduits shall be staggered by rows and layers so as to provide a duct line having the maximum strength.
 4. During construction, partially completed duct lines shall be protected from the entrance of debris such as mud, sand and dirt by means of suitable conduit plugs.
- B. **Conduit Termination to Pull Boxes:** Conduits shall terminate in end-bells at right angles with the wall, where duct lines enter manholes. As each section of a duct line is completed from manhole to manhole, a testing mandrel not less than 12 inches long with a diameter 1/4 inch less than the size of the conduit shall be drawn through each conduit, after which a brush having the diameter of the duct, and having stiff bristles shall be drawn through until the conduit is clear of all particles of earth, sand, or gravel; conduit plugs shall then be immediately installed.
- C. **Connections to Existing Ducts:** Where connections to existing duct lines are indicated, excavate the lines to the maximum depth necessary. Cut off the lines and remove loose concrete from the conduits before new concrete encased ducts are installed. Provide a reinforced concrete collar, poured monolithically with the new duct line, to take the shear at the joint of the duct lines. Abandon in place those unused ducts which do not interfere with the work.
- D. **Concrete Envelope and Excavation:** Securely anchor duct to prevent movement during concrete placement. Excavated material shall be removed from the site on the same day as excavation. Backfill shall be a two sack slurry. Base of trench excavation shall be compacted to 95%.
- E. **Underground Warning Tape:** Identifying tapes shall be buried in all utility line trenches. Place one tape above the centerline of each duct bank. Refer to Section 16195.

3.2 PREPARATION FOR PULLING IN CONDUCTORS

- A. Do not install crushed or deformed raceways. Avoid traps in raceways where possible. Take care to prevent the lodging of concrete, dirt, or trash in raceways, boxes, fittings, and equipment during the course of construction. Make raceways entirely free of obstructions or replace them. Ream all raceways, remove burrs, and clean raceway interior before introducing conductors or pull wires.
- B. Immediately after installation, plug or cap all raceway ends with water-tight and dust-tight seals until the time for pulling in conductors.
- C. For all new and existing ductbanks part of this project, pull a mandrel of a diameter approximately 1/4 inch less than the raceway inside diameter, through each raceway. Then pull a bristle brush through each raceway to remove debris.
- D. Rod, clean and provide pull rope in all existing ducts to be used for conductor paths under this Contract. For existing underground raceways, pull a mandrel of a diameter approximately 1/2 inch less than the raceway inside diameter, through each raceway. Then pull a bristle brush through each raceway to remove debris.

3.3 EMPTY RACEWAYS

- A. Certain raceways will have no conductors pulled in as part of the Contract. Identify with tags at each end and at any intermediate pull point the origin and destination of each such empty raceway. Where a raceway has been identified with a name (number) in the Feeder Schedule, use that name on the tag in lieu of origin and destination. Provide a removable permanent cap over each end of each empty raceway. Provide a 3/8" nylon pull cord in each empty raceway.

3.4 GROUNDING: Grounding shall be in accordance with ANSI C2. All ground wire shall be copper. Refer to Section 16170 "Grounding and Bonding".

3.5 CABLE SLACK: A minimum six (6) feet cable slack shall be configured in manholes to allow installation of future splices.

3.6 PULL BOXES: Pull boxes shall be installed on a minimum 6" bed of 1" aggregate rock.

END OF SECTION

SECTION 16470

PANELBOARDS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Panelboards.

1.2 RELATED SECTIONS

- A. Section 16010 - Electrical General Requirements, applies to this section, with the additions and modifications specified herein.
- B. Section 16050 - Basic Materials and Methods.
- C. Section 16170 - Grounding and Bonding.
- D. Section 16195 - Electrical Identification.

1.3 APPLICABLE PUBLICATIONS: The following publications form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

- A. National Electrical Contractors Association (NECA) Publication:
 - 1. Standard of Installation.
- B. National Electrical Manufacturer's Association (NEMA) Publications:
 - 1. NEMA AB 1 Molded Case Circuit Breakers.
 - 2. NEMA ICS 2 Industrial Control Devices, Controllers, and Assemblies.
 - 3. NEMA PB 1 Panelboards.
 - 4. NEMA PB 1.1 Instructions for Safe Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less.
- C. National Fire Protection Association (NFPA) Publication:
 - 1. 70-08 National Electrical Code (NEC)
- D. Underwriters Laboratories, Inc. (U.L.) Publications:
 - 1. 50-80 Cabinet and Boxes
 - 2. 67-79 Standard for Panelboards
 - 3. 869-84 Standard for Service Equipment

1.4 SUBMITTALS

- A. Product Data: Indicate outline and support point dimensions, voltage, main bus ampacity, integrated short circuit ampere rating, circuit breaker arrangement and sizes.
- B. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of Product.

1.5 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing Products specified in this Section with minimum five years documented experience.

1.6 MAINTENANCE MATERIALS

- A. Provide two panelboard keys with maximum of 24 of each type.

PART 2 - PRODUCTS

- 2.1 MATERIALS AND EQUIPMENT: Materials and equipment shall conform to the respective specifications and standards and to the specifications herein. Electrical ratings shall be as indicated. Except where specifically indicated otherwise, provide only new materials having all legally required approvals and/or labels. Items of a similar nature shall be of the same type and manufacturer.

2.2 ACCEPTABLE MANUFACTURERS

- A. Cutler-Hammer
- B. Square D
- C. General Electric

2.3 PANELBOARDS

- A. Panelboards: UL 50, UL 67, NEMA PB1, circuit breaker type, size and number of breakers as indicated.
- B. Panelboard Bus: Copper, ratings as indicated. Provide copper ground bus in each panelboard.
- C. Minimum integrated short circuit rating: 10,000 amperes rms symmetrical for 240 volt panelboards; 14,000 amperes rms symmetrical for 480 volt panelboards, or as indicated.
- D. Molded Case Circuit Breakers: NEMA AB 1, bolt-on type, ambient compensated, thermal magnetic trip circuit breakers, with common trip handle for all poles. Provide circuit breakers UL listed as Type HACR for air conditioning equipment branch circuits. Provide circuit breakers UL listed as Type SWD for lighting circuits. Provide UL Class A ground fault interrupter circuit breakers where scheduled. Do not use tandem circuit breakers. Where main breaker is shown as non-automatic, it shall be equipped with high magnetic trip with same interrupting capacity as all branch circuit breakers.
- E. Enclosure: NEMA PB 1, Type 1 or as indicated.
- F. Cabinet box: 6 inches deep; width: 20 inches.
- G. Cabinet Front: Flush or surface cabinet front as indicated with concealed trim clamps, concealed hinge, and flush lock all keyed alike. Finish in manufacturer's standard gray enamel.
- H. Cover shall have a permanently mounted marking stating: WARNING – Potential Arc-Flash Hazards Exist While Working On This Equipment.

PART 3 - EXECUTION

- 3.1 INSTALLATION: Electrical installation shall conform to requirements of NFPA 70, state and local codes, and to requirements specified herein.
 - A. Install panelboards in accordance with NEMA PB 1.1 and NECA Standard of Installation.
 - B. Align and level panelboards and securely fasten to the building. Do not use connecting conduits to support the panelboards. Install trim plumb and square.

- C. Height: 6 ft to top of panelboard; install panelboards taller than 6 ft with bottom no more than 4 inches above floor.
- D. Provide filler plates for unused spaces in panelboards.
- E. Provide typed circuit directory for each branch circuit panelboard affected by work under this contract. Revise directory to reflect circuiting changes required to balance phase loads.
- F. Provide engraved plastic nameplates under the provisions of Section 16195.
- G. Provide spare conduits out of each recessed panelboard to an accessible location above ceiling. Minimum spare conduits: 5 empty 1-inch. Identify each as SPARE.

3.2 FIELD QUALITY CONTROL

- A. Visual and Mechanical Inspection: Inspect for physical damage, proper alignment, anchorage, and grounding. Check proper installation and tightness of connections for circuit breakers.
- B. Field inspection and testing will be performed under provisions of Section 01400.

3.3 SPARE PARTS

- A. Provide the University four (4) spare circuit breakers loose for each provided size and type 225 ampere and below, and one (1) spare for circuit breakers each size and type above 225 ampere.

END OF SECTION

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SECTION 16510

LIGHTING

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Provide all lighting fixtures as shown, scheduled on the drawings, and for certain fixtures specified in detail herein. Provide complete with all lamps, completely wired, controlled, and securely attached to supports. Support shall comply with local Codes and ordinances for securing against seismic forces.
- B. Where both, catalog number and narrative and/or pictorial description are indicated, the requirements of the description shall take precedence and prevail.
- C. General Contractor shall provide electrical subcontractor with entire lighting specification (including fixture catalog cuts and sketches); electrical subcontractor shall provide each specified manufacturer with complete information about the fixtures they will supply.
- D. Type of fixtures shall be as indicated alphanumerically and as specified.
- E. Fixture details shown may be modified by the manufacturer provided all of the following conditions have been met:
 - 1. Fixture performance is equal or improved;
 - 2. Structural, mechanical, electrical, safety and maintenance characteristics are equal or improved;
 - 3. Cost to the Owner is unchanged or reduced;
 - 4. Modifications have been reviewed by the Engineer and have been approved by the Architect in writing.
- F. Reflector cones, baffles, louvers, aperture plates, and decorative elements of fixtures shall be packed by the manufacturer separate from the housing (body, stem, etc.) of the fixture.
- G. Blemished, damaged or unsatisfactory fixtures shall be replaced in a satisfactory manner.

1.2 RELATED SECTIONS: Examine other Sections of Division 16 and ascertain their effect upon, and relationship to the work of this Section. Provide the products, and execute the work in this Section in accordance with the product and execution requirements, where applicable, as set forth in the other Sections of Division 16, to provide an interrelated electrical system.

- A. Section 16010 - Electrical General Requirements, applies to this section, with the additions and modifications specified herein.
- B. Section 16050 - Basic Materials and Methods.
- C. Section 16450 - Grounding and Bonding.
- D. Section 16195 - Electrical Identification.

1.3 APPLICABLE PUBLICATIONS: The following publications form a part of this specification. The publications are referred to in the text by the basic designation only.

- A. American National Standards Institute, Inc. (ANSI) Publications:
 - 1. C78.379 Electric Lamps - Incandescent and High-Intensity Discharge Reflector Lamps - Classification of Beam Patterns.
 - 2. C82.01 Specification for Fluorescent Lamp Ballasts.
 - 3. C82.04 High-Intensity Discharge Lamp Ballast (Multiple Supply Types).
- B. American Society for Testing and Materials (ASTM) Publications:
 - 1. B136-84(2008) Measurements of Stain Resistance
- C. National Electrical Manufacturers Association (NEMA) Publications:
 - 1. WD 6 Wiring Device Configurations.
- D. National Fire Protection Association (NFPA) Publication:
 - 1. 2010 California Electrical Code (CEC)
 - 2. 101 Life Safety Code.

1.4 SUBMITTALS

- A. Submit under provisions of Section 01300 and 16010.
- B. Shop Drawings:
 - 1. Fixtures: Indicate name of project; building name; fixture type; complete details and/or data of fixtures, including manufacturer's name, catalog numbers for lampholders, ballasts, lightshields, switches; metal gauges; type of wiring; color and texture of finishes; and list of materials. If scallop shields, wallwash reflectors or baffles are required, shop drawings shall indicate their relative position to the wall or adjacent vertical surface.
- C. Product Data: Provide dimensions, ratings, and performance data for lighting fixtures electronic ballast. Submit samples of finishes and photometric data from an independent testing laboratory to completely describe fixture performance.
- D. Manufacturer's Installation Instructions: Indicate handling and installation methods.
- E. Manufacturer's Certificate: Certify that Products meet or exceed specified requirements.

1.5 OPERATION AND MAINTENANCE MANUAL

- A. Submit operation and maintenance manual for fixtures and ballast under provisions of Section 16010.
- B. Maintenance Data: Include replacement parts list.

1.6 INSTRUCTION TO COLLEGE PERSONNEL

- A. Instruction shall be provided for items specified in this Section. See Section 16010, "Electrical General Requirements". Provide completed Manufacturer's Instruction Certificate (Form 16010-B) for all instruction given to the College.

1.7 PROJECT RECORD DOCUMENTS

- A. Submit under provisions of Section 01700.
- B. Accurately record actual locations of each luminaire.

1.8 QUALIFICATIONS

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

1.9 REGULATORY REQUIREMENTS

- A. Conform to requirements of NFPA 70 and NFPA 101.
- B. Furnish products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and shown.
- C. Fixtures installed outdoors in areas exposed directly to weather shall be UL listed for wet locations.
- D. Fixtures installed in outdoor protected areas (such as building soffits) and indoors in areas subject to water or extreme humidity shall be UL listed for damp locations.
- E. All fixtures shall meet all required local codes and regulations.

1.10 GENERAL LIGHTING REQUIREMENTS

- A. Verify ceiling materials employed and coordinate fixtures to mount to the ceiling system used.
- B. Provide support materials of all types necessary to secure lighting fixtures to the building structure.

1.11 FIXTURE EVALUATION

- A. Fixtures offered as equal to the fixtures listed herein shall be equal in the following characteristics:
 - 1. General appearance and physical dimension.
 - 2. Finish of materials.
 - 3. Gage and type of metal used.
 - 4. Equivalent optical system and lighting efficiency as determined by certified photometric test report.
 - 5. Equivalent lamp (and ballast) types.
 - 6. General construction, including door hanging, method of suspension, wire quantities permitted in attached junction boxes and other pertinent construction features.
 - 7. Type, quality, and thickness of plastic and glass material used for lenses, diffusers or trim.

1.12 VOLTAGE AND CEILING SYSTEMS COORDINATION

- A. Fixtures as scheduled on the drawings and specified herein include catalog numbers indicating the basic design intent. The fixtures installed shall be suitable for the circuit electrical characteristics indicated for their supply, and compatible with the specified ceiling systems where installed, or with alternate ceiling systems which may be substituted for the specified ceiling systems.
- B. Do not order any lighting fixtures, after approval of shop drawings, without first certifying that the fixtures have correct electrical characteristics and are of proper dimension and have mounting

methods and trims conforming to the ceiling systems into or onto which the lighting fixtures will be installed.

- C. Approval of shop drawings is for general design concept, quality of materials, finish, optical characteristics, general construction and lighting efficiency, and shall not relieve the Contractor from the necessity of coordinating with indicated electrical characteristics and with ceiling systems being installed prior to ordering fixtures.

1.13 FIXTURE SUPPORT AND INSTALLATION

A. Surface fixtures:

1. Do not mount fluorescent fixtures directly on combustible material such as fiber acoustical tile unless specifically approved for such use. Provide material required for complying with this code requirement. Install in perfect vertical and horizontal alignment.
2. Support surface mounted fixtures over 4" in width and over 50" in length with a minimum of six fastenings per fixture, two located near each fixture end and two near each fixture center.
3. Locate fastenings for all surface mounted fixtures to provide maximum fixture support and optimum fixture alignment.
4. Fastenings for surface mounted fixtures that are installed on concrete slab or concrete joist construction shall consist of 1/4" minimum size machine screws fastened to concrete inserts that are installed in the slab or joist areas before the concrete is poured.

B. Pendant fixtures:

1. Supports for suspended fluorescent fixtures shall consist of code approved single stem hangers. Chain hangers shall not be approved unless specifically identified on the drawings.
2. Stems for pendant fixtures shall have a swivel hanger and canopy at the ceiling. The method for connecting stems to fluorescent fixtures shall be of a type to allow a 45° fixture swing. Spacing between stems shall be the manufacturer's standard or shall be based on code requirements, whichever is the most stringent.
3. Individually mounted, suspended fluorescent fixtures over 50" in length shall have a minimum of two supports per fixture. Supports shall be located near each fixture end and in the fixture center.
4. Suspended fluorescent fixtures that are mounted in continuous rows shall have an additional stem hanger greater than number of fixtures in row.
5. Code approved wiring channel that is used to support suspended fixtures shall have hanger supports as per manufacturer's and/or code requirements, whichever is the more stringent. Maximum distance between hanger supports shall be 100".
6. Fastenings for suspended fixture supports that are attached to suspended ceilings shall consist of a minimum of two 3/8" machine screws fastened to metal straps or channels that are supported by the suspended ceiling supporting channels.
7. Fastenings for suspended fixture supports that are attached to concrete slab or concrete joist construction shall consist of a minimum of two 3/8" machine screws fastened to concrete inserts for each individual fixture support.
8. Provide canopies on stems fitting snugly to and covering outlet boxes and support devices.
9. Provide lateral seismic bracing for fixtures per the requirements of the UBC.

C. Recessed fixtures:

1. Equip recessed fixtures with attached junction boxes unless noted otherwise in the fixture list.
2. Provide plaster frames, and other mounting material compatible with the ceiling and wall systems employed.
3. Support recessed fixtures separately from ceiling system where ceiling members are not structurally capable of supporting lighting fixtures, or where required by Code.

Interconnect fixture bodies and ceiling system members to prevent independent movement where required by Code.

D. Supplemental support:

1. Include any supplemental support and framing material and fastenings necessary to support lighting fixtures in the locations indicated. Attach this material onto the building structural members. All such materials and installations shall comply with code requirements.
2. Include any foundations required for the support of base mounted lighting fixtures. If the pedestals, poles, or standards supporting such fixtures exceed 10 feet in height, and no foundation details are included on the Contract Documents, provide details of proposed foundations for review by the Structural Engineer. If required by code, proposed foundation designs must be signed by a registered Structural Engineer.

1.14 BIDDING PROCEDURE FOR SUBSTITUTIONS

Bidders' attention is called to the following procedure to be followed in submitting their bids for the Lighting section of the Electrical Work:

- A. Bidders wishing to obtain approval on brands other than those specified by name and catalog number on the drawings, shall submit their requests not later than fourteen (14) days before the bid opening. Approval will be in the form of an addendum to the specifications issued to all prospective bidders indicating that the additional brand or brands are approved as equal to those specified as far as the requirements of the project are concerned. If the bidders do not elect to obtain prior approval during the time so specified, the owner has no obligation to review or consider any such article after the contract award.
- B. If the bidder wishes to substitute fixtures from alternate manufacturers, refer to Paragraph 2.02 of this section of the specifications. Note that the dimensions of visible parts of many fixtures, (for example, the aperture diameters of recessed fixtures) are binding to the bidder and cannot be changed without prior approval by the Engineer.
- C. Request for approval shall be accompanied with the name and location of at least one completed project where each proposed substitute has been in operation for a period of at least six (6) months, as well as the names and addresses of the Owner, the Architect and the Engineer of record.

1.15 DELIVERY, STORAGE, AND HANDLING

- A. Store, protect, and handle products to site under provisions of Sections 01600 and 16010.
- B. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
- C. Handle in accordance with manufacturer's written instructions.

1.16 WARRANTY

- A. Ballasts for fluorescent and high intensity discharge fixtures shall be covered by a two-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 ballasts.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT: Materials and equipment shall conform to the respective specifications and standards and to the specifications herein. Electrical ratings shall be as indicated. Except where specifically indicated otherwise, provide only new materials having all legally required approvals and/or labels.

2.2 GENERAL MATERIAL REQUIREMENTS

- A. Ferrous mounting hardware and accessories shall be finished using either a galvanic or phosphate primer/baked paint process to prevent corrosion and discoloration of plaster.
- B. For weatherproof installation and painted finishes of fixtures and accessories shall be weatherproof enamel using proper primers or galvanized and bonderized epoxy, so that the entire assembly is completely corrosion resistant for the service intended.
 - 1. Hangers shall be conduit with chemically resistant, weatherproof, baked enamel finish.
 - 2. Where aluminum parts come in contact with bronze parts, apply to both surfaces a coating material to prevent corrosion.
- C. Fasteners shall be manufactured of non-magnetic stainless steel or anodized aluminum, except in indoor applications where galvanized steel shall be acceptable.
- D. Fixtures shall be free of light leaks and shall be designed to provide sufficient ventilation of lamps and ballasts including vent holes where required. Outdoor fixtures shall have wire mesh corrosion resistant screens in the vent holes.
- E. All sheet metal work shall be free from tool marks and dents and shall have accurate angles bent as sharp as compatible with the gauges of the required metal. All intersections and joints shall be formed true and of adequate strength and structural rigidity to prevent any deformation after assembly. All sheet metal shall be free of light leaks. All edges shall be finished so there are no sharp edges exposed. All mitres shall be in accurate alignment with abutting intersecting members. Piecing of plates in individual runs in single planes and the use of spliced pieces or filler material to cover defective workmanship shall not be allowed. Sheet metal work shall be properly fabricated so that planes will not deform, i.e. become concave or convex, due to normal expected ambient and operating conditions.
- F. Lampholders shall hold lamps securely against normal vibrations and maintenance handling. Provide solid nickel or nickel-and-silver-plated contacts in lampholders for following types of lamps:
 - 1. Metal halide lamps.
 - 2. Lamps in outdoor fixtures.
 - 3. Tungsten-halogen lamps.
- G. Wiring channels and lampholder mountings shall be rigid and accurately made.
- H. Fluorescent Fixtures:
 - 1. Hot Cathode:
 - a. Housing:
 - 1) No. 20 minimum gauge steel, bonderized or equal rust protected, or No. 16 gauge aluminum rigid construction suitable for continuous row mounting where indicated.

- 2) Finish: Baked enamel paint finish unless otherwise specified, color as specified or as selected. For exterior finish, refer to "Exterior Fixture Finishes" below.
- b. Reflector: Minimum 85% reflectance.
 - c. Light shields:
 - 1) Louvers: Continuously bound in channel formed frame, finish and color as specified or as selected. When more than one louver panel occurs in a fixture, submit as a part of the shop drawings the dimensioned layout of individual louver panels and supporting "tee" members.
 - 2) Louvers shall be of 100% virgin acrylic (except as shown) and shall have matte finish on exterior (facing away from lamps) surface (except as shown).
 - 3) Lenses shall fully eliminate lamp images when viewed from all directions within the 45° to 90° angle from vertical when the ratio of lamp spacing to the distance from lamp underside to top of lens does not exceed 1:50. Within the viewing angle from 0° to 45° the ratio of maximum brightness (under a lamp) to minimum brightness (between lamps) shall not exceed 3 to 1.
 - 4) No cross bars shall be permitted over lightshields.
 - d. For rapid start lamps on single ballast, provide one (1) grounding lampholder per lamp. Lampholders operating with open circuit voltage in excess of 300 volts shall be safety type and shall open supply circuit when lamp is removed from lampholder.
 - 1) Mount lamps used in rapid start circuits 40 watts and below: within 1/2" of grounded metal as long as the lamp.
 - e. Fluorescent fixtures shall conform to NEMA Standards, including references to fixture dimensions and temperature ratings.
 - f. Ballasts shall be high power factor (greater than 90%), approved by UL and certified by ETL and shall comply with the regulatory requirement of California Administrative Code, Title 20, Section 16-120 (3) and Federal Ballast Energy Law (Public Law No. 100-357, National Appliance Energy Conservation Amendments of 1988) where applicable Ballasts shall be certified for voltage and number of lamps specified and equipped with internal thermal overload protectors unless otherwise specified.
 - 1) Ballasts for indoor applications shall be marked "Class P".
 - 2) Provide two-lamp ballasts where possible including continuous rows of one-lamp fixtures, and one lamp ballasts where the fixture layout does not permit the use of two lamp ballast, or as specified on the drawing.
 - 3) All ballasts shall operate on voltage as specified and confirmed on the electrical drawings. Non-dimmable electronic ballasts shall be as follows. All ballasts including approved equals shall meet the requirements of this section. Manufacturer shall be Magnetek, Advance, or approved equal. Unless otherwise specified, low wattage, instant start, parallel wired electronic ballasts shall be used.
 - 4) Frequency shall be 60 hertz except as noted.
 - 5) Ballast minimum sound ratings:
 - a) 265ma: Class :A"
 - 6) All 32 watt fluorescent ballasts for interior use shall be energy saving, electronic type, dedicated T8 or equal.

- 7) All fixtures installed in exterior or unheated interior spaces shall be supplied with ballasts which start lamps down to 0°F.
 - g. Lighting fixtures recessed in a hung ceiling where the space above the hung ceiling is used as a plenum chamber for either supply or return air for the air conditioning system shall be designed, manufactured and wired to conform to NEC Article 300-22.
 - h. Acceptable manufacturers: Advance Magnetek or approved equal.
- I. Incandescent Fixtures:
- 1. Incandescent fixtures, unless otherwise specified, shall be operated at 90% of rated lamp voltage.
 - a. Steel, bonderized or equal rust protected or aluminum, rigid construction. Minimum gauge thickness shall be as follows:
 - 1) Interior locations: No. 20 gauge steel, No. 16 gauge aluminum.
 - 2) Exterior locations: No. 18 gauge steel, No. 14 gauge aluminum.
 - b. Finish: Baked enamel finish (except when otherwise specified).
 - 1) Concealed interior surfaces (this applies to interior hardware, lampholders, yokes, brackets, etc.): matte black.
 - 2) Concealed exterior surfaces: matted black.
 - 3) Visible surfaces: color and texture as specified below for each fixture type or as selected.
 - 4) Exterior fixture finish: Refer to "Exterior Fixture Finishes" below.
 - 3. Reflectors not visible within the normal viewing angles shall be highly specular as produced under the Alzak process, except when otherwise specified. Minimum reflectance shall be 83%.
 - 4. Provide safety devices for removable fixture elements (cones, reflectors, lenses, and fixture doors, etc.). Safety devices shall support removable elements when not in normal position, and be detachable if necessary. These devices shall not interfere with fixture performance, maintenance, or the seating of any fixture element, and shall not be visible during normal fixture operation.
 - 5. Thermal protection device shall be provided as required by code.
 - 6. Tungsten-halogen lamp seal temperature shall not exceed 350° at ambient of 25°C when tested per UL Bulletin 57, Par. 328-334. Submit certified heat test data by independent testing laboratory.
- J. High Intensity Discharge Fixtures:
- 1. Housing, where applicable:
 - a. Steel, bonderized or equal rust protected or aluminum, rigid construction. Minimum gauge thickness shall be as follows:
 - 1) Interior locations: No. 20 gauge steel, No. 16 gauge aluminum.
 - 2) Exterior locations: No. 18 gauge steel, No. 14 gauge aluminum.
 - b. Finish: Baked enamel finish
 - 1) Concealed surfaces: matted black.
 - 2) Visible surfaces: color and texture as specified below for each fixture type or as selected by Architect.
 - 3) Exterior fixture finish: Refer to paragraph N., "Exterior Fixture Finishes" below.

- c. Lampholder housing: cast aluminum with integral heat radiating fins to assure cool lamp base operation.
 - d. Fixture housing design shall provide for top and bottom relamping, unless otherwise specified.
2. Reflectors: High purity (not less than 99.0%) aluminum. Specular finish shall be achieved by mechanical-and electro-polishing. Reflector shall be anodized to prevent surface corrosion or deterioration. Minimum reflectance shall be 83%.
 3. Provide safety devices for removable fixture elements (cones, reflectors, lenses, and fixture doors, etc.). Safety devices shall support removable elements when not in normal position, and be detachable if necessary. These devices shall not interfere with fixture performance, maintenance, or the seating of any fixture element, and shall not be visible during normal fixture operation.
 4. Ballasts: High power factor, UL approved constant wattage auto-transformer type for voltage and lamp specified, 60 hertz.
 5. Lighting fixtures recessed in a hung ceiling where the space above the hung ceiling is used as a plenum chamber for either supply or return air for the air conditioning system shall be designed, manufactured and wired to conform to NEC Article 300-22.

K. Wiring:

1. Voltage Rating

- a. For voltages up to 120 volts fixture wiring shall be rated for 300 volts minimum.
- b. For voltages above 120 volts fixture wiring shall be rated for 600 volts minimum.

2. Temperature Rating - Internal to Fixture

All wiring shall be code-approved for fixture wiring and shall comply with the following temperature ratings unless fixture design or local codes require higher temperature wire.

a. Incandescent

- 1) 150°C minimum rating between lampholder(s) and separately mounted junction box or internal transformer.
- 2) 150°C minimum rating between internal transformer and separately mounted junction box.

b. Fluorescent

- 1) 90°C minimum rating between lampholder(s) and internal ballast.
- 2) 90°C minimum rating between ballast and separate junction box or connection with integral wireway.

c. High Intensity Discharge

- 1) 150°C minimum rating between lampholder(s) and separate junction box or connections with ballast components.
- 2) 150°C minimum rated between core and coil ballast components and separate junction box.
- 3) 90°C minimum rating between encased and potted ballast components and separate junction box.

3. Temperature Rating - External to Fixture

- a. All flexible cord wiring between fixture components or to electrical receptacle and not in wireways shall have a minimum temperature rating of 105°C.
- b. Cord type shall be suitable for application and shall be fitted with proper strain reliefs and watertight entries where required by application.

4. Splices

- a. Splices internal to fixture shall be made within separate splice compartments and shall utilize nylon insulated crimped connections or insulated quick disconnects.
 - b. Splices to branch circuit wiring in separate junction boxes shall utilize flame retardant thermoplastic caps with fully seated helical metal spring and threaded entry.
5. No internal wiring shall be visible at normal viewing angles, i.e., above 45° from vertical. Use additional wire clamps if necessary. Anticipate increased visibility if fixtures are mounted on or recessed within a sloping surface.
6. Any fixture fed from more than one panel, i.e., for normal and night or emergency operation, shall have separate neutrals to each panel.
7. Furnish code-approved wiring in ceiling cavities forming air plenums.

L. Lamps:

1. Hot cathode fluorescent lamps: warm white except as shown. Refer to fixture schedules on drawings. All lamps, except as specified, shall be of the same manufacturer (General Electric, GTE Sylvania, North American Philips, or Osram).
2. Incandescent lamps: 120 volt, except as shown. Refer to fixture schedules on drawings. All lamps, except as specified, shall be of the same manufacturer (General Electric, GTE Sylvania, North American Philips, Venture or Osram).
3. High intensity discharge lamps: Refer to fixture schedules on drawings. All lamps, unless specified otherwise, shall be of the same manufacturer (General Electric, GTE Sylvania, North American Philips, or Osram).

- M. Where acrylic plastic is specified, use 100% raw virgin acrylic plastic meeting the ASTM Specification for methacrylate molding compound equal to Rohm and Haas "Plexiglass". The raw material used must be of the quality to exceed IES-SPI-NEMA Specifications with a minimum requirement of 2000 hours of exposure in a Fade-O-Meter and not exceed (3) units of yellowing. E.T.L. report to be supplied confirming above requirements.

N. Exterior Fixture Finishes:

1. Unless otherwise specified, all painted surfaces shall have an outdoor life expectancy of not less than 20 years. Surfaces shall be prepared, primed, and material applied in accordance with the manufacturers requirements.
2. Color: Colors shall be as specified on drawings or selected by Architect.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrate and supporting grids for luminaires.
- B. Examine each luminaire to determine suitability for lamps specified.

3.2 INSTALLATION: Electrical installation shall conform to requirements of NFPA 70, state and local codes, and to requirements specified herein.

- A. Provide a lighting fixture for each lighting outlet as indicated.
- B. Provide complete fixtures, including glassware, diffusers, lenses, fitters, canopies, sockets, reflectors, ballasts, wiring, hangers and any accessories necessary to complete each fixture installation.

- C. Provide spacers where required for surface-mounted fixtures mounted to low density cellulose or similar ceiling materials.
- D. Aim floodlights and other adjustable fixtures to the satisfaction of Architect and Engineers or their representative.
- E. Provide accessories as required for ceiling construction type indicated on Finish Schedule. Fixture catalog numbers do not necessarily denote specific mounting accessories for type of ceiling in which a fixture may be installed.
- F. Provide adequate and sturdy support for each lighting fixture. Verify weight and mounting method of all fixtures and furnish and install suitable supports. Fixture mounting assemblies shall comply with all local seismic codes and regulations.
- G. Install rows of fixtures accurately on straight lines unless otherwise indicated on drawings. Coordinate with mechanical work.
- H. Install fixtures with vent holes free of air blocking obstacles.
- I. Top Relamping Fixtures: Top relamping fixtures shall have the necessary top-relamping screws loosened and moderately tightened, prior to installation, to assure ease of operation when relamping is required.
- J. Fluorescent Fixtures: Replace noisy ballasts as directed, at no cost to the owner.
- K. High Intensity Discharge Fixtures:
 - 1. Replace noisy ballasts as directed, at no cost to the College.
 - 2. Ballasts for indoor application shall be encased in a housing which provides necessary wiring compartments and provisions for required electrical connectors or devices.
 - 3. Ballast components shall be surrounded with a thermosetting fill to assure adequate heat dissipation and quiet operation.
 - 4. Ballasts shall be provided with necessary mounting hardware and vibration dampers.
 - 5. Ballasts for outdoor use shall be encased in weathertight enclosures with proper outdoor type wiring devices. Ballasts shall be suitable for starting lamps between -29°C and 41°C.
- L. Mask the trims and bottoms of all lighting fixtures if necessary to protect the fixture during construction.
- M. All lighting fixtures recessed in a ceiling which has a fire resistive rating of one hour or more shall be enclosed in a box which has a fire rating equal to that of the ceiling. The space from the fixture to the enclosure shall be a minimum of one inch.
- N. At the completion of construction clean the bottoms, the trim, the reflecting surfaces, lenses, baffles, louvers and reflector cones of all lighting fixtures so as to render them free of any material, substance or film foreign to the fixture.
- O. Ascertain and ensure that all lamps installed are exactly as specified for each fixture type.
- P. Provide labor and materials for final targeting of all adjustable fixtures under the Engineer's supervision. Targeting shall take place immediately before building is turned over to the owner, after regular working hours where required.
- Q. Replace all burned-out or inoperative lamps and inoperative ballasts in all high intensity discharge and fluorescent fixtures before the project is accepted by the owner so that all lighting fixtures will be in first-class operating condition.

3.3 FIXTURE LOCATIONS

- A. Locations of fixtures are shown diagrammatically. Verify exact location and spacing with Reflected Ceiling Plans and other reference data before ordering of fixtures and during installation.
 - 1. Notify Architect about field conditions at variance with Contract Documents before commencing installation.
 - 2. Coordinate space conditions with other trades before ordering of fixtures.
 - 3. Coordinate length of continuous-run fluorescent fixtures with adjacent walls, partitions, coffers and other architectural elements as required.
- B. Prior to installing fixture outlets, examine the plans of other trades in order to conform to all of the following conditions:
 - 1. Locate fixtures to conform with reflected ceiling plans included in the Contract Drawings.
 - 2. Fixtures shall not conflict with the installation of doors or cabinets.
 - 3. Locate fixtures symmetrical with tile and wall material patterns and room dimensions.
 - 4. Fixture outlets shall be accessible and fixtures shall hang clear of ducts and piping. Verify exposed duct and piping locations prior to rough-in of electrical outlets. Adjust outlet locations to coordinate with ducts and piping.
 - 5. Follow indicated mounting heights. Obtain missing heights, if any, from Architect.

3.4 EXPANSION SHIELD ANCHORS

- A. Expansion shields may be used for supporting lighting fixtures instead of concrete inserts under the following conditions:
 - 1. Fastenings and expansion shield anchors shall be one trade size larger than Specification requirements for fastenings used with concrete inserts.
 - 2. Holes for expansion shield anchors, cinch anchors, etc., shall be self-drilled or drilled with carbide tipped, rotary type concrete drills. Do not drill holes with pneumatic or impact tools. Do not install fasteners in concrete by powder actuated methods.
 - 3. Drill holes for expansion shields carefully in a workmanlike manner. Drill to the full depth of the expansion shield anchor and in a manner that will develop the full strength of the fastening.

3.5 INTERFACE WITH OTHER PRODUCTS

- A. Interface with air handling accessories furnished and installed under Section 15855.

3.6 CLEANING

- A. Clean Work under provisions of Section 01700.
- B. Clean electrical parts to remove conductive and deleterious materials.
- C. Remove dirt and debris from enclosure.
- D. Clean photometric control surfaces as recommended by manufacturer.
- E. Clean finishes and touch up damage.

3.7 FIELD QUALITY CONTROL

- A. Provide systems demonstration under provisions of Section 01650.

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SECTION 16515

LIGHTING CONTROL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. Provisions of Division 01 apply to this section
- B. Section Includes:
 - 1. Furnish and install a low-voltage lighting control system, as indicated on the Drawings and as specified.
 - 2. Systems shall be furnished with networkable relay panels each complete with the required relays, transformers, and control electronics. The system shall be furnished with all hardware and resident software, occupancy sensors, constant light controllers, exterior light sensors, occupancy sensors, local wall switches and dimmer switches and all required conduit and wiring for a complete and functional installation.
- C. Related Sections:
 - 1. Section 16010: Basic Electrical Requirements.
 - 2. Section 16050: Basic Electrical Materials and Methods.
 - 3. Section 16510: Lighting.

1.2 SUBMITTALS

- A. Provide in accordance with Division 01.
- B. Submit a complete one-line diagram of the proposed system configuration for Architect/Engineer's review. The riser diagram shall identify but not be limited to all wiring, equipment, components, interconnection with other systems, and location and type of raceways.
- C. Manufacturer's Data: Submit catalog cuts and description of each system component.
- D. Provide wiring diagrams and installation details for lighting control equipment.
- E. Shop Drawings: Submit a complete set of detailed Shop Drawings for the entire lighting control system; the shop drawings shall include but not be limited to relay panels with designations and dimensions, day light sensors locations based on manufacturer's recommendations, and system components with manufacturer's part numbers.
- F. Installation Instructions: Submit manufacturer's written installation instructions, wiring diagrams. Instructions shall include recommendations for handling of equipment and parts, and protection and storage requirements.

1.3 QUALITY ASSURANCE

- A. Components shall be listed and labeled by Underwriter's Laboratories (UL), or another Nationally Recognized Testing Laboratory (NRTL).
- B. Lighting Control Systems shall comply with the state of California Building and Electrical Codes, and Title 24 energy requirements in effect at time of submittal for building permit.

1.4 WARRANTY

- A. Manufacturer shall provide a 3 year material warranty.
- B. Installer shall provide a 2 year labor warranty.
- C. Submit in accordance with Division 1.

1.5 SYSTEM REQUIREMENTS

- A. The lighting control system must be able to communicate with fully digital centralized relay panels, remote relay panels, digital switches, photocells, analog switches, various interfaces, and shall include all operational software. The lighting control system shall be integrated into a single system, except for areas controlled by a motion sensor; such as rooms with one luminaire and emergency fixtures designed to operate 24 hours a day, 7 days a week. Distributed lighting control shall be provided using a networkable remote relay panel. A Centralized relay panel shall control corridors and site lighting. Lighting control system shall include all hardware and software; software shall be resident within the lighting control system. System shall provide local access to all programming functions at the master Lighting Control Panel (LCP) and remote access to all programming functions via dial-up modem and through any standard computer workstation running an industry standard internet browser. Lighting control system shall have a server built into the master LCP that "serves" HTML pages to any authorized workstation. WEB front end shall be accessible over an LAUSD provided Ethernet 10/100 Mbps to the local area network. Protocol shall be TCP/IP and allow either http (hypertext transfer protocol) or https (hypertext transfer protocol secured) connections. Desktop computers are not part of this section and will be provided by others. Non-networked, non-digital, non-server capable systems are not acceptable.
- B. System software shall provide real time status of each relay, each zone and each group.
- C. Lighting control system shall be able to be monitored and take commands from a remote Personal Computer (PC); should the remote PC go off-line all system programming uploaded to the lighting control system shall continue to operate as intended. Systems requiring an on line PC or server for normal operation are not acceptable
- D. All devices shall be able to be pre-addressed at the factory. Systems requiring field addressing only are not acceptable.
- E. All programs, schedules, time of day, etc., shall be held in non-volatile memory at power failure. At restoration of power, lighting control system shall implement programs required by current time and date.
- F. System shall be capable of flashing lighting OFF/ON for any relay or lighting zone prior to the lights beings turned OFF. The warning interval time between the flash and the final lights off signal shall be definable for each zone. Occupant shall be able to override any scheduled OFF sweep using local lighting zone override switches within the zone or occupied space. Occupant override time shall be pre-programmed not to exceed two hours, or current California Title 24 requirements.
- G. The system shall be capable of implementing ON, OFF, Raise (dimming), and Lower (dimming) commands for any relay, group or zone by means of digital specification grade line voltage type wall switches, analog low voltage switches, photocells, web based software, or other devices connected to programmable inputs in the lighting control system.
- H. The lighting control system shall provide the ability to control each relay and each relay group. All programming and scheduling shall be able to be done locally at the master LCP and remotely via dial up modem and via the Internet. Remote connection to the lighting control system shall provide real time control and real time feedback.
- I. System may consist of centralized relay panels, remote relay panels, digital switches, analog switches, photocells, motion sensors, lumen control devices, dimmer switches, and various digital interfaces. Verify exact components specified. Remote relay panels, smart breaker panels, centralized relay panels and digital switches shall communicate as one network. Where Remote Relay Panels (RRP) are indicated on drawings, they shall control all lighting fixtures in that area or space, provide power to occupancy sensors and take input from daylight and

occupancy sensors. RRP's shall be capable of taking inputs from LAUSD specification line voltage type switches, and if classroom dimming is indicated on the plans, they shall be capable of outputting an independent 0v - 10v dimming signal for each remote relay provided. All remote relay panels, switches, photocells and occupancy sensors shall be wired per lighting control manufacturer's instructions.

PART 2 - PRODUCTS

2.1 CENTRAL LIGHTING CONTROL PANELS

- A. Central Lighting Control Panels (CLCP) shall be located in the electrical closets and shall be LC & D #GR-2400 series or approved equal. Panels shall be surface or flush mounted type as indicated on Drawings, with a hinged door assembly. Doors shall be furnished with flush type locks, spring latching, Corbin locks for metal doors, keyed to Corbin No. 60 keys to match existing. Panels shall include the following components or features:
 - 1. Shall be preprogrammed and preassembled with all required control equipment and relays as indicated on the lighting plans.
 - 2. Shall be equipped with suitable dividers separating Class 1 and Class 2 compartments, 120v and 277v compartments as well as "normal and emergency" compartments.
 - 3. Lighting control relays as indicated on Drawings. Provide 10% spare relays for all centralized relay panels up to the maximum capacity of panel.
 - 4. Shall be equipped with a neatly typewritten schedule with number and name of rooms or areas served by the relay circuits. Room numbers and names used shall be determined at the Project site and may not be those indicated on Drawings. Schedule shall indicate panel designation and voltage and shall be mounted in a frame under transparent plastic 1/32" thick on inside of panel cabinet.
 - 5. Each panel shall be rated for 120 or 277 VAC.
 - 6. Shall be preassembled, preprogrammed and include relays capable of switching 20 amps lighting loads for 120 or 277 VAC.
 - 7. Central lighting control panels, remote lighting control panels, relays, low voltage switches, interior light sensors, exterior light sensors, and associated control electronics shall be furnished by Lighting Control and Design (LC & D) or approved equal.

2.2 RELAYS

- A. Relays shall be warranted for a minimum of 3 years.
- B. Relays shall be individually added or replaced. Lighting control systems not capable of replacing individual relays are not acceptable.
- C. Each lighting control relay shall be capable of controlling incandescent, fluorescent, electronic ballast and HID lighting loads. Relays not rated for all types of lighting loads are not acceptable.
- D. Relays shall be:
 - 1. Single Pole: LC&D SL-120-NC, or equal.
 - 2. Double Pole: LC&D SL-208-NC, or equal.

2.3 LOW VOLTAGE SWITCHES

- A. All low voltage switches shall be wired per the lighting control manufactures requirements. Digital switches shall be part of the lighting control system network. Analog switches shall be wired to lighting control panel designated by manufacturer. Use LC&D Chelsea series or Owner approved analog switch.
- B. Physical removal of any single switch shall have no effect on the communication between relay panels in the rest of the lighting control network. Lighting control systems requiring the continuous connection of all low voltage switches are not acceptable.

- C. Keyed switches shall be analog or digital and connect to programmable inputs in the nearest lighting control panel or be digital and connect to the lighting control system network. Use LC&D KS Series approved equal.
- D. Provide stainless steel switch covers as specified.

2.4 OCCUPANCY SENSORS

A. Occupancy Sensors:

1. Ceiling-Mounted Dual Technology Sensors:

- a. Sensors shall be dual technology infrared-ultrasonic capable of detecting presence in floor area to be controlled, by detecting Doppler shifts in transmitted ultrasound and infrared technology.
- b. Detection shall be maintained when a person moves only within a maximum distance of 12 inches, in either a horizontal or vertical manner, at approximate speed of 12 inches per second. Lights shall not go off when a person is reading or writing while seated at a desk.
- c. Each sensor shall be furnished with a convenient shunt provision, which will enable a person to by-pass sensor in event of failure.
- d. Sensitivity shall not change more than 10 percent in temperature range of 0 degrees F. to 120 degrees F., and in humidity range of 10 percent to 80 percent. Sensitivity adjustment shall be provided for each technology.
- e. Time delay range shall be adjustable from 15 seconds to 15 minutes.
- f. Sensors shall operate on DC power (12 volts to 24 volts). Power supply shall be provided by power pack, consisting of a transformer and contact closure relay in one package. Power output of transformer shall be capable of operating a minimum of 2 sensors.
- g. Manufacturers: Sensor Switch or approved equal.

2. Passive Infrared Wall Switch Sensors:

- a. Sensors shall be capable of detecting presence in floor area to be controlled, by detecting changes in infrared energy. Small movements shall be detected such as when a person is writing while seated at a desk.
- b. Passive infrared sensor shall utilize a dual-element sensor and a multi-element fresnel lens.
- c. Sensors shall be furnished with convenient bypass provisions, which enable lighting to be turned on in case of failure.
- d. Time delay range shall be adjustable from 15 seconds to 15 minutes.
- e. Sensitivity adjustment shall range from 0 (off) to 10 (maximum).
- f. Adjustments and mounting hardware shall be concealed under a removable cover to prevent tampering with adjustments and hardware.
- g. Each sensor shall cover up to 800 square feet, with a field-of-view of 150 degrees.
- h. Sensor shall be 2-wire, completely self-contained control system that replaces standard toggle switch. Power supply shall be an internal transformer, and switching mechanism shall be a latching dry contact relay.
- i. Sensor shall be capable of switching from 50 to 1000 watt, incandescent or fluorescent.
- j. Sensors shall be dual voltage, 120 volt and 277 volt.
- k. Manufacturers: Sensor Switch or equal.

PART 3 - EXECUTION

3.1 GENERAL

- A. Lighting control system shall not be used for any other purpose other than its intended use and application.

- B. Provide all required interconnections with other systems such as emergency power sources, fire alarm systems, and building management system as required or indicated on drawings.
- C. Installation shall meet or exceed standard practice of workmanship and quality.
- D. Drawings generally indicate work to be provided, but do not indicate all bends, transitions, or special fittings required to clear beams, girders or other work already in place. Investigate conditions where conduits are to be installed, and furnished and install required fittings.

3.2 INSTALLATION AND SET-UP

- A. Verify that conduit for line voltage wires enters panel in line voltage areas and conduit for low-voltage control wires enters panel on low-voltage areas. Refer to manufacturer's drawings for location of line and low-voltage areas.
- B. Digital switches and wire shall be according to lighting control manufactures requirements.
- C. Central lighting control panels and remote lighting control panels are connected via a dataline (LC&D use Cat5 4 twisted pair cable, with RJ45 end connectors). Connect entire lighting control system per manufacturer's requirements. Do not exceed manufacturer's total dataline length requirement.
- D. Panels shall be located so that they are readily accessible and not exposed to physical damage.
- E. Panel locations shall be furnished with sufficient working space around panels to comply with the California Electrical Code.
- F. Panels shall be securely fastened to the mounting surface by at least 4 points.
- G. Unused openings in the cabinet shall be effectively closed.
- H. Cabinets shall be grounded in accordance with Article 250 of the California Electrical Code, and manufacturer's recommendations.
- I. Lugs shall be suitable and listed for installation with the conductor being connected.
- J. Conductor lengths shall be maintained to a minimum within the wiring gutter space. Conductors shall be long enough to reach the terminal location in a manner that avoids strain on the connecting lugs.
- K. Maintain the required bending radius of conductors inside cabinets.
- L. Clean cabinets of foreign material such as cement, plaster and paint.
- M. Distribute and arrange conductors neatly in the wiring gutters.
- N. Follow the manufacturer's torque values to tighten lugs.
- O. Before energizing the panelboard, the following steps shall be taken:
 - 1. Retighten connections to the manufacturer's torque specifications. Verify that required connections have been furnished.
 - 2. Remove shipping blocks from component devices and the panel interior.
 - 3. Remove debris from panelboard interior.
- P. Follow manufacturers' instructions for installation.

3.3 OPERATING/SERVICE MANUALS

- A. Service and Operation Manuals:
 - 1. Submit operation and service manuals. Complete manuals shall be bound in flexible binders and data shall be typewritten or drafted.

2. Provide a printed copy of the systems configuration as programmed, including all system labeling codes, and passwords.
3. Provide an electronic copy on compact disk of the system configuration program.
4. Manuals shall include instructions necessary for proper operation and servicing of system and shall include complete wiring circuit diagrams of system, wiring destination schedules for circuits and replacement part numbers. Manuals shall include as-built cable Project site plot plans and floor plans indicating cables, both underground and in each building with conduit, and as-built coding used on cables. Programming forms of systems shall be submitted with complete information.
5. Record Drawings: Provide a copy on vellum of Project site and building drawings, indicating location of equipment, conduit and cable runs, and other pertinent information.

3.4 PROTECTION

- A. Protect the Work of this section until Substantial Completion.

3.5 TESTING

- A. Set-up, commissioning and testing of the lighting control system, and Owner instruction shall include:
 1. Confirmation of system programming.
 2. Confirmation of operation of individual relays, switches, occupancy sensors and daylight sensors.
 3. Operation of system's features under normal and emergency operations.
 4. Before energizing check and demonstrate in the presence of the IOR that cables and wire connections are free from short circuits, ground faults, and that there is continuity, and necessary insulation.
 5. Confirm system operations and functionality.
 6. Check system interface response to other systems such as fire alarm and emergency power system conditions.
 7. Provide training to cover installation, maintenance, troubleshooting, programming, and repair and operation of the lighting control system.

3.6 INSTRUCTION PERIODS

- A. Before Completion, arrange and provide instruction period for designated personnel.
 1. Provide two (2) hours instruction for building users on occupancy sensor programming and control panel operation.
 2. Provide four (4) hours instruction for maintenance staff (electricians) on occupancy sensor and control panel operation, wiring and programming.

3.7 SPARE PARTS

- A. Provide a minimum of 5% spare parts of each type of relay, sensors, switches, and peripheral devices.

3.8 CLEANUP

- A. Remove rubbish, debris, and waste materials and legally dispose of off the Project site.

END OF SECTION

SECTION 16521
EXTERIOR LIGHTING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Exterior luminaires with lamps and ballasts, but not mounted on exterior surfaces of buildings.
 - 2. Luminaire-mounted photoelectric switches.
- B. Related Sections include the following:
 - 1. Division 2 Light Poles and Standards.

1.2 SUBMITTALS

- A. Product Data: For each luminaire, arranged in the order of lighting unit designation. Include data on features, accessories, finishes, and the following:
 - 1. Physical description of fixture, including dimensions and verification of indicated parameters.
 - 2. Luminaire dimensions, effective projected area, details of attaching luminaires, accessories, and installation and construction details.
 - 3. Luminaire materials.
 - 4. Lamps.
 - 5. Electrical and energy-efficiency data for ballasts.
- B. Shop Drawings: Anchor-bolt templates keyed to specific poles and certified by manufacturer.
- C. Wiring Diagrams: Power, signal, and control wiring.
- D. Retain paragraph below if Drawings do not include detailed plans or if Project involves unusual coordination requirements.
- E. Coordination Drawings: Mounting and connection details, drawn to scale, for exterior luminaires.
- F. Retain paragraph and subparagraphs below if Samples of exterior luminaires are required for verification purposes. Edit if sample requirements are indicated in other than an exterior luminaire schedule. As an alternative, list of fixture types for sample submission can be added below.
- G. Samples for Verification: For exterior luminaires designated for sample submission in the Exterior Luminaire Schedule.
 - 1. Lamps: Specified units installed.
 - 2. Ballast: 120-V models of specified ballast types.
 - 3. Finishes: For each finished metal used in support components.

- H. Retain paragraph below if "Source Quality Control" Article is retained in Part 2.
- I. Source quality-control test reports.
- J. Field quality-control test reports.
- K. Operation and Maintenance Data: For luminaires to include in maintenance manuals.
- L. Warranties: Special warranties specified in this Section.

1.3 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. FMG Compliance: Fixtures for hazardous locations shall be listed and labeled for indicated class and division of hazard by FMG.
- C. Comply with IEEE C2, "National Electrical Safety Code."
- D. Comply with NFPA 70.

1.4 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace luminaires or components of luminaires and lamps that fail in materials or workmanship; corrode; or fade, stain, or chalk due to effects of weather or solar radiation within specified warranty period. Manufacturer may exclude lightning damage, hail damage, vandalism, abuse, or unauthorized repairs or alterations from special warranty coverage.
 - 1. Warranty Period for Luminaires: Five years.
 - a. Warranty Period for Metal Corrosion: Five years.
 - b. Warranty Period for Color Retention: Five years.
 - 2. Warranty Period for Lamps: Replace lamps and fuses that fail within 12 months from date of Substantial Completion; furnish replacement lamps and fuses that fail within the second 12 months from date of Substantial Completion.

1.5 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Lamps: 10 for every 100 of each type and rating installed. Furnish at least one of each type.
 - 2. Glass and Plastic Lenses, Covers, and Other Optical Parts: 10 for every 100 of each type and rating installed. Furnish at least one of each type.
 - 3. Ballasts: 10 for every 100 of each type and rating installed. Furnish at least one of each type.
 - 4. Globes and Guards: 2 for every 20 of each type and rating installed. Furnish at least one of each type.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Products: Subject to compliance with requirements, provide one of the products specified.

2.2 LUMINAIRES, GENERAL

- A. Complying with UL 1572, 1598 and listed for installation in wet locations.
- B. Comply with IESNA RP-8 for parameters of lateral light distribution patterns indicated for luminaires.
- C. Metal Parts: Free of burrs and sharp corners and edges.
- D. Sheet Metal Components: Corrosion-resistant aluminum, unless otherwise indicated. Form and support to prevent warping and sagging.
- E. Housings: Rigidly formed, weather- and light-tight enclosures that will not warp, sag, or deform in use. Provide filter/breather for enclosed luminaires.
- F. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position. Doors shall be removable for cleaning or replacing lenses. Designed to disconnect ballast when door opens.
- G. Exposed Hardware Material: Stainless steel.
- H. Plastic Parts: High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
- I. Reflecting surfaces shall have minimum reflectance as follows, unless otherwise indicated:
 - 1. White Surfaces: 85 percent.
 - 2. Specular Surfaces: 83 percent.
 - 3. Diffusing Specular Surfaces: 75 percent.
- J. Lenses and Refractors Gaskets: Use heat- and aging-resistant resilient gaskets to seal and cushion lenses and refractors in luminaire doors.

2.3 EXTERIOR LUMINAIRES

- A. Luminaire
 - 1. Products:
 - a. Provide fixture as shown on fixture schedule on Sheet E3.0.
 - 2. Nominal Luminaire Dimensions: As shown on plans.
 - 3. Lamps: As shown on plans.
 - 4. Ballast Types and Features: Electronic.
 - 5. Lens: As shown on plans.
 - 6. Reflector: As indicated on fixture schedule.
 - 7. Focusing and Aiming Provisions: As indicated on fixture schedule.

8. IESNA Lateral Distribution Class: III.
9. IESNA Cutoff Category: Cutoff.
10. Photometric Performance of Installed Units:
 - a. Spot Intensity: Minimum initial horizontal illumination at grade is 1 fc at a point.
 - b. Average Intensity: Minimum average initial horizontal illumination at grade in the illuminated area is 2 fc.
 - c. Uniformity: For a spacing between adjacent fixtures in parallel rows of 2 fc, fixture to fixture and row to row, the maximum-to-minimum initial horizontal point illumination between any pair of adjacent lighting units, including those in parallel rows, is not greater than 8:1.
 - d. Cutoff: Maximum initial horizontal illumination does not exceed 5 fc at a point.
11. Minimum ballast factor, calculated as the ratio of lamp lumen output on a particular ballast as compared to that lamp's lumen output on a reference ballast under NEMA test conditions, is 0.90.
12. Minimum luminaire efficacy rating, calculated according to NEMA LE 5, NEMA LE 5A, or NEMA LE 5B, is.

2.4 FACTORY FINISHES

- A. Field Painting Finish: Manufacturer's standard prime-coat finish ready for field painting.
- B. Finish: Coordinate finish with fixture schedule show on sheet E3.0.
- C. Factory-Painted Finish for Steel Luminaires: Comply with NAAMM's "Metal Finishes Manual for Campus's Representativeur and Metal Products" for recommendations for applying and designating finishes.
 1. Surface Preparation: Clean surfaces to comply with SSPC-SP 1, "Solvent Cleaning," to remove dirt, oil, grease, and other contaminants that could impair paint bond. Grind welds and polish surfaces to a smooth, even finish. Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning," or SSPC-SP 8, "Pickling."
 2. Interior Surfaces: Apply one coat of bituminous paint on interior of pole, or otherwise treat to prevent corrosion.
 3. Exterior Surfaces: Manufacturer's standard finish consisting of one or more coats of primer and two finish coats of high-gloss, high-build polyurethane enamel.
- D. Factory-Applied Finish for Aluminum Luminaires: Comply with NAAMM's "Metal Finishes Manual for Campus's Representativeur and Metal Products" for recommendations for applying and designating finishes.
 1. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
 2. Natural Satin Finish: Provide fine, directional, medium satin polish (AA-M32); buff complying with AA-M20; and seal aluminum surfaces with clear, hard-coat wax.
 3. Class I, Clear Anodic Finish: AA-M32C22A41 (Mechanical Finish: medium satin; Chemical Finish: etched, medium matte; Anodic Coating: Campus's Representativeur Class I, clear coating 0.018 mm or thicker) complying with AAMA 611.
 4. Class I, Color Anodic Finish: AA-M32C22A42/A44 (Mechanical Finish: medium satin; Chemical Finish: etched, medium matte; Anodic Coating: Campus's Representativeur Class I, integrally colored or electrolytically deposited color coating 0.018 mm or thicker) complying with AAMA 611.
 - a. Color: as specified on fixture schedule on sheet E1.0.

5. Gold Anodic Finish: AA-M32C22A43 (Mechanical Finish: medium satin; Chemical Finish: etched, medium matte; Anodic Coating: Campus's Representative Class I, impregnated color coating 0.018 mm or thicker) complying with AAMA 611.

2.5 SOURCE QUALITY CONTROL

- A. Provide services of a qualified, independent testing and inspecting agency to factory test luminaires with ballasts and lamps; certify results for isofootcandle curves, zonal lumen, average and minimum ratios, and electrical and energy-efficiency data for ballasts.
- B. Factory test fixtures with ballasts and lamps; certify results for isofootcandle curves, zonal lumen, average and minimum ratios, and electrical and energy-efficiency data for ballasts.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install lamps in each fixture.
- B. Luminaire Attachment: Fasten to indicated structural supports.
- C. Adjust luminaires that require field adjustment or aiming.

3.2 CONNECTIONS

- A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.3 FIELD QUALITY CONTROL

- A. Inspect each installed fixture for damage. Replace damaged fixtures and components.
- B. Tests and Observations: Verify normal operation of lighting units after installing luminaires and energizing circuits with normal power source. Measure light intensities at night. Use photometers with calibration referenced to NIST standards. Comply with the following IESNA testing guide(s):
 1. IESNA LM-5.
 2. IESNA LM-50.
 3. IESNA LM-52.
 4. IESNA LM-64.
 5. IESNA LM-72.
- C. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

END OF SECTION

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SECTION 16560

WIRELESS LIGHTING CONTROLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and other documentation provided with this Specification apply.

1.2 SUMMARY

- A. The intent of this specification is to define a complete, functional, distributed intelligence, networked lighting control system providing individual addressability of incandescent, low-voltage, fluorescent, LED, induction, and HID lighting sources using the DALI (Digitally Addressable Lighting Interface) protocol for indoor areas and the wireless ZigBee communication protocol for outdoor areas (and indoor where applicable).

1.3 DEFINITIONS

- A. DALI: Digitally Addressable Lighting Interface. An international standard for bi-directional communication between smart addressable lighting equipment such as fluorescent ballasts, motion sensors, and wall switches. Relies on a polarity-insensitive two-wire bus running between all devices. Wire may be run in conduit with power or free in plenum with appropriately rated wire. Each DALI bus is powered by either an Exergy Digital Control Cabinet or a standalone DALI power supply.
- B. Hybrid system: A system that is composed of both wired and wireless communications components, supporting both indoor and outdoor control of lighting using wires where appropriate and wireless where appropriate, all from the same control base station.
- C. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling and power-limited circuits. All devices considered low voltage must utilize DC power only.
- D. Mesh network: A robust and highly reliable method of communicating between wireless devices. Designed to withstand failures of individual nodes by routing around the issue. Used to communicate between:
 - *Digital Control Cabinets (where an Ethernet connection between cabinets is not possible)
 - *Remote devices controlling individual fixtures (both indoor and outdoor) or stand-alone wired DALI communications busses.

Each device in the network is able to "route" or "rebroadcast" wireless traffic such that a given device need only contain a transmitter powerful enough to reach its neighbor nodes.

- E. Monitoring: Acquisition, processing, communication, and display of equipment status data including current light level of each fixture, calculated electrical parameter values, event and alarm signals, tabulated reports, graphical visualizations, and event logs.
- F. PC: Personal computer; sometimes plural as "PCs."
- G. ZigBee: An international standard for bi-directional wireless mesh network communication. Works at the unlicensed 2.4GHz frequency and uses secure 128-bit encryption for all traffic. A total of 16 channels shall be available for use by each device, and frequency-agile radio technology shall ensure resilience in noisy wireless environments.

- H. 0-10V: An industry- standard interface for controlling dimmable lighting loads where the signal voltage from 0 to 10 volts is proportional to the light output of the lamp being controlled.

1.4 SUBMITTALS

Manufacturer submittal package shall include, but not be limited to, the following informational requirements. Submittals that do not contain all the information listed below will not be considered for approval. All information must be provided in both printed and electronic formats. Manufacturer must receive design team approval of complete system (components and operation) prior to beginning manufacture of equipment.

- A. Product Data Sheets: Data sheets must be provided for all devices required to provide full system functionality.
- B. Shop Drawings: Submittals shall include detailed drawings showing integration of all required components assembled to accomplish specific system design intent.
 - 1. Outline Drawings: Indicate dimensions, arrangement of components, and clearance and access requirements.
 - 2. Block Diagram: Show interconnections between components specified in this section and devices furnished with interrelated system. Indicate data communication paths and identify networks, data buses, and other devices to be used. Describe characteristics of network and required data communication lines.
 - 3. Wiring Diagrams: Provide drawings which clearly indicate power, signal, and control wiring.
- C. Coordination Drawings: Submit evidence that lighting controls are compatible with connected monitoring and control devices and systems specified in other Sections.
 - 1. Show interconnecting signal and control wiring and interfacing devices that support compatibility of inputs and outputs.
- D. Software and Firmware Operational Documentation:
 - 1. Manuals: Provide software operating and upgrade manuals.
 - 2. Program Software Backup: On magnetic media, USB drive, or compact disc, supply initial commissioning tables complete with data files.
 - 3. Device address list.
- E. Field quality-control test reports.
- F. Software licenses: Provide names and ownership certifications of all software required by and installed for operation and programming of digital and analog devices.
- G. Operation Data: Provide "Sequence of Operations" for established lighting scenes including all normal and emergency modes of operation.
- H. Warranty: Specify warranty for all hardware and software elements covered in this Section.

1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: All Components must be listed and labeled by a recognized testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Factory Assembly: All relays, controllers, enclosures, switch stations, photo sensors, occupancy sensors and miscellaneous components shall be factory assembled and tested. All system components shall arrive at the job site completely pre-wired and ready for installation, requiring only the connection of lighting circuits, control circuits, and network terminations. Systems that require field assembly shall not be acceptable.

- C. Component Testing: All system components and assemblies shall be individually tested prior to assembly. Once assembled, all finished products shall be tested for proper operation of all control functions per specifications prior to shipment.
- D. NEC Compliance: All system components shall comply with all applicable sections of the National Electrical Code (NEC) as required.
- E. UL Approval: All applicable equipment shall be tested to and listed under UL standard 508 and/or UL 916 and shall bare labels to indicate compliance.
- F. FCC Emissions: All applicable equipment shall comply with FCC emissions standards specified in Part 15, subpart B.
- G. Title 24: All applicable system components and the system as a whole shall be certified as complying with Title 24 requirements.

1.6 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of lighting controls that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Failure of software input/output to execute switching or dimming commands.
 - b. Failures of hardware to execute switching or dimming commands.
 - 2. Warranty Period: One year from date of Substantial Completion.

1.7 SOFTWARE SERVICE AGREEMENT

- A. Technical Support: Provide remote software support for one year (requires system internet access) from date of Substantial Completion
- B. Upgrade Service: Update software to latest version at Project completion. Install and program software upgrades that become available with one year from date of Substantial Completion. Upgrade shall include new or revised licenses for use of the software.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Exergy Controls, LLC

2.2 SYSTEM REQUIREMENTS

- A. Performance Requirements: Individually addressable devices are operated via digital signals transmitted and received through a two-wire DALI-based network and/or a wireless mesh network. Network control is achieved via wired Ethernet connection to the Internet (requiring no extra gateway or translator equipment aside from a CAT5 cable) and/or ZigBee transceiver – both communication technologies integrated into each Digital Control Cabinet. System shall support simultaneous wired and wireless bidirectional communication between Digital Control Cabinet and each wired/wireless device. The system shall therefore be capable of controlling both interior and exterior lighting fixtures in a cost-effective manner.

- B. Systems that do not provide both indoor and outdoor lighting control from a single control cabinet, shall not meet requirements.
- C. Summary of required system features. System shall:
- Be based on the international DALI standard, the ZigBee wireless mesh network standard, and the ubiquitous Ethernet communication standard.
 - All wireless components shall operate at the internationally-licensed 2.4GHz frequency. Wireless systems utilizing the 900 MHz frequency range are not acceptable.
 - Consist of one or more digital control cabinets that act as base stations for the DALI and wireless network
 - Provide a digital control cabinet to be mounted indoors with an Internet connection via a 10/100 Base-T Ethernet line that allows remote monitoring and control of the entire system without requiring a dedicated telephone line to the system.
 - Provide individually-addressable, bi-directional communication between each control device in the system. Controllers and ballasts shall respond appropriately to status queries.
 - Support grouping of ballasts into as many as 16 different groups per DALI bus.
 - Support up to 16 different preset scenes per DALI ballast.
 - Utilize industry-standard 256-bit AES encryption for Ethernet communication and 128-bit AES encryption for wireless communication
 - Come standard with PC-based control software allowing users to control and monitor the system at no additional cost. System operational history (energy used) shall be logged and be retrievable via software so performance can be measured.
 - Provide a robust scheduling system based on an astronomical time clock and/or photocell allowing individual fixture control
 - Come with a no-additional-cost 1-year support contract. Extended yearly support available at competitive rates

2.3 CONTROL BASE STATION

- A. The system is controlled via a network of Digital Control Cabinets. The control cabinet(s) provides the base station for the wireless network as well a wired Ethernet connection for communication with any Internet-enabled device. Any number of Digital Control Cabinets may be added to the system as needed.

Each control cabinet shall be capable of providing four wired DALI busses as well as providing a wireless base station for the network.

2.4 MATERIALS

Electrical contractor shall provide and install a complete Digital System (Control Cabinets, Switches, Sensors and all ancillary devices) of the types and quantities shown on the drawings and specified herein to complete a comprehensive and fully functioning system to meet the design intent.

- A. Digital Control Cabinet:

Base station for simultaneous wired and wireless digital communication between fixtures, devices, other system Digital Control Cabinets and the Internet

1. Hybrid system connectivity
 - a. Multiple DALI networks can be linked together using wireless ZigBee or Ethernet communication
 - b. Seamless communication between DALI networks

- c. Mesh networked wireless digital communications
 - d. Allows integration of multiple control cabinets into one unified system
 - e. Control cabinet can be used as an independent element or multiple control cabinets can be combined into a robust network with Ethernet or wireless connectivity between nodes.
 - f. Supported external communication protocols including Internet standards such as XML, SOAP, http, plus RS-232 and others.
2. Wired communication
- a. Each control cabinet supports up to 4 DALI digital control busses, with up to 64 fixtures (50 fixtures recommended to allow for future expansion) on each bus.
 - b. Up to 2 programmable-function dry-contact inputs per cabinet
 - c. 128-bit hardware-assisted AES encryption for all wireless traffic
 - d. Makes full use of a Local Area Network (LAN) connection to provide wired connectivity between control cabinets
 - e. Autosensing 10/100 Base-T LAN and Internet connectivity directly into cabinet

3. Comprehensive web server interface for configuration of network parameters

Two externally-visible ports forwarded to each XRG-1000 Digital Control Cabinet are required for Internet-based system monitoring, control, data logging, and remote troubleshooting features. Local port 80 and local port 2727 must be made externally accessible for each Digital Control Cabinet in the system.

Software-based control is considered an optional system feature and will not function without providing Internet access (by others) and open ports as required.

4. Automatic network discovery of peer cabinets on LAN
5. Wireless communication
- a. IEEE 802.15.4-based standard
 - b. Supports up to 250 wireless devices per wireless network. A virtually unlimited number of wireless networks can be combined into a unified system using Ethernet connections.
 - c. Spread spectrum frequency agile wireless communication
 - d. Secure bi-directional wireless mesh network
 - e. Cellular-technology based communication systems are not acceptable.
6. Maintenance, monitoring, control, and remote access
- a. System shall not rely on the continuous use and proper operation of an on-site PC (personal computer) server, blade or rack-mounted server, or other "PC-like" solutions for basic system operation. All on-site lighting control hardware including the base station shall be built using rugged embedded computer equipment. If IT issues require it, a noncritical PC may be provided to facilitate cross-subnet Intranet communication.
 - b. Allows remote troubleshooting by authorized manufacturer personnel to review system operation and aid in commissioning activities
 - c. Real-Time System Status: True two-way communication between cabinet, ballasts and all devices allows current status of all components and knowledge of any device failures.
 - d. Generation of work-orders and/or emails to the same effect can be generated by the system as problems are detected.
7. Certifications
- a. All control components meet or exceed Title 24 efficiency standards and are listed with the California Energy Commission, where appropriate
8. Construction:
- a. Each lighting control panel shall be manufactured of continuously welded steel
 - 1) 16 GA for housing and covers

- 2) 18 GA or thicker for all internal (non-structural) covers/elements.
 - b. Finish: Control Cabinets shall be primed and painted with a powder coat finish. Unpainted or galvanized enclosures are not acceptable.
 - c. Computer circuitry fully enclosed in tamper- resistant compartment with 16 GA steel cover
 - d. Power Supply: Listed Dual 120/277 VAC, 60Hz, 40VA MAX Class II transformer
 - e. Connections: All connections shall be made to clearly and permanently labeled termination points.
9. Computer Hardware: Digital circuit design will incorporate a motherboard capable of:
- a. Providing back-up storage of ballast and device settings for all elements supported by its control circuits
 - b. Coordinating communication between all internal and external digital circuits comprising the complete system
 - c. Incorporating removable circuit cards providing
 - 1) 1 to 4 digital communication busses, providing expansion as needed
 - 2) Wireless communication via 2.4GHz ZigBee protocol
 - 3) Additional slot for future expansion or technological improvements
- B. Lighting Control Software:
Powerful post-installation data logging and system support
1. Individual user control via simple-to-use Windows taskbar icon
 2. Comprehensive system control and monitoring for building managers
 3. Ability to change settings and light levels on the fly
 4. Track ballast and lamp life down to the minute to take advantage of warranties
 5. Track history of power usage with detail down to a single fixture
 6. Integrated Demand Response over the internet
 7. Flexibility to set schedules base on what a user wants
 8. Create maintenance reports automatically and email someone daily/weekly/monthly...
- Two externally-visible ports forwarded to each XRG-1000 Digital Control Cabinet are required for Internet-based system monitoring, control, data logging, and remote troubleshooting features. Local port 80 and local port 2727 must be made externally accessible for each Digital Control Cabinet in the system.
- Software-based control is considered an optional system feature and will not function without providing Internet access (by others) and open ports as required.
- Indoor only controls to be provided where applicable:
- C. Occupancy sensor
1. Sensing options available in the system: passive infrared (PIR), ultrasonic (US), PIR + US dual-technology, acoustic, acoustic + PIR dual-technology.
 2. 450, 1000, and 2000 square foot coverage options, with 180° or 360° patterns
 3. Powered by direct connection to DALI bus
 - a. No power pack required
 4. 4.5" Diameter, 1.5" high for ceiling mount sensors; standard decora-style form factor for wall sensors.
 5. Ceiling or wall mountable
 6. Supports sensitivity and time delay adjustment
- D. Photo sensor
1. Robust light level input options from 1FC to 10000 FC
 2. Direct connection to the DALI bus. No additional wiring required.
 3. Can control up to 64 fixtures per photocell

4. Interchangeable lens covers to support any environmental conditions
5. Low-profile design, approx. 1" diameter, 2" tall with lens

E. 5-button Wall switch

1. The 5-button switch is made up of two primary parts:
 - a. Cover plate and backbox containing the control circuitry
 - b. Two wires for connection to a DALI bus
2. Simple to label and relabel with protective plastic cover
3. Screwless cover
4. Designed for installation into a single-gang box
5. Dimensions: 2.75" x 4.5" x .94" (69.8mm x 114.3mm x 23.9mm)
6. Can call up to 16 different lighting scenes
7. Button function can be locked-out based on time schedule

F. 5-button Wall switch with raise/lower paddle

1. Fits conventional decorator switch openings
2. Simple two-wire connection to a DALI loop.
3. No extra wiring required
4. Dimensions: 2.65" x 1.75" x 1.98" (67.1mm x 44.5 mm x 50.3mm) = L x W x D;
 - a. Depth in wall = 1.65" (41.9mm)
5. Designed for installation into a single-gang box with any Decora-style faceplate.
6. Comes with dim up/dim down functionality and ability to call up to 16 scenes
7. Elegant look and reliable operation for areas that demand fine-grained adjustment

G. Wireless controls

1. All wireless controllers come standard with the following features:
 - Communicates via a secure bidirectional wireless link to all other wireless devices at the site, allowing individual control of each fixture, providing seamless 24/7 access to the fixture with the reliability of a wired system
 - 128-bit hardware-assisted AES encryption for all wireless traffic
 - ZigBee IEEE 802.15.4-based open standard at 2.4 GHz
 - Spread-spectrum frequency agile wireless communication for interference-free operation
 - Supports up to 250 wireless devices per wireless network. A virtually unlimited number of wireless networks can be combined into a unified system using Ethernet connections.
 - System shall support an in-pole mounted wireless controller wherein the controller is completely hidden within the pole except for an externally-mounted antenna.
 - System shall support an in-fixture mounted wireless controller wherein the controller is completely hidden within the fixture except for an externally-mounted antenna.
 - For pole-mounted devices, a trouble-free mounting system designed to slide within standard 4" to 6" (inner diameter) poles is provided. The controller is housed within a damp-location rated extruded aluminum housing. Integral wires make system installation a snap.
 - Low profile antenna options mean the system is almost invisible to the naked eye. No externally-visible pole-mounted or fixture-mounted equipment is acceptable with the exception of antennas. Antenna length shall be limited to 3 inches or shorter.
 - All wireless controllers shall support up to two integral 0-10V control signal power supplies that do not require an additional or otherwise secondary dimming control module. Systems that require an "add-on" for 0-10V control are not acceptable.
 - Photocell control for a given area shall be achieved via a single remotely-mounted photocell that relays brightness information via Ethernet to a Digital Control Cabinet. Systems that require pole-mounted or fixture-mounted photocells are not acceptable.

- All wireless control devices are able to measure the instantaneous current consumption of their loads.
 - Open-air wireless range with an optional high-power transmitter at each shall be up to one mile.
2. Available wireless control options include the following:
- Wirelessly-controlled 0-10V with line voltage switching
 - Designed to be easily mounted in the pole of a parking lot light fixture, providing easy access to existing circuits for retrofit situations.
 - Able to line-voltage switch up to four circuits independent of one another from a single wireless controller, allowing precise control over each head of a multi-head pole
 - Provides up to two industry standard 0-10VDC outputs to dim any type of fluorescent, HID, LED, and HPS source accepting a 0-10V input. A flexible wiring scheme allows each of the two 0-10V outputs to control one or more fixtures as needed. Simple bi-level or continuous dimming is available from the same wireless device.
 - Provides robust, zero-crossover line voltage switching using all solid-state components for improved switching life. No bulky contactors with life-limited moving parts are used.
 - Wirelessly-controlled Standalone DALI power supply board
 - Provides power to a single DALI digital communications bus with a robust wireless communication front-end.
 - Allows the installation of a DALI control bus in remote locations where home-runs back to an Exergy Digital Control Cabinet would be impractical.
 - Supports a complete array of DALI functionality including up to 64 fixtures, 250mA of device load, and bidirectional communication with the larger lighting control network.

PART 3 - EXECUTION

3.1 WIRING INSTALLATION

- A. Comply with NECA 1.

3.2 MANUFACTURER'S SERVICES

- A. Installation Assistance: During the installation process, the manufacturer shall provide, at no cost, technical support via a toll-free telephone line to the installing contractor or Owner's representative to answer questions and supply additional information when required.
- B. System Start-Up: The system manufacturer shall provide a factory authorized field engineer to the project site after installation has been completed and prior to system energization for the purpose of testing and adjustment of the system. Factory field engineer shall test and verify all system functions and ensure proper operation of the system components in accordance with the specifications and on-site conditions. The installing contractor shall notify the system manufacturer in writing that the system is completely wired and ready to be energized and tested 2 weeks prior to scheduling a field engineer for start-up of the system. Should the field engineer arrive on the job site and find the installation incomplete, the installing contractor shall pay the cost of any future visits by the field engineer required to complete the system start-up.
- C. On-Site Programming: During the start-up procedure, the factory field engineer shall provide programming assistance and guidance to the building operating personnel in order to program the systems for initial operation.

- D. Instruction: During the start-up procedure, the factory field engineer shall provide training to the building operating personnel in the operation, programming and maintenance of the lighting control system.

3.3 SOFTWARE INSTALLATION

- A. Install and program software with initial settings of adjustable values. Make backup copies of software and user-supplied values.

3.4 REMOTE ASSISTANCE

- A. Remote Support: The system manufacturer shall provide remote programming assistance (via Internet Access provided by others) for changes to system settings or reconfiguration of spaces for a period of one year from date of substantial completion. This support is intended to assist the owner with minor changes to the facilities operation and does not cover a complete redesign or recommissioning of system operation and/or function.

Two externally-visible ports forwarded to each XRG-1000 Digital Control Cabinet are required for Internet-based system monitoring, control, data logging, and remote troubleshooting features. Local port 80 and local port 2727 must be made externally accessible for each Digital Control Cabinet in the system.

Software-based control is considered an optional system feature and will not function without providing Internet access (by others) and open ports as required.

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SECTION 16560

LIGHTING CONTROL

PART 1 - GENERAL

1.1 INTRODUCTION

- A. The work covered in this section is subject to all of the requirements in the General Conditions of the Specifications.
- B. Contractor shall coordinate all of the work in this section with all of the trades covered in other sections of the specification to provide a complete and operable system.

1.2 SYSTEM DESCRIPTION

- A. Install a lighting control system consisting of microprocessor based control panel(s), relay panels, control switches, photocell, and other controlling devices connected by low voltage wiring. The general operation of lighting and controlled loads shall include:
 - 1. Exterior lighting: photocell or astronomic on/time off, time on/photocell or astronomic off
 - 2. Exterior security lighting: photocell or astronomic on, photocell or astronomic off
 - 3. Lighting control system shall interface with the campus energy management system for control and monitoring.
- B. Requirements are indicated elsewhere in the specifications for work including, but not limited to, raceways and electrical boxes and fitting required for installation of control equipment and wiring.

1.3 QUALITY ASSURANCE

- A. Manufacturers: Firms regularly engaged in the manufacture of lighting control equipment and ancillary equipment, of types and capacities required, whose products have been in satisfactory use in similar service for not less than five (5) years. Manufacturer shall be ISO 9001 certified.
- B. Component Pre-testing: All components and assemblies are to be factory pre-tested prior to installation.
- C. System Support: Factory applications engineers shall be available for telephone support.
- D. NEC Compliance: Comply with NEC as applicable to electrical wiring work.
- E. NEMA Compliance: Comply with applicable portions of NEMA standards pertaining to types of electrical equipment and enclosures.
- F. UL Approvals: Remote panels are to be UL listed under UL 916 Energy Management Equipment.
- G. FCC Emissions: All assemblies are to be in compliance with FCC emissions Standards specified in Part 15 Subpart J for Class A application.
- H. All lighting control components and devices shall be certified by the California Energy Commission.

1.4 SUBMITTALS

- A. Lighting circuits and low voltage controls are shown diagrammatic on drawings. Submit dimensioned drawings of complete lighting control system and accessories including but not limited to relay panels, switches, photo cells, and other interfaces. Drawings shall include exact location of all devices, interconnecting wiring, sequence of operation and switch/button engraving.
- B. Submit dimensional drawings of all lighting control system components and accessories.
- C. Typical Wiring Diagrams: Submit typical wiring diagrams for all components including, but not limited to, control panels, photocells, switches, occupancy sensors and daylighting controls.

PART 2 - MATERIALS AND COMPONENTS

2.1 BASIC CONTROL CONTACTOR PANEL

- A. Basic Control contactor panel shall be UL listed and consist of the following:
 - 1. Tub: Empty NEMA 1 enclosure that can accept an interior sized to accept up to 8, 16, or 32 contactor poles.
 - 2. Cover: Surface or Flush as required, with captive screws in a hinged, lockable configuration.
 - 3. Interior: Metal back plate and barrier for separation of high voltage (class 1) and low voltage (class 2) wiring. Intelligence board with eight channels of control provided regardless of interior size. Interiors shall be provided with up to 8, 16, or 32 DIN rail mounted contactor poles.
- B. Contactors shall be DIN rail mounted, four pole, normally closed, electrically held with coil voltage to match panel control power voltage. Contactors shall be compatible with all lighting, ballast and HID loads and be rated for 20 Amp tungsten up to 277V and rated for 30 Amp ballast and general use up to 600V. Contactors shall fail in the closed position. Provide 20% spare contactor poles.
- C. Eight automatic control channels for operating contactors controlling exterior and/or interior lighting. Each channel shall be individually configurable to meet project needs. Each channel shall include an LED light status indicator to provide channel status and a separate ON/OFF/Auto switch for manual channel control.
- D. Clock port for connection to an optional system clock. When a system clock is installed, eight override inputs are activated providing logic control of the eight channels from external photocells, switches, occupancy sensors, timers, daylighting controllers, etc.
- E. Expansion terminals shall be provided for low voltage wiring connection between main and expansion panels in a multiple panel system. All automatic channel operation in the designated main panel (panel with the system clock), shall signal expansion panels' corresponding channels to operate.
- F. Auxiliary power for operating optional system devices provides 350mA at 24VDC and 350mA at 24VAC power.

2.2 SYSTEM CLOCK

- A. The system time clock shall be installed in the main or central panel of a multiple panel system or in each panel when individual panel time control is desired. The system clock shall provide time-based control with eight year time back-up, non-volatile memory program storage, automatic daylight savings adjustment, selectable 12/24 hour time formats and selectable date formats. All clock programming shall be accessible from the clock front display/keypad.

- B. Control of eight control channels shall be available on the clock. Provide status and manual ON/OFF control of each channel from the front display and keypad.
- C. The clock shall have control of eight individual override inputs, which can be used to connect external devices such as photocells, switches and daylighting controllers. Each of these inputs can be configured to operate as a photocell, as an ON/Auto switch, as a maintained ON/OFF switch, or as a momentary ON/OFF switch.
- D. Schedules shall be assigned to any combination of days of the week and/or 3 holiday day types. Other scheduling features shall include:
 - 1. Temporary schedules: schedules that execute on an assigned day then automatically delete themselves from memory.
 - 2. Repeating schedules: repeat a schedule at intervals that are adjustable from 5 minutes to 10 hours.
- E. 32 perpetual holidays assigned to any one of three holiday day schedules and continuing for 1 to 120 days. Holiday dates shall be specific day/month/year, or perpetual dates including day/month/all years or day of the week in a given month every year or self-calculating Easter Sunday.
- F. Astronomic capability for calculating sunrise and sunset based on time, latitude, longitude, and time zones. All scheduled astronomic/time operations shall be interlocked so loads are not turned on when astronomic off times are earlier than scheduled on times or astronomic on times are later than scheduled off times. Each schedule shall have an independent astronomic offset of + 120 minutes.
- G. Following a power outage, the system clock shall run a start-up process that executes schedules that would have been missed during the power outage.

2.3 EXTERIOR PHOTOCELL

- A. The exterior photocell shall offer a footcandle range of 1-15 and an eight-second time delay. The photocell shall mount on the exterior or roof of a building with its light level window facing the northern sky. The photocell shall provide an ON signal when the ambient light level drops below a user-defined dark setpoint, and an OFF signal when the ambient light level rises above a user-defined light setpoint.
- B. The photocell shall use a set of normally open, isolated relay contacts that are rated for one Amp at 30 VAC/VDC.
- C. The photocell shall have an adjustable ON/OFF dark setpoint.

2.4 APPROVED MANUFACTURERS

- A. Lighting Control System:
 - 1. LC&D
 - 2. WattStopper
 - 3. Sensor Switch
 - 4. Approved Equal

PART 3 - EXECUTION AND SUPPORT SERVICES

3.1 INSTALLATION

- A. Automatic control switches and/or photocells shall be mounted as indicated on the plans. All wiring shall be labeled clearly indicating which contactor panel it connects to. Use only properly color-coded, stranded wire per manufacturer's recommendations. All channels and switches shall be tested after installation to confirm proper operation, and all connected loads shall be recorded on the contactor schedule for each panel.
- B. The contactor panels shall be mounted in electrical closets as indicated on the drawings. The contactors shall be wired to control the power of each load as indicated on the Lighting Control Panel Schedules included in the drawings. All power wiring will be identified with the circuit breaker number controlling the load. If multiple circuit breaker panels are feeding into a control panel, wires shall clearly indicate the originating panel's designation.

3.2 CONTRACTOR PROVIDED INFORMATION

- A. Contractor shall provide system documentation after the equipment has been installed:
 - 1. Lighting control panel schedule
 - 2. Lighting channel schedule
 - 3. System Clock schedule
 - 4. System Installation and Operation Manual

3.3 SYSTEM STARTUP

- A. Manufacturer shall provide a factory authorized technician to confirm proper installation and operation of all system components.

3.4 TRAINING

- A. Manufacturer shall provide factory authorized application engineer on site for a four hour duration to train owner personnel in the operation and programming of the lighting control system. Session shall be video taped.

3.5 DOCUMENTATION

- A. Manufacturer shall provide system documentation including:
 - 1. System 1-line diagram showing all panels, number and types of switches and sensors
 - 2. Lighting Control Panel Schedules
 - 3. Lighting Channel Schedule
 - 4. Typical wiring diagrams for each component

3.6 WARRANTY

- 1. Manufacturer shall provide a one year warranty for all system components.

END OF SECTION

SECTION 16700
FIRE ALARM SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Section 16010 - Electrical General Requirements

1.2 SECTION INCLUDES

- A. This section specifies building main fire alarm panel, auxiliary power supply panels, manual fire alarm stations, automatic smoke and heat detectors, fire alarm signaling appliances, auxiliary fire alarm equipment, remote annunciator and HVAC Equipment interlock.

1.3 QUALITY ASSURANCE

- A. References: This section contains references to the following documents. They are a part of this section as specified and modified. In case of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

NEC	National Electrical Code.
NFPA 70	National Fire Code.
NFPA 72	Installation Maintenance, and Use of Protective Signaling Systems, Currently Effective Edition.
NFPA 90A	Installation of air conditioning and ventilating systems
U.L.	Underwriters Laboratories.
CSFM	California State Fire Marshal.

1.4 SYSTEM DESCRIPTION

- A. Fire Alarm System: NFPA 72, manual and partial automatic local fire alarm system monitored by a UL listed Central Station.

1.5 SUBMITTALS

- A. Submit under provisions of Section 01340.
- B. Shop Drawings: Provide a complete system design submittal equivalent to the full system design indicated on the drawings. Provide all battery calculations, voltage drop calculations, device/system wiring diagrams, mounting details, floor plans with every device shown, riser diagrams, parts lists, annunciator layout, sequence of operation, etc.
- C. Product Data: Provide electrical characteristics and connection requirements. Submit data including all CSFM listing numbers for each device.
- D. Test Reports: indicate satisfactory completion of required tests and inspections.
- E. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by Product test agency. Include instructions for storage, handling, protection, examination, installation, and starting of products.

1.6 PROJECT RECORD DOCUMENTS

**CITRUS COLLEGE
CENTRAL PLANT PROJECT**

- A. Submit under provisions of Section 01700.
- B. Provide a complete set of reproducible "as-built" drawings in the latest version of AutoCAD showing installed wiring, color coding, wire tag notations, exact locations, and program address of all equipment, specific interconnections between all equipment, and internal wiring of the equipment shall be delivered to the owner upon completion of system.

1.7 OPERATION AND MAINTENANCE DATA

- A. Submit under provisions of Section 01730
- B. Provide operating and instruction manuals shall be submitted prior to testing of the system. Six (6) complete sets of operating and instruction manuals shall be delivered to the owner upon completion. User operating instructions shall be provided prominently displayed on a separate sheet located next to the control unit in accordance with U.L. Standard 864.
- C. Provide maintenance, programming and repair procedures. Provide Three (3) copies of maintenance, troubleshooting, and programming manuals.
- D. Provide one (1) legal copy of any specialized software needed to program and/or troubleshoot the finished system at the time of initial submittals per paragraph 1.04.

1.8 QUALIFICATIONS

- A. Installer must be a certified fire alarm installer in the State of California.

1.9 REGULATORY REQUIREMENTS

- A. Conform to requirements of NFPA 70 and NFPA 101
- B. Provide written certification by the fire alarm equipment manufacturer and submit to the Architect, stating that the system and its component parts are listed and approved by the California State Fire Marshal and that the installation has been tested, is operational and conforms to the requirements as set forth in Part 3, Article 24, Title 19, California Administrative Code.

1.10 MAINTENANCE SERVICE

- A. Furnish programming, service, and maintenance of fire alarm system for one year from date of Substantial Completion.

PART 2 – SYSTEM OPERATION

2.1 ALARM CONDITION

- A. When a device indicates an alarm or supervisory condition the control panel must respond within 3 seconds. The General Alarm or Supervisory Alarm LED on the annunciator(s) shall light and the LCD shall prompt the user as to the number of current events. All notification circuits associated with the alarm or supervisory condition shall activate. If the digital dialer is being utilized it shall transmit a signal to the digital alarm receiving unit. The alarm shall also cause the appropriate door holders and mechanical equipment to shut down. The alarm information must be stored in event memory for later review. Event memory shall be available at the main and all remote annunciators. The alarm memory must be capable of storing up to 1000 events.
- B. When the alarmed device is restored to normal, the control panel shall be required to be

manually reset to clear the alarm condition, except that the audible alarms may be silenced as programmed.

- C. All audible alarms shall be silenced by a code or Firefighter key at the main or remote annunciators. When silenced, this shall not prevent the resounding of subsequent events if another event should occur (subsequent alarm feature). When alarms are silenced the visual devices shall continue to operate and the "silenced" LED on the control panel, and on any remote annunciators, shall remain lit until the alarmed device is returned to normal.

2.2 TROUBLE CONDITION

- A. When a device indicates a trouble condition, the control panel System Trouble LED should light and the LCD should prompt the user as to the number of current events. The trouble information must be stored in event memory for later review. Event memory must be available at the main and all remote annunciators.
- B. When the device in trouble is restored to normal, the control panel shall be automatically reset; the trouble restore information must be stored in event memory for later review. Event memory must be available at the main and all remote annunciators. A trouble shall be silenced by a code or Firefighter key at the main or remote annunciators. When silenced, this shall not prevent the resounding of subsequent events if another event should occur.

2.3 SUPERVISION METHODS

- A. Each addressable communication loop shall be electrically supervised for opens and ground faults in the circuit wiring, and shall be so arranged that a fault condition on any loop will not cause an alarm to sound. Additionally, every device connected to the addressable communication loop will be supervised and individually identified if in a fault condition. The occurrence of any fault will light a trouble LED and sound the system trouble sounder, but will not interfere with the proper operation of any circuit which does not have a fault condition.

PART 3 – PRODUCTS

3.1 MANUFACTURERS

- A. The drawings indicate a fire alarm system manufactured by Edwards. This was done to establish device types, quantities, and locations and to define system operation for submission to DSA for plan review. Furnish and install a NON-PROPRIETARY Fire Alarm system. Non-Proprietary meaning that all components in the system are available from more than one source and the District, if it so chooses can directly order and install any device including panels into the system. EST3 part numbers and terminology were used in this specification as the basis of design.
- B. Substitutions: Submission of products purported to be equal to those specified herein will be considered as possible substitutes only when all of the following requirements have been met:
 - 1. Any deviation from the equipment, operations, methods, design or other criteria specified herein must be submitted in detail to the specifying Project Engineer and District per the requirements of Section 01600. Each deviation from the operation detailed in these specifications must be documented in detail, including page number and section number, which lists the system function for which the substitution is being proposed.
 - 2. A complete list of such substituted products with three (3) copies of working drawings thereof shall be submitted to the Project Engineer and District.
 - 3. The contractor shall functionally demonstrate that the proposed substitute products are in fact equal in quality and performance to those specified herein.

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CENTRAL PLANT PROJECT**

4. Substitution of products will be reviewed as indicated in the paragraphs above. However, any substitution that changes the system design including device and equipment types, locations, and quantities or system sequence of operation will not be allowed.

3.2 BUILDING FIRE ALARM AND SMOKE DETECTION CONTROL PANEL

- A. The fire alarm control panel (FACP) shall be the EST3 analog addressable control panel. The FACP must have a power supply and be capable of expansion to via bus connected expander modules that supervise low battery, loss of AC and loss of communication.
 1. The fire alarm control panel or panels and all system devices (horn-strobes, strobes, pull stations, smoke and heat detectors, etc. shall be Edwards Systems Technology (EST) type EST3 series (or equal). All under one label "UL/ULC listed and approved" for the use of fire alarm systems in this area of the United States of America.
 2. The operating controls shall be located behind locked door with viewing window. All control modules shall be labeled, and all zone locations shall be identified.
 3. The main controller 3-CPU shall be supervised, site programmable, and of modular design supporting up to 64 network nodes. The peer-to-peer network shall contain multiple nodes consisting of the command center, main controller, remote control panels, LCD/LED annunciation nodes, and workstations. Each node is an equal, active functional node of the network, which is capable of making all local decisions and generating network tasks to other nodes in the event of node failure or communications failure between a nodes. When utilizing a network and multiple wiring faults occur, the network shall re-configure into many sub-networks and continue to respond to alarm events from every panel that can transmit and receive network messages.
 4. The Main Controller Module shall control and monitor all local or remote peripherals. It shall support a large 168 character LCD, power supply, remote LCD and zone display annunciators, printers, and support communication interface standard protocol (CSI) devices such as color computer annunciators and color graphic displays.
 5. Each controller shall contain a RS232 printer/programming port for programming locally via an IBM PC. When operational, each controller shall support a printer through the RS232 port and be capable of message routing.
 6. The programmer shall be able to download all network and firmware applications from the configuration computer to all the network panels from a single location on the system.
 7. The panels shall have the ability to add an operator interface control/display at each node that shall annunciate, command and control system functions.
 8. The system shall store all basic system functionality and job specific data in non-volatile memory. All site specific and operating data shall survive a complete power failure intact. Passwords shall protect any changes to system operations.
 9. The control panel shall contain a standby power supply that automatically supplies electrical energy to the system upon primary power supply failure. The system shall include a charging circuit to automatically maintain the electrical charge of the battery.

3.3 SYSTEM WIRING

- A. The SLC and Data Communication Bus shall be wired with standard NEC 760 compliant wiring, no twisted, shielded or mid capacitance wiring is required for standard installations. All FACP screw terminals shall be capable of accepting 12-18 AWG wire.
- B. Fire Alarm Power Branch Circuits: Building wire as specified.
- C. Indicating Appliance Circuits: #12 AWG THHN building wire as specified.

3.4 SIGNALING LINE CIRCUITS (SLC)

- A. Each SLC shall be capable of a wiring distance of 10,000 feet from the SLC driver module and

be capable of supporting 125 devices. Any SLC loop device, which goes into alarm, must interrupt the polling cycle for priority response from the FACP. The FACP must respond consistently to a device that goes into alarm on an SLC in under 3 seconds. The auxiliary SLC loop module must be capable of being located up to 6000 feet from the FACP on an RS-485 bus, which is separate from the SLC bus. The SLC shall be capable of functioning in a class A or class B configuration.

3.5 SLC LOOP DEVICES

- A. Devices supported must include analog photoelectric, ionization smoke detectors, analog heat detectors, contact monitoring modules and relay output modules. There is to be no limit to the number of any particular device type, up to the maximum of 125 that can be connected to the SLC.

3.6 ADDRESSABLE DETECTOR FUNCTIONS

- A. The products of combustion detectors must communicate to the control panel for the following functions:
 1. Automatic compliance with NFPA 72 standards for detector sensitivity testing.
 2. Drift compensation to assure detector is operating correctly.
 3. Maintenance alert when a detector nears the trouble condition.
 4. Trouble alert when a detector is out of tolerance.
 5. Alert control panel of analog values that indicate fire.

3.7 SERIAL/PARALLEL INTERFACE

- A. The fire system shall be capable of supporting up to two serial / parallel interfaces that are capable of driving standard computer style printers. The interface shall be programmable as to what information is sent to it and shall include the ability to print out Detector Status, Event History and System Programming.

3.8 DIGITAL COMMUNICATOR

- A. The digital communicator must be an integral part of the control panel and be capable of reporting all zones or points of alarm, supervisory, and trouble as well as all system status information such as loss of AC, low battery, ground fault, loss of supervision to any remote devices with individual and distinct messages to a central station or remote station. The communicator must also be capable of up/downloading of all system programming options, Event history and Sensitivity compliance information to a PC on site or at a remote location. The communicator shall have an answering machine bypass feature that will allow the panel to respond to communication even on phone lines that have other communication equipment present. The communicator must be capable of reporting via SIA and Contact ID formats. The communicator shall have a delayed AC loss report function which will provide a programmable report delay plus a 10-25 min random component to help ease traffic to the central station during a power outage.

3.9 DRY CONTACTS

- A. The FACP shall have three form "C" dry contacts, one will be dedicated to trouble conditions, the other two will be programmable for alarm, trouble, supervisory, notification, pre-alarm, waterflow, manual pull, aux. 1 or aux. 2 conditions. The trouble contact shall be normal in an electrically energized state so that any total power loss (AC and Backup) will cause a trouble condition. In the event that the Microprocessor on the FACP fails the trouble contacts shall also indicate a trouble condition.

3.10 GROUND FAULT DETECTION

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CENTRAL PLANT PROJECT**

- A. The FACP shall have a ground fault detection circuit to detect positive and negative grounds on all field wiring. The ground fault detector shall operate the general trouble devices as specified but shall not cause an alarm to be sounded. Ground fault will not interfere with the normal operation, such as alarm, or other trouble conditions.

3.11 OVER CURRENT PROTECTION

- A. All low voltage circuits will be protected by microprocessor controlled power limiting or have self restoring poly-switches for the following: smoke detector power, main power supply, indicating appliance circuits, battery standby power and auxiliary output.

3.12 TEST FUNCTIONS

- A. A "Lamp Test" mode shall be a standard feature of the fire alarm control panel and shall test all LED's and the LCD display on the main panel and remote annunciators.
- B. A "Walk Test" mode shall be a standard feature of the fire alarm control panel. The walk test feature shall function so that each alarm input tested will operate the associated notification appliance for two seconds. The FACP will then automatically perform a reset and confirm normal device operation. The event memory shall contain the information on the point tested, the zone tripped, the zone restore and the individual points return too normal.
- C. A "Fire Drill" mode shall allow the manual testing of the fire alarm system notification circuits. The "Fire Drill" shall be capable of being controlled at the main annunciator, remote annunciators and via a remote contact input.
- D. A "Bypass Mode" shall allow for any zone, point, group, or notification appliance circuit to be bypassed without effecting the operation of the total fire system.

3.13 REMOTE INPUT CAPABILITIES

- A. The control panel shall have provisions for supervised switch inputs for the purpose of Alarm reset and Alarm and trouble restore.

3.14 ON BOARD PROGRAMMER

- A. The FACP shall have an on board programmer which will allow for all system functions and options to be programmed. Any panel that does not have this capability will not be accepted.

3.15 DOWNLOADING SOFTWARE

- A. The fire alarm control panel must support up/downloading of system programming from a PC operating under Windows 95 or higher. The FACP must also be able to upload the detector sensitivity test results and a 1000 event system event buffer to the PC. Communication shall take place over a direct connection to the PC and/or via the same telephone lines as the built in digital communicator and shall not require an external modem to be connected to the panel.
 - The downloading software shall contain a code that will block unauthorized persons from accessing the panel via direct connection or over the phone lines.

3.16 FACILITY MANAGEMENT SOFTWARE

- A. The FACP must support facility management software that is capable of providing off site access to FACP data necessary to manage fire system operation. A software package capable of uploading the detector sensitivity test results and the 1000 event system event buffer to the PC shall be required as part of the submittal package. Communication shall take place over a direct connection to the PC and/or via the same telephone lines as the built in digital communicator. The facility management package must be separate from the downloader

package and must not be capable of affecting programmed system options.

3.17 ENGLISH LANGUAGE DESCRIPTIONS

- A. The FACP shall provide the ability to have a text description of each system device input zone and output group on the system. The use of individual lights to provide descriptions will not be acceptable.

3.18 SYSTEM CABINET

- A. The system cabinet shall be red and surface mounted. The cabinet door shall be easily removable to facilitate installation and service.

3.19 AUDIBLE SYSTEM TROUBLE SOUNDER

- A. An audible system trouble sounder shall be an integral part of the control unit. Provisions shall also be provided for an optional supervised remote trouble signal.

3.20 POWER SUPPLY AND CHARGER:

- A. The entire system shall operate on 24 VDC, filtered switch mode power supply. The FACP must have a battery charging circuit capable of complying with the following requirements:
 - 1. Sixty (60) hours of battery standby with five (5) minutes of alarm signaling at the end of this sixty (60) hour period (as required per NFPA 72 remote station signaling requirements) using rechargeable batteries with automatic charger to maintain standby gel-cell batteries in a fully charged condition.
- B. The power supply shall comply with UL Standard 864 for power limiting.
- C. The FACP will indicate a trouble condition if there is a loss of AC power or if the batteries are missing or of insufficient capacity to support proper system operation in the event of AC failure. A "Battery Test" will be performed automatically every minute to check the integrity of the batteries. The test must disconnect the batteries from the charging circuit and place a load on the battery to verify the battery condition.

3.21 CONNECTIONS AND CIRCUITS

- A. Connections to the light and power service shall be on a dedicated branch circuit in accordance with the National Electrical Code (NEC) and the local authority having jurisdiction (AHJ).
- B. The circuit and connections shall be mechanically protected.
- C. A circuit disconnecting means shall be accessible only to authorized personnel and shall be clearly marked "FIRE ALARM CIRCUIT CONTROL".

PART 4 – ACCESSORY COMPONENTS

4.1 DEVICES SUPPORTED:

- A. The FACP shall support the operation of the following devices (up to a total of 125 devices per SLC loop) without regard to device type:
 - 1. SIGA-270 Manual Pull Station
 - 2. SIGA-CC1S Synchronized Signal Module
 - 3. SIGA-PS Photoelectric Smoke Detector
 - 4. SIGA-SB/SIGA-SB4 Standard Detector Base
- B. The FACP shall support these other Silent Knight devices via addressable or conventional

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CENTRAL PLANT PROJECT**

inputs.

1. G1 and 757 Series Wall/Horn Strobes

4.2 MANUAL FIRE ALARM STATIONS

- A. Manual Fire Alarm Stations shall be non-coded, break glass, double action type, with a key operated test reset lock in order that they may be tested, and so designed that after actual emergency operation, they cannot be restored to normal except by use of a key. The reset key shall be so designed that it will reset the manual Pull Station and open the FACP cabinet without use of another key. An operated station shall automatically condition itself so as to visually detected, as operated, at a minimum distance of fifty feet, front or side. Manual stations shall be constructed of die cast metal with clearly visible operating instructions on the front of the station in raised letters. Stations shall be suitable for surface mounting on matching back box, or semi-flush mounting on a standard single gang box, and shall be installed within the limits defined by the Americans with Disabilities Act (ADA) dependent on Manual Station accessibility or per local requirements. Manual Stations shall be EST3 SIGA-270 and Underwriters Laboratories listed.

4.3 NOTIFICATION DEVICES

- A. The visible and audible/visible signal shall be EST Model G1 and 757 series signal devices and be listed by Underwriters Laboratories Inc. per UL 1971 and/or 1638 for the G1 and also UL464 for the 757. Each indicating appliance circuit shall be electrically supervised for opens, grounds and short circuit faults, on the circuit wiring, and shall be so arranged that a fault condition on any indicating appliance circuit or group of circuits will not cause an alarm to sound. The occurrence of any fault will light the trouble LED and sound the system trouble sounder, but will not interfere with the proper operation of any circuit which does not have a fault condition. The notification appliance (combination audible/visible units only) shall produce a peak sound output of 90dba or greater as measured in an anechoic chamber. The audible and visible sections shall have separate connections to allow for the silencing of the audible alarm while the visible continues to operate. The visible signaling appliance shall maintain a minimum flash rate of 1Hz or greater regardless of power input voltage. The appliance shall also be capable of meeting the candela requirements of the blueprints presented by the Engineer and ADA. The appliance shall have an operation current of 57ma or less at 24VDC for the 15/75Cd.
- B. The appliance shall be polarized to allow for electrical supervision of the system wiring. The unit shall be provided with terminals with barriers for input/output wiring and be able to mount a single gang or double gang box or double workbox with the use of an adapter plate. The unit shall have an input voltage range of 20-30 volts with either direct current or full wave rectified power.

4.4 SMOKE DETECTORS

- A. All detectors shall be the EST3 SIGA-PS Photoelectric Smoke Detector. The base shall be the EST Model SIGA-SB/SIGA-SB4. The Smoke detector shall have a flashing status LED for visual supervision. When the detector is actuated, the flashing LED will latch on steady at full brilliance. The sensitivity of the detector shall be capable of being measured by the control panel without the need for external test apparatus. The detector shall be a double EE-prom technology and be programmed using the internal programming loop located on the FACP.

PART 5 – EXECUTION

5.1 INSTALLATION

- A. It shall be the installer's responsibility to coordinate with the supplier, regarding the correct wiring procedures before installing any conduits or conductors.

- B. Install manual pull stations with the operating handle 4 feet above the finished floor surface.
- C. Install audible and visual signal devices as indicated.
- D. Automatic detector Installation shall conform to NFPA 72E
- E. Install all wiring in conduit.
 - 1. Provide fire alarm circuit conductors with insulation color to match existing campus standards.
 - a. Addressable Loop – Two conductor cable with Red Jacket
 - b. Audible Notification Devices: - Brown and Orange
 - c. Visual Notification Devices: - Blue and Yellow OR Violet and Pink.
 - d. 24 VDC power – Black and Red.
 - 2. Label all wires clearly at all terminations. Hand written labels are NOT acceptable.
 - 3. Cut wire in-and-out at each device.
 - 4. Do not loop wires through devices.
 - 5. Mount end-of-line device with the last device on in each circuit or in a separate box adjacent to the last device.
 - 6. Connections to the following devices shall be in conduit:
 - a. Door release devices
 - b. Indicating appliances
 - c. Initiating devices
 - d. HVAC motor controllers

PART 6 – WARRANTY AND FINAL TEST

6.1 GENERAL

- A. The contractor shall warrant all equipment and wiring free from inherent mechanical and electrical defects for one year (365 days) from the date of final acceptance.

6.2 FINAL TEST

- A. Before the installation shall be considered completed and acceptable by the awarding authority, a test of the system shall be performed as follows:
 - 1. Prior to final test the fire department must be notified in accordance with local requirements.
 - 2. The contractor's job foreman, a representative of the owner, and an inspector from the Los Angeles County Fire Department shall operate every building fire alarm device to ensure proper operation and correct annunciation at the control panel.
 - 3. At least one half of all tests shall be performed on battery standby power.
 - 4. Where application of heat would destroy any detector, it may be manually activated.
 - 5. The communication loops and the indicating appliance circuits shall be opened in at least two (2) locations per circuit to check for the presence of correct supervision circuitry.
 - 6. The contractor shall leave the fire alarm system in proper working order, and, without additional expense to the owner, shall replace any defective materials or equipment provided by him under this contract within one year (365 days) from the date of final acceptance by the awarding authority.

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SECTION 16710

TELECOMMUNICATIONS GENERAL REQUIREMENTS

PART 1 – GENERAL

1.1 SECTION INCLUDES

- A. Scope of Work
- B. Codes and Specifications
- C. General Requirements and Conditions
- D. Product Requirements
- E. Structured Cabling System
- F. Submittals
- G. Record Drawings
- H. Definitions

1.2 RELATED SECTIONS

- A. Contract Terms and Conditions
- B. Division 7 – Fire-stopping
- C. Section 16715 - Acceptance Testing
- D. Section 16720 - Basic Materials and Methods
- E. Section 16725 - Telecommunications Cable
- F. Section 16760 - Telecommunications Grounding and Bonding

1.3 SCOPE

A. General Scope

1. The scope of work includes the provision, installation, testing and documentation of physical resources for voice and data systems required by the construction documents for the Building 71 Cole Conservatory of Music. The work shall include new telecommunications outlets, category 6 horizontal cables from outlets to telecommunications rooms All cabling systems shall be installed by certified technicians under the University Standard, structured cabling systems. All labor and materials shall be covered by manufacturers' extended warranties.
2. The Contractor shall provide all labor, materials, tools, equipment and permits necessary for the satisfactory and timely completion of the project.

3. The Contractor and Bond Management Team (BMT) shall jointly coordinate the implementation of the project.

B. Statement of Work

1. The work includes, but is not limited to, the items outlined in these specifications and indicated on the drawings, as well as all incidental items required to provide complete and operable systems. The Contractor, the Engineer of Record, the College, and the University Team shall mutually agree on the general conduct for the work prior to initiation of construction and shall each be responsible for following these general guidelines throughout the construction period unless modified in writing based upon discussions at the project coordination meetings. The Contractor shall also be responsible for cutting over existing telecommunication services to the new cabling systems.

1.4 CODES AND SPECIFICATIONS

- A. All work shall be performed in compliance with the most restrictive of Municipal, State, and/or Federal Codes which may govern this work and shall conform to the following codes and specifications:

1. National Fire Protection Association
 - a. NFPA 70-2001 National Electric Code.
 - b. NFPA 258 - Standard Test Method for Measuring Smoke Generated by Solid Materials.
2. ANSI Specifications:
 - a. ANSI C2-1981 National Electrical Safety Code.
 - b. ANSI C80.3 Specification for Zinc-coated Electrical Metallic Tubing.
 - c. ANSI/UL 797 Electrical Metallic Tubing.
 - d. ANSI/ICEA S-83-596-1994 - Fiber Optic Premises Distribution Cable Technical Requirements.
3. Electronics Industry Alliance/Telecommunications Industry Association (EIA/TIA):
 - a. ANSI/EIA/TIA 568-B.1, B.2, B.3 - Commercial Building Telecommunications Wiring Standard. 2001
 - b. EIA/TIA 569 - Commercial Building Standard for Telecommunications Pathways and Spaces 1998 and Addendum #1& 2, 2000.
 - c. EIA/TIA TSB 36 - Technical Systems Bulletin Additional Cable Specifications for Unshielded Twisted Pair Cables.
 - d. EIA/TIA TSB 67 - Transmission Performance Specifications for Field Testing of Unshielded Twisted-Pair Cabling Systems.
 - e. EIA/TIA TSB 72 - Centralized Optical Fiber Cabling Guidelines.
 - f. EIA/TIA 75 – Additional Horizontal Cabling Practices for Open Offices.

- g. EIA/TIA 606A - Administration Standard for the Telecommunications Infrastructure of Commercial Buildings.
 - h. EIA/TIA 607 - Commercial Building Grounding and Bonding Requirements for Telecommunications. 1994
 - i. EIA - 310-D - Cabinets, Racks, Panels, and Associated Equipment.
 - j. EIA/TIA 526-14A - Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant.
 - k. EIA/TIA 455-57A - Optical Fiber End Preparation and Examination.
 - l. EIA/TIA 455-59 - Measurement of Fiber Point Defects Using an OTDR.
 - m. EIA/TIA 455-60 - Measurement of Fiber Cable Length Using an OTDR.
 - n. EIA/TIA 455-61- Measurement of Fiber Cable Attenuation Using an OTDR.
 - o. EIA/TIA 455-95 - Absolute Optical Power Test for Optical Fibers and Cables.
 - p. EIA RS-458A Standard Optical Waveguide Fiber Material Classes and Preferred Sizes.
 - q. EIA-472 Generic Specification for Optical Waveguide Fibers.
- 4. Federal Communications Commission (FCC) Part 15 and Part 68.
 - 5. Title 24 - State of California Code of Regulations.
 - 6. 2001 California Building Code.
 - 7. 2001 California Electrical Code
 - 8. Occupational Safety and Health Administration (OSHA) Specifications.
 - 9. IEEE Specifications:
 - a. IEEE 802.2 Logical Link Control Working Group
 - b. IEEE 802.3 Carrier Sense Multiple Access with Collision Detection (CSMA/CD)
 - 10. NEMA VE1 Cable Tray Systems.
 - 11. Underwriters Laboratories Specifications:
 - a. UL 497 Electrical Grounding and Bonding Equipment.
 - b. UL 1479 Fire Tests of Through-Penetration Firestops.
 - c. UL Building Materials Directory; Through-Penetration Firestops Systems, and Fill, Void or Cavity Materials.
 - 12. The California Mechanical Code.
 - 13. ASTM Specifications:

- a. ASTM E 814 Methods of Fire Tests of Through-Penetration Fire Stops.
 - b. ASTM E 136 Test Method for Behavior of Materials in a Vertical Tube Furnace at 750 degrees C.
- 14. Rural Utilities Services (RUS), Bulletin 345-63, RUS Specifications for Acceptance Tests and Measurements of Telephone Plant.
- 15. Americans With Disabilities Act (ADA).
- B. Where reference is made to a requirement that exceeds minimum code requirements, the specification requirement shall take precedence. The Contractor and owner's representative shall jointly resolve any work that is in apparent conflict with applicable codes.
- C. When these specifications call for materials or construction of better quality or larger sizes than required by the above-mentioned rules and regulations, the provisions of these specifications shall take precedence.
- D. In accordance with these laws, rules, and regulations, the Contractor shall provide the following:
 - 1. Any additional material and labor that may be required for compliance with these laws, rules, and regulations, even though the work is not mentioned in these particular specifications.
 - 2. All permits required by any of the legally constituted public authorities for the installation or construction of the work.
 - 3. Any inspection or examinations required. Copies of certificates of all such inspections shall be delivered to the owner's representative.
 - 4. If any work is concealed without proper inspection and approval, the Contractor shall be responsible for all work required opening and restoring the concealed areas, in addition to all required modifications.

1.5 GENERAL REQUIREMENTS AND CONDITIONS

A. Safety

- 1. The Contractor shall be solely and completely responsible for conditions of the job site, including safety of persons and property during performance of work.
- 2. The Contractor shall ensure that all personnel working in or anywhere on the site shall be provided a hard hat, safety shoes, a face shield or safety goggles, etc. for their protection.
- 3. All personnel working in or anywhere on the site shall display a photo-ID.
- 4. The Contractor shall ensure that all personnel working in or anywhere on the site shall conform to the campus's regulations regarding confined space.
- 5. No act, service, drawing review, or construction observance by owner's representative or any other party employed by the campus is intended to include review or approval of adequacy of the Contractor's safety measures, in, on, or near the construction site.

B. Quality Assurance

- 1. The specifications contained herein are set forth as the minimum acceptable requirements of the Contractor's Quality Assurance program. The Contractor is

responsible for executing any other Quality Assurance measures necessary to ensure complete and fully functioning systems within the scope of this project.

2. The Contractor shall ensure that all design, workmanship, materials employed, required equipment, and the manner and method of installation conforms to accepted practices. Where specific specifications do not apply, the more stringent of industry publications, campus policies, manufacturer's guidelines, or previous (similar) work at the project site shall apply.
 3. The Contractor shall also ensure that each piece of equipment is in satisfactory working condition.
 4. The Contractor shall certify that the cable manufacturers have carried out the quality assurance tests and procedures as specified herein. All cable must be manufactured by an ISO9001 Certified Manufacturer.
 5. The Contractor is responsible for ensuring that the cable packaging for shipping/storage purposes meets or exceeds the following requirements:
 - a. One continuous length of cable per shipping reel/container.
 - b. Reels must be wooden or steel, sturdy, lagged, and shall have thermal protection jackets applied prior to lagging.
 - c. Each reel/container shall be individually identified and marked with the length of the cable it contains. Said marking shall withstand weather and shipping conditions and remain readable.
 - d. For fiber optic cable, results of the 100% Attenuation tests conducted at the factory shall accompany each reel.
 - e. Cable shall be packed in a manner that facilitates the pre-installation tests to be conducted while the cable is still on the reel (i.e., both ends of the cable must be accessible while protected from moisture).
 - f. The Quality Assurance Plan employed shall include on-reel testing of fiber, and UTP, including, but not limited to, OTDR, power loss, attenuation, etc. (as applicable for given cable media).
- C. Manufacturer's Literature: Where these specifications call for an installation to be made in accordance with the manufacturer's recommendations, a copy of such recommendations shall always be kept on the job site and shall be available to owner's representative.
- D. Acceptance of Telecommunications Work
1. The Contractor must demonstrate successful completion of the following tasks for the College to accept the telecommunications work:
 - a. Before executing any performance testing, the Contractor shall present a test plan to the Academic Computing and Information Technology (ACIT) representative and the Engineer of Record for approval.
 - b. The Contractor has completed all testing and delivered copies of all test results to the Engineer of Record.
 - c. All test results have been examined and approved by the College and Engineer of Record.

- d. Copies of all documentation required by this section have been delivered to the Engineer of Record.
 - e. All punch list items are completed to the satisfaction of the project manager or Inspector of Record.
 - f. Structured Cabling System Certification is provided to the College.
2. Minor failures such as incomplete resolutions to punch list items shall be responded to at the College's discretion or within one business day.

E. Guarantee and Warranties

1. The installed copper cables and all fiber optic cables must be installed by certified installers and covered under the College's Structured Cabling Systems. See paragraph 1.07.
2. The Contractor shall be responsible for correcting any problems and malfunctions that are warranty-related for the entire warranty period.
3. Copies of any extended material warranties shall be passed through to the owner's representative.
4. During the installation and up to the date of final acceptance, the Contractor shall protect all finished and unfinished work against damage and loss. In the event of such damage or loss, the Contractor shall replace or repair such work at no cost to the College.

1.6 PRODUCT REQUIREMENTS

A. General Information

1. These specifications identify the minimum specifications for product quality acceptable on this project by designating a manufacturer's trade or brand name and catalog or model number and by describing attributes, performance, or other specifications.
2. Where applicable, the most recent manufactured product line consistent with the structured cable system supplier identified in the technical specification sections is to be the minimum standard for quality and performance of products to be used on this project.
3. For any product described only by attributes, performance, or specifications, the Contractor shall develop a Product Submittal in accordance with the requirements set forth herein. All Product Submittals must be reviewed with owner's representative prior to their use and installation on the project. The Engineer of Record must approve all product submittals.
4. Such phrases as "or equal," "or equivalent," and "or acceptable substitute" indicate that an equivalent product may be proposed as a substitute for that which is specified. The proposed substitution must meet or exceed the attributes, performance, or other specifications of the specified product and must be approved by the owner's representative.
5. Failure of the Contractor to submit proposed substitutions for approval in the manner described above shall be sufficient cause for disapproval by the Engineer of Record of any substitutions otherwise proposed.
6. Physical samples may be required. If tests to determine equality and utility are required by the Engineer of Record, they shall be made by a testing laboratory with the acceptance

of the test procedure first given by the Engineer of Record, at the expense of the Contractor.

B. Quality of Materials

1. All materials and equipment supplied by the Contractor shall be new, manufactured within one (1) year prior to installation, and meet or exceed the latest published specifications of the manufacturer. All material shall be acceptable to and approved by the College as meeting these specifications.
2. All communications materials used on this project shall conform, where applicable, to the following specifications, unless otherwise noted:
 - a. NEMA - National Electrical Manufacturers Association.
 - b. ANSI - American National Specifications Institute.
 - c. UL - Underwriters Laboratories, Inc.
 - d. The latest IEEE and EIA/TIA specifications.
3. Telephone system materials and equipment shall be FCC Type-accepted and certified as such by supplier.
4. No material employed shall present environmental or toxicological hazards as defined by current industry specifications. All materials shall comply with CAL OSHA and EPA specifications or applicable federal or state laws or regulations.
5. The equipment, apparatus, and material for fiber optic equipment and apparatus shall conform to existing CAL OSHA health and safety laws. The equipment and apparatus shall have provision for application of safety labels, such as LASER identification, or warning labels as required by system considerations.

C. Materials Delivery and Storage

1. Costs of all shipping to the site, inside handling, and all unusual storage requirements shall be borne by the Contractor.
2. The Contractor shall make appropriate arrangements and coordinate with authorized personnel at the site for the proper acceptance, handling, protection, and storage of materials so delivered.
3. All materials delivered to the site shall be received, handled and stored by employees of the contractor.

1.7 STRUCTURED CABLING SYSTEM

- A. General: All telecommunications cables for the voice and data systems shall be installed under the College standard structured cabling systems. The only acceptable systems are listed below for each type of cable network.
- B. SYSTIMAX® Structured Cabling System (University Standard)

The horizontal, Category 6, copper station cables and terminating equipment shall be installed by a certified Contractor under the SYSTIMAX® Structured Cabling System and covered by a 20 year warranty for materials and labor.

C. Corning LANscape® Solutions (University Standard)

The installed fiber cables and terminating equipment shall be installed by a certified Contractor under the Corning LANscape Extended Warranty Program and covered by a 25 year warranty for materials and labor.

1.8 SUBMITTALS

A. Structured Cabling System Pre-Qualification Certificate: The Contractor shall submit a letter of approval from the manufacturers indicating completion of pre-qualification requirements for installation of the Structured Cabling Systems. Documentation shall include training certificates for installation of the proposed products. These documents shall be submitted for approval with the first telecommunications product submittals.

B. Shop Drawings and Supplemental Data

1. Copies of shop drawings and supplemental data shall be provided for the engineer's review. Shop drawings shall be submitted for all communications equipment, cabling, and structure pertaining to the job (distribution frames, conduit, wire, fiber optic cable, terminations, splices, etc.)
2. Design submittals (reflecting field conditions, actual cable lengths, equipment elevations, and performance expectations) shall be prepared for each system included in the project scope and reviewed with Engineer of Record.
3. Copies of final shop drawings and supplemental data, where called for, shall be submitted to the Engineer of Record. Final corrected copies of schedules and shop drawings or supplemental data shall be as follows (exceptions shall be noted in Specification Sections):
 - a. One (1) for the Telecommunications Master Plan Engineer's files.
 - b. Two (2) for College
 - c. One (1) to the Contractor's job files and additional copies as the Contractor may desire for office files and/or for distribution to subcontractors or vendors.
4. The shop drawings and supplemental data called for shall be submitted as the instruments of the Contractor, even though they may have been prepared by a subcontractor, supplier, dealer, manufacturer, or by any other person, firm, or organization. Prior to submission, the Contractor shall conduct a review and stamp with acceptance and then submit to Engineer of Record for final review. By accepting and submitting shop drawings and supplemental data, the Contractor has determined and verified all field measurements, the physical construction, the quality of materials, the applicability of catalog numbers, and similar data. The Contractor has also checked and coordinated each shop drawing with the requirements of the field conditions and resolved conflicts between trades prior to the actual construction.
5. All shop drawings shall be drawn accurately on paper suitable for duplicate copying by black, blue line printing processes or Xerox.
6. Supplemental data shall include information as noted in the specification paragraphs requiring them.
7. Engineer of Record will review shop drawings and supplemental data submitted by the Contractor only for general design conformance with the concept of the project and compliance with the information given in the Contract Documents. A review status of "No

Exceptions Taken" on a submittal does not relieve the contractor of the requirements to comply with building codes or the contract specifications."

8. Shop drawings shall be submitted for review and approval by the Engineer of Record prior to use on the job.
9. Shop drawings delineation: The shop drawings shall be drawn to scale and shall be completely dimensioned, giving the plan together with such sections as are necessary to clearly show construction detail.
10. Responsibility
 - a. The Contractor or Contractor's suppliers shall prepare the shop drawings and all supporting data, catalogs, etc. The Contractor shall check all drawings before submission.
 - b. In particular, the Contractor shall insure that the drawings meet all requirements of the drawings and specifications and also conform to the structural and space conditions.
 - c. Each shop drawing submitted for College approval shall bear a stamp certifying that the Contractor in accordance with the specifications has checked it. If such shop drawings show variations from Contract Documents, whether because of standard shop practice or other reasons, the Contractor shall make special mention thereof in the transmittal letter.
 - d. The Contractor shall be fully responsible for observing the need for and making any changes in the arrangement of piping, connections, wiring, manner of installation etc. that may be required by the proposed equipment to accommodate any work affected under other parts, headings, or divisions of Drawings and Specifications.
11. Identification: Shop drawings shall be titled with the name of the project on each sheet and shall otherwise be identified by listing the particular division, section, article or reference of the work to which they pertain. Different items shall be submitted on separate sheets, and all submittals shall be numbered serially.
12. Manner: The Contractor shall furnish separate submittal sheets for each specialty item for engineer of records approval in the following manner:
 - a. Five (5) copies of catalog cuts shall be submitted. The cut sheets shall be photocopied or reproduced in some other acceptable manner on one side only of an 8 1/2" x 11" sheet, noting only the items in question, together with the descriptive (specification) data. Drawings shall be submitted in ozalid transparency form.
 - b. Each sheet shall be identified with the division, section, article or reference in the Contract Documents that covers the item submitted for approval.
 - c. Each sheet shall be identified with the project name.
 - d. Each sheet shall bear the Contractor's stamp and signature of approval.

1.9 RECORD DRAWINGS

- A. The Contractor shall keep one set of drawings on site to continually maintain an accurate record of the as-constructed work.
- B. The marked-up drawings shall accurately indicate location of equipment, pull-boxes, conduits,

cable types and labeling.

- C. Within 30 days of completing work, the Contractor shall submit five (5) copies of as-built drawings to the owner's representative. In addition, the Contractor shall provide an electronic copy of the as-built drawings in a format specified (Auto CAD 2012) by the owner's representative.

1.10 DEFINITIONS

- **Backboard:** Backboard generally refers to the A-C, fire-retardant, plywood sheeting lining the walls of the telecommunications facilities. Backboards may also refer to the entire wall-mounted assembly, including wire management and termination frames.
- **Building Distribution Frame (BDF):** The BDF is the location within a building where the entire inside cable and fiber optic plant originates. The entire cable and fiber optic entrance facilities also terminate here. Part of the Horizontal Distribution System may originate here as well. It may include: the physical location, enclosure, wire and copper cable management hardware, fiber and management hardware, termination hardware, distribution hardware, protection hardware, active electronic components, and equipment racks. EIA/TIA-569 "Commercial Building Standard for Telecommunications Pathways and Spaces" refers to the room housing the BDF as the Equipment Room. Throughout this specification, BDF and Telecommunications Equipment Room are equivalent.
- **CATV:** Cable Antenna Television system.
- **Cable Plant:** Cable, conduit raceways, vaults, junction/pull boxes, rooms, racks, equipment, patch bays/blocks, and other infrastructure required to provide physical, electrical, optical connectivity between buildings on the Campus.
- **Cable Rack:** Hardware designed and manufactured for horizontal pathway distribution of cable and inside wiring inside the MDF, BDF, or IDF rooms.
- **Cable Tray:** Hardware designed and manufactured for horizontal pathway distribution of cable and inside wire from the MDF, BDF, or IDF to the Information Outlet access point.
- **Copper Entrance Cable:** Copper Cable that joins the College's backbone infrastructure at its connecting point to the buildings BDF.
- **Designation Strips:** Paper or plastic strips, usually contained in a clear or color tinted plastic carrier, designated for insertion into a termination frame. Designation strips are usually imprinted with the adjacent terminal number and are used to aid in locating a specific pair, group of pairs, or information outlet inserted into the termination frame, or for the purpose of delineating a termination field.
- **Entrance Conduit:** Conduit that connects the College's underground infrastructure with the building's BDF.
- **Fiber Entrance Cable:** Fiber Optic cable that joins the College's backbone infrastructure at its connecting point to the buildings BDF.
- **Horizontal cables:** Cables linking the information outlets with the IDF or BDF.
- **Information Outlet:** An integral assembly containing one of the following:
 1. The standard outlet used for voice and data services will consist of three, 4 pair category 6 jacks that can be used for various services (voice, data, network, etc.).

2. The standard outlet for voice telephone service will consist of one, 4 pair category 6, jack mounted in wall phone faceplate.
 3. The category 6 jacks shall be mounted in faceplates that are secured to standard metal electrical outlet boxes or non-metallic communications surface mounted boxes. Blank dust cover(s) shall be provided in the unused faceplate positions.
- Inside Plant (ISP): Communications system inside a building (wire, fiber, coaxial cable, equipment and racks, information outlets, etc.).
 - Intermediate Distribution Frame (IDF): The IDF is the location in a building where a transition between the Riser System and the Horizontal Distribution System occurs. It may include: the physical location, enclosure, wire and cable management hardware, fiber and management hardware, active electronic components, termination hardware, and equipment racks. EIA/TIA-569-A, "Commercial Building Specifications for Telecommunications Pathways and Spaces" refers to the IDF as the Telecommunications Closet. Throughout this specification IDF and Telecommunications Closet/Room are equivalent.
 - LAN: Local Area Network.
 - Building Distribution Frame (BDF): The BDF is the location, within a building, where the entire outside copper cable and fiber optic plant terminates. It may include the physical location, enclosure, wire, fiber, and copper cable hardware, protection, active electronic components, equipment frames and racks. EIA/TIA –569-A "Commercial Building Standard for Telecommunications Pathways and Spaces": refers to the room housing the BDF as the Equipment Room.
 - MPOE: Minimum Point of Entry, Utility Partnerships/Alternate Carrier, located within the MDF.
 - Management Hardware
 1. Fiber Management: Hardware designed and manufactured for the purpose of keeping fiber patch cords neat and orderly. Most termination frame manufacturers provide fiber management components designed to work in conjunction with their termination frames. Fiber management may also refer to other types of hardware for the purpose of securing fiber optic cable to the building.
 2. Wire Management (Copper, Data, Network): Hardware designed and manufactured for the purpose of keeping cross-connect wire and patch cables neat and orderly. Most termination frame manufacturers provide wire management components designed to work in conjunction with their termination frames. Wire management may also refer to other types of hardware for the purpose of securing wire and cable to the building.
 - Outside Plant (OSP): Communications system outside of the buildings (typically underground conduit and vaults, exterior/underground, aerial, and buried rated wire and cable, etc.).
 - Provide: Supply, furnish, deliver, install, terminate, label, test, ground and document the components per these specifications.
 - Riser Cable: High volume cable (copper) that connects the BDF with the IDF or backboards located on the same or different floors.
 - Riser Conduit: Conduit that connects the BDF to the IDF or backboards located on the same or different floors.
 - Riser Fiber Cable: Fiber Optic Cables that connects the BDF with IDF or backboards located on

the same or different floors.

- SPOE: Secondary Point of Entry, Utility/Alternate Carrier Partnership in buildings other than the MDF.
- Station Wire: 4 pair, unshielded, twisted pair, category 6 wire that connects the information outlet to the BDF or IDF.
- Telecommunications Ground: An electrical ground (as defined by local codes), usually the main building ground electrode extended by a continuous AWG "3/0" wire to ground bus bars in the BDF, IDF, and roof telecommunications terminal point.
- Termination Fields
 1. Copper, Data, Network Termination Fields: A group of termination frames clustered together to provide terminations for specific cable or inside wiring groups, where all of the cable or wiring in the group is used for a single purpose, constitutes a copper, data, or network termination field. The extent of a specific field, located in a group of fields, may be distinguished by a physical separation between the frames forming the field, by uniquely colored designation strips, or by a series of terminal numbers.
 2. Fiber Optic Termination Fields: A group of termination frames clustered together to provide terminations for fiber optic cable fibers, where all of the cable fibers are used for a single purpose, constitutes a fiber termination field.
- Termination Frames
 1. Copper Termination Frame: Device designed and manufactured for the purpose of terminating large numbers of copper cable or station wire pairs. These devices generally utilize insulation displacement connections and usually require special tools to make the terminations. Throughout this specification, the terms Copper Termination Frame and Wiring Block are equivalent.
 2. Data Termination Frame: Device designed and manufactured for the purpose of terminating copper cable pairs from the active data electronic hardware. These devices generally utilize insulation displacement connections and usually require special tools to make the terminations. Throughout this specification, the terms Data Termination Frame and/or Data Patch Panel are equivalent.
 3. Fiber Termination Frame: Device designed and manufactured for the purpose of terminating fiber optic cable fibers into "LC" connector field.
 4. Network Termination Frame: Device designed and manufactured for the purpose of terminating copper cable pairs from the active data electronic hardware. These devices generally utilize insulation displacement connections and usually require special tools to make the terminations. Throughout this specification, the terms Network Termination Frame and Network Jack Panel are equivalent.

PART 2 - MATERIALS

Not used

PART 3 - EXECUTION

3.1 SEISMIC REQUIREMENTS

GENERAL:

- A. Earthquake-resistive design shall comply with the requirements of the 2001 California Building Code (CBC).
- B. Equipment and piping shall be braced in accordance with the most current edition of Seismic Restraint Manual Guidelines for Mechanical Systems (SMACNA) with Addendum No. 1 and National Uniform Seismic Installation Guidelines (NUSIG).

END OF SECTION

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SECTION 16715

TELECOMMUNICATIONS ACCEPTANCE TESTING

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Testing Publications and Standards
- B. Inspection and testing procedures for copper cables and fiber optic cables
- C. Documentation and As-Built Requirements

1.2 PUBLICATIONS AND STANDARDS

- A. Electronics Industry Alliance/Telecommunications Industry Association (EIA/TIA)
 - 1. ANSI/EIA/TIA 568-B.1, B.2, B.3 – Commercial Building Telecommunications Wiring Standard.
 - 2. EIA/TIA 569 – Commercial Building Standard for Telecommunications Pathways and Spaces
 - 3. EIA/TIA TSB 36 – Technical Systems Bulletin Additional Cable Specifications for Unshielded Twisted Pair Cables
 - 4. EIA/TIA TSB 40A – Additional Transmission Specifications for Unshielded Twisted-Pair Connecting Hardware
 - 5. EIA/TIA TSB 67 – Transmission Performance Specifications for Field Testing of Unshielded Twisted-Pair Cabling Systems.
 - 6. EIA/TIA TSB 72 – Centralized Optical Fiber Cabling Guidelines
 - 7. EIA/TIA 606A – Administration Standard for the Telecommunications Infrastructure of Commercial Buildings
 - 8. EIA/TIA 607 – Commercial Building Grounding and Bonding Requirements for Telecommunications
 - 9. EIA – 310-D – Cabinets, Racks, Panels, and Associated Equipment
 - 10. EIA/TIA-455-57A – Optical Fiber End Preparation and Examination
 - 11. EIA/TIA 455-59 – Measurement of Fiber Point Defects Using An OTDR
 - 12. EIA/TIA 455-60 – Measurement of Fiber or Cable Length Using An OTDR
 - 13. EIA/TIA 455-61 – Measurement of Fiber or Cable Attenuation Using An OTDR
 - 14. EIA/TIA 455-95 – Absolute Optical Power Test for Optical Fibers and Cables
 - 15. EIA/TIA 526-14 – Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant
 - 16. ANSI/ICEA S-83-596-1994 – Fiber Optic Premises Distribution Cable Technical Requirements
- B. Federal Communications Commission (FCC) part 15 and part 68
- C. Rural Utilities Services (RUS), Bulletin 345-63, RUS Standards for Acceptance Tests and Measurements of Telephone Plant.

1.3 RELATED SECTIONS

- A. Section 16710 - Telecommunications General Requirements
- B. Section 16720 - Telecommunications Basic Materials and Methods
- C. Section 16725 - Telecommunications Cable

D. Section 16760 - Telecommunications Grounding and Bonding

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

3.1 GENERAL PROCEDURES

- A. The Contractor will provide all tools, equipment, and fully trained staff necessary to conduct fully witnessed acceptance testing of all installed telecommunications-related products and systems.
- B. The Contractor shall prepare a complete test plan for all installed telecommunications systems for review and approval by the owner's representative. The plan shall show, at a minimum, test configurations, calibration procedures, impedances, and measurement equipment. The scope of this work includes, but is not limited to, the following:
 - 1. All system(s) shall be checked for compliance with these specifications.
 - 2. The Contractor shall maintain a check-off list for College's reference during tests.
 - 3. The result of the measurements outlined shall be recorded and submitted along with current as-built drawings to the owner's representative as final proof of system performance.
 - 4. The Contractor shall expeditiously replace any system not meeting specifications at no cost to the College. Failure to act in an expeditious manner to properly remedy any abnormality resulting from installation/construction defects or workmanship; faulty material; and/or the failure of the systems, components, or the cable medium to perform in accordance with the College and/or Manufacturer's technical specifications shall cause the College to place a "hold" on any other telecommunications development or construction associated with this project. The owner's representative will notify the Contractor in writing of such action and is absolved and shall be held harmless from any delays, costs over-runs, scheduling difficulties, etc. assessed by others due to the Contractor's failure to meet the final proof of system performance specifications. Final as built will be provided, as specified, at the end of the project.
 - 5. All systems shall meet the bid specifications and be accepted by the owner's representative before the work will be considered complete.
- C. After the Contractor has provided complete documentation of all testing and the documentation have been reviewed by the owner's representative, the Contractor shall conduct "proof of performance" testing on selected components at the direction and discretion of the owner's representative. Such testing will utilize the same equipment and procedures used to conduct and document the initial tests but will be applied on a random basis to verify the testing documentation. If in the judgment of the owner's representative, the proof-of-performance test results vary significantly from the acceptance test results, the Contractor shall continue with testing until cleared by the owner's representative.
- D. All test equipment shall be calibrated by a certified laboratory or by the manufacturer within the last six months, and such certification shall be submitted to the owner's representative prior to testing.
- E. The following test equipment shall be used for all copper and fiber optic cable testing:
 - 1. Copper tester: Fluke DSP-4300; Part # DSP-4300 – first year support Part # GOLD-DSP-4300
 - 2. Fluke Optifiber certifying OTDR; Part # OF-500-30 – First year support Part # GLD-OF-50030-X

- F. All testing shall be coordinated with the owner's representative (providing a minimum of one week's notice) to ensure all acceptances and qualified personnel can witness proof-of-performance testing.
- G. A representative of the District ACIT Department shall be present during all fiber optic cable testing.

3.2 INSPECTION AND TESTING PROCEDURES FOR COPPER CABLE

- A. The owner's representative will conduct routine inspections of the work in progress, and any deficiencies will be discussed at the regular progress meeting. In the event the owner's representative determines work is progressing in an incorrect manner and waiting for the regular meeting could cause further problems, the Contractor's on-site project manager will be notified.
- B. Copper Station and Riser Cables: The Contractor shall conduct witnessed acceptance testing on all station and riser cable installed as part of this project as defined below:
 - 1. The correct and continuous bonding of cable shields through all riser and tie cable splices will be verified. This test shall be conducted from the BDF prior to strapping shield grounds at splice or termination points.
 - 2. Each station cable and all riser cable pairs will be tested for crosses, opens, grounds, reversed and/or transposed pairs, shorts, foreign battery, continuity, and resistance (in ohms). All riser cable pairs shall be tested for loss in dB. All problems will be resolved and the cable re-tested to ensure compliance.
 - 3. Using a Category 6 rated pair scanner or similar device, all copper station cables shall be tested to verify the installation meets the EIA/TIA Category 6 performance specifications as defined in TSB-40A and TSB 67. All test results, including jack numbers, shall be printed on a hardcopy report. All stations shall meet or exceed this performance standard.
 - 4. All pair scanners used on the project shall be calibrated to a single common test cable at the start of each shift and after changing batteries. The hardcopy of the calibration results shall be included as a reference with each batch of station test results submitted.
- C. Copper Interbuilding and Entrance Cables: The Contractor's witnessed acceptance testing on all interbuilding and entrance cables installed as part of this project is defined below:
 - 1. The correct and continuous bonding of cable shields through all splices and tie cable splices shall be verified. This test shall be conducted between protected terminals from the building BDF to the University MDF. The test for continuous bonding of cable shields shall be performed prior to strapping shield grounds at splice or termination points.
 - 2. Each cable pair shall be tested for crosses, opens, grounds, reversed and/or transposed pairs, shorts, foreign battery, continuity, resistance (in ohms) and loss in dB.
 - 3. All irregularities will be resolved and the cable re-tested to ensure compliance.

3.3 INSPECTION AND TESTING PROCEDURES FIBER CABLE

- A. University project staff will conduct routine inspections of the fiber optic cable installation process, and any deficiencies will be discussed at the regular progress meeting. In the event University project staff determines work is progressing in an incorrect manner and waiting for the regular meeting could cause further problems, the Contractor's on-site project manager will be immediately notified.
- B. The Contractor shall conduct witnessed acceptance testing on all fiber optic cables installed as part of this project as defined below:
 - 1. OTDR and power meter tests shall be performed on the fiber OSP cable between patch panels in BDF room in the building to the MDF Building in accordance with the field test specifications defined by the ANSI/TIA/EIA-568-B.

2. ANSI/TIA/EIA-568-B, defines the passive cabling network, to include cable, connectors, and splices (if present), between two optical fiber patch panels (connecting hardware). A typical horizontal link segment is from the telecommunications outlet/connector to the horizontal cross-connect. The TIA document describes three typical backbone link segments: (1) main cross-connect to intermediate cross-connect, (2) main cross-connect to horizontal cross-connect, or (3) intermediate cross-connect to horizontal cross-connect. The test shall include the representative connector performance at the connecting hardware associated with the mating of patch cords. The test does not, however, include the performance of the connector at the interface with the test equipment.
3. 100% of the installed cabling links shall be tested and must pass the requirements of the standards mentioned above. Any failing link shall be diagnosed and corrected. The corrective action shall be followed with a new test to prove that the corrected link meets the performance requirements. The final and passing result of the test for all links shall be provided in the test results documentation.
4. Trained technicians who have successfully attended an appropriate training program and have obtained a certificate as proof thereof shall execute the tests. These certificates may have been issued by any of the following organizations or an equivalent organization:
 - a. The manufacturer of the fiber optic cable and/or fiber optic connectors.
 - b. The manufacturer of the test equipment used for the field certification.
 - c. Training organizations authorized by Building Industry Consulting Services International (BICSI).
 - d. Training organizations authorized by the Association of Cabling Professionals (ACP).
5. Field test instruments for multimode fiber cabling shall meet the requirements of ANSI/TIA/EIA-526-14A. The light source shall meet the launch requirements of ANSI/TIA/EIA-455-50B, Method A. This launch condition can be achieved either within the field test equipment or by use of an external mandrel wrap (as described in clause 11 of ANSI/TIA/EIA-568-B.1) with a Category 1 light source.
6. Field test instruments for singlemode fiber cabling shall meet the requirements of ANSI/TIA/EIA-526-7.
7. The test equipment shall be within the calibration period recommended by the manufacturer in order to achieve the manufacturer's specified measurement accuracy. A copy of the calibration record(s) shall be included as a reference with each batch of fiber optic cable test results submitted.
8. The fiber optic launch cables and adapters must be of high quality and the cables shall not show excessive wear resulting from repetitive coiling and storing of the test equipment interface adapters.
9. The Pass or Fail condition for the link under test is determined by the results of the required individual tests.
10. A Pass or Fail result for each parameter is determined by comparing the measured values with the specified test limits for that parameter.

3.4 DOCUMENTATION

A. Fiber Cable Systems

1. All documentation shall be neatly and legibly done and shall provide a clear understanding of the installed system.
2. The Contractor shall prepare "as-built" plans of all work including interbuilding and entrance cable locations with footage. All approved changes and actual in-place footage shall be marked, in red, on full size drawing. The as-built drawing shall include all fiber optic cable placed with cable lengths, fiber assignments, and cable numbers and counts.
3. The Contractor shall provide signed originals of all acceptance testing documents, which are:
 - a. Complete Fiber optic insertion loss results on CD in a format approved by the College.

- b. Written summary of OTDR graphs and printouts and test results in a 3-ring binder.
- c. Current test equipment certifications

B. Copper Cable Systems

1. The Contractor shall provide on CD complete testing results in a format recommended by the Structured Cabling System manufacturer and approved by the College. Document shall include the successful testing of all interbuilding tie cables. The Contractor shall also provide the software required to read the electronic records.
2. The Contractor is to provide a written summary of the Pass/Fail test results in a 3 ring binder.
3. Interbuilding and entrance cable plans shall be updated to include actual routes, cable numbers and counts, and lengths of cables.
4. Category 6 station cable test results noting unique station number and group test results by floor shall be provided in written summary.
5. The Contractor shall neatly note floor plans with "as-built" station number and any changes, additions, or deletions to outlet placement.

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SECTION 16720

TELECOMMUNICATIONS BASIC MATERIALS AND METHODS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Conduit
- B. Conduit Supports
- C. Hangers and Cable Ties
- D. Intrabuilding Cable Tags
- E. Labels
- F. Station Outlets
- G. Faceplates
- H. Copper Cable Termination Blocks
- I. Data Network Patch Panels

1.2 RELATED SECTIONS

- A. Section 16710 – Telecommunications General Requirements
- B. Section 16715 – Telecommunications Acceptance Testing
- C. Section 16725 – Telecommunications Cable
- D. Section 16760 – Telecommunications Grounding and Bonding

1.3 APPLICABLE PUBLICATIONS

- A. As defined in Section 16710 – Telecommunications General Requirements.

1.4 SUBMITTALS

Contractor shall comply with requirements of Section 01300. Contractor shall provide submittals for all listed products in paragraph 1.01.

PART 2 – MATERIALS

The Contractor shall install materials and equipment as part of the SYSTIMAX® and Corning LANscape® Solutions as defined in paragraph 1.07 of specification 16710. Various sections of this specification pertain to specific products and/or installation requirements that must conform to the warranty requirements of these structured cabling systems.

2.1 CONDUIT

- A. Rigid Steel Conduit

Rigid steel conduit shall comply with Underwriter's Laboratories UL-6 Specification, ANSI C80.1 and Federal specification WW-C-581E or latest revisions. Conduit shall be hot dip galvanized on the exterior, with zinc or enamel coating on the interior.

1. Manufacturer: Western Tube and Conduit, Allied Tube and Conduit, and Wheatland Tube Company, or approved equal.
2. Couplings, locknuts, and all other fittings shall be galvanized or sheardized, waterproof and threaded type only. Rigid conduit shall terminate with two locknuts – one outside and one inside enclosures and specified bushings. No running threads or chase nipples shall be used without approval.
Manufacturer: O-Z Gedney, Appleton, Crouse-Hinds or approved equal.
3. Bushings shall be non-metallic for 1 inch and smaller and insulated metallic for conduits larger than 1 inch.
Manufacturer: O-Z Gedney, Appleton, Crouse-Hinds or approved equal.

B. Electrical Metallic Tubing (EMT)

1. EMT conduit shall comply with Underwriter's Laboratories UL 797, ANSI C80.3 and Federal Specification WW-C-563 or latest revision. EMT shall be galvanized or sheardized.
Manufacturer: Western Tube and Conduit, Allied Tube and Conduit, and Wheatland Tube Company or approved equal.
2. Couplings and connectors for EMT shall be galvanized or cadmium plated and shall be of the compression type requiring the tightening of a nut on a gland ring. No die cast type shall be allowed. All connections shall have permanent insulated throats.
Manufacturer: O-Z Gedney, Appleton, Crouse-Hinds or approved equal.

C. For underground telecommunications conduit, see Division 16 section 16730.

D. All communication conduits shall be equipped with a terminating bushing or collar to protect cables during placement.

E. All station conduits shall be no smaller than one and one-quarter inch (1¼") in diameter unless otherwise noted.

2.2 CONDUIT SUPPORTS

- A. Pipe hangers for individual conduits shall be factory made, consisting of a pipe ring and threaded suspension rod. The pipe ring shall be malleable iron, split and hinged, or shall be interlocked with the suspension rod socket.
- B. Pipe racks for a group of parallel conduits shall be galvanized structural steel preformed channels of length as required, suspended on threaded rods and secured thereto with nuts above and below the cross bar. All offsets shall be in the same plane and shall be parallel.
- C. Factory made pipe straps shall be one-hole malleable iron or two-hole galvanized clamps.
- D. Manufacturer: Kindorf, Unistrut, T&B, Copper B-Line or approved equivalent.

2.3 HANGERS AND CABLE TIES

A. Materials:

1. All hangers and cable ties shall be designed to support communications cable (including the fiber) without kinking or damage. Horizontal cable supporting hardware shall be UL Listed. The J-hook(s) shall provide a broad base for proper cable support, thereby reducing stress and bending of cabling. Contractor shall utilize the sufficient number of J-hooks per manufacturer's recommended cable capacities for the number of cables to be installed. One spare j-hook shall be installed at each location for future placement of cables.

2. Hangers shall be metal construction and shall provide a cable support hanger in a "J" configuration designed to support multiple communications cables.
3. No more than twelve (12) station cables may be supported by a single hanger without using a saddle (3 inches wide at a minimum) to support the weight of the additional cables.
4. Larger types of wire hangers (larger J-hooks or Tri-hooks) are acceptable for locations requiring more than twelve cables. Copper and fiber cables must be properly installed per the manufacturer's specifications to insure maximum cable performance.
5. Velcro type cable ties used within a rated ceiling plenum space shall be rated low smoke and shall be certified for use in a plenum environment. (UL Listed) NEC section 300-21.

B. Manufacturers: Hangers: CPI Chatsworth, B-Line, Caddy, or approved equivalent.

Ties: Velcro, T&B, and HellermanTyton or approved equivalent.

2.4 FIBER TERMINAL UNITS

A. Materials

1. The fiber optic terminals/patch panels shall utilize Corning Cable Systems Closet Connector Housings (CCH).
2. Each CCH shall have the following specifications:
 - a. Suitable for installation in EIA 19" mounting frame.
 - b. Provide cross-connect, inter-connect, and splicing capabilities and contain the proper troughs for supporting and routing the fiber cables/jumpers.
 - c. Consist of a modular enclosure with retainer rings in the slack storage section to limit the bending radius of fibers.
 - d. Equipped with a "window" section to insert connector panels for mounting of connectorized fibers (LC, duplex, style couplers and connectors).
 - e. Provide terminating capability of couplers, in the quantity noted on the contract drawings, in panels of 6 or 12 respectively.
 - f. Corning Cable Systems Unicam LC connectors for 50 μ m multimode fiber with ceramic ferrule and Unicam LC with ceramic ferrule for singlemode fibers. The connectors shall have composite couplers in all patch bays that meet or exceed the following specifications:

(1)	Unicam LC Connectors (Singlemode)	Part Number: 95-200-99
(2)	Unicam LC Connectors (Multimode)	Part Number: 95-050-99-X
	(50 μ m LaserOptimized multimode fiber)	
(3)	Interconnect Compatibility:	Compatibility with FOICS 10 for LC junior version
(4)	Operating Temperature:	≤ 0.3 db change -40° to 140°F (-40° to 60°C) in 21 cycles
(5)	Insertion Loss:	Multimode 0.2dB average, 0.5 dB max. for laser-optimized multimode fiber
	Singlemode	0.3dB average, 0.77 dB max.
(6)	Durability	$\leq$ or = .2 dB change, 500 remateings, FOTP-21
(7)	Tensile Strength	10 lb $\leq$ or + .2dB change, on jacketed cable; 0.5 lb $\leq$ or = .2dB change on 900 μ m cable, FOTP-6
(8)	Reflectance:	≤ -50 dB (+18° to +26°C)
(9)	Nominal fiber OD:	125 μ m
(10)	Housing Color Code:	
	Single-mode:	Ceramic ferrule blue housing
	Multimode:	Ceramic ferrule black housing
(11)	Boot Color:	
	Single-mode:	Blue
	Multimode:	Aqua

- (12) A common panel shall be used to terminate singlemode and multimode optical fibers.

B. Manufacturer: Corning Cable Closet Connector Housings (CCH-02U), (College Standard)

2.5 LABELS

A. Materials:

1. Provide labels for station cables, outlets, communication blocks and patch panels.
2. The lettering on each label shall be as large as is practicable. All labels shall be machine-produced. Hand-written labels will not be acceptable.
3. A standard relative orientation shall be adopted for all labels unless otherwise specified.
4. Labels shall be durable, resist abrasion and shall be UV inhibiting, permanent and indelible.
5. All labels shall be readily visible and shall be fixed so that they remain in a visible position wherever practical.
6. Cable labels
 - a. Provide self-laminating wrap labels for cables with less than ½" diameter. The labels shall be permanently attached to each cable once they have been installed.
7. Outlet labels shall be according the College standard. Prior to installing the labels, the Contractor must submit a sample label to the College for approval prior to labeling the new outlets.

B. Manufacturer: Panduit, or approved equal.

2.7 STATION OUTLETS

A. Materials:

1. Metal Outlet Boxes

- a. Metal outlet boxes shall be installed as receptacles for the information outlets in the following locations: new interior wall construction, exterior locations, locations with special vapor proof or explosion proof applications, and floor mounted outlets. Outlet boxes shall be galvanized steel. Boxes installed in any exterior location where exposed to rain or moisture laden atmosphere shall be cast screw hub type with gaskets and weatherproof covers. Boxes for vapor proof or explosion proof applications shall be designed specifically for such use.
- b. In new wall construction, each box shall be flush mounted, **two gang**, metal box. If the outlet is designated for four or less cables, provide a single gang mud ring. If the outlet is designated for more than four cables and less than nine cables, provide a two gang mud ring. Each box shall be equipped with a 1 ¼" conduit stubbed into the ceiling area and equipped with a 12 inch radial bend angled toward cable tray or wire pathway. If cable trays are used as horizontal raceways, the 1 ¼" conduit will be extended to the top of the cable tray.
- c. Manufacturers: Appleton, Raco, Steel City or approved equal.

2. Non-Metallic Outlet Boxes

- a. Non-metallic outlet boxes shall be used for interior surface mounted locations only when outlets can be installed inside the wall. Surface mounted outlet boxes must be approved by the College representative prior to installation. Boxes shall be from same manufacturer as the non-metallic raceways used for installation of station wire.
- b. The type of box must be from the same manufacturer and compatible with the wiremold raceway. Single (one) gang box shall be used in locations with four or less voice and data cables. Dual (two) gang box shall be used in locations with more than four and less than nine cables.
- c. Manufacturer: Panduit, Wiremold, or approved equal.

3. Mounting Brackets
 - a. For new outlets in existing fishable walls, flush mount brackets shall be utilized in lieu of outlet boxes to attach faceplates.
 - b. Single gang, mounting brackets and faceplates shall be used for outlets with four cables or less. A dual gang mounting bracket shall be used for a new outlet with more than four and less than nine cables.
 - c. Manufacturer: Caddy or approved equal.
4. Standard Data Outlet
 - a. The standard data outlet will be used for all data applications as well as voice services. b. The standard data outlet shall consist of three (3) Category 6 four-pair cables, each terminated on a separate Category 6 rated RJ45 8-position jack following T-568 B wiring standards. The color of one jack will be white for voice services and the color of the other two jacks will be blue for data services.
 - c. One of the Category 6 copper cables will be white in color and terminated on the white jack mounted in the outlet. The other end of the cable will be terminated in the telecom room on a 110-A1 100 PAIR comm. block designated for the termination of all white cables. d. Two of the Category 6 copper cables will be blue in color and terminated on the blue jacks mounted in the outlet. The other end of the cables will be terminated in the telecom room on a rack mounted data jack patch panel designated for the termination of all blue cables.
 - f. The modular jacks shall be rated for Category 6 performance in the configuration installed.
 - g. The faceplate will be clearly labeled with outlet number, and each jack will be labeled with jack number. All labels will be typed or preprinted and shall be securely affixed to the faceplate.
 - h. Dust covers shall be placed in the vacant slots and the color of the dust covers the same as the faceplates.
 - i. Manufacturer: SYSTIMAX® (UniversityStandard)
5. Other Data Outlets
 - a. Other data outlets shall consist of one to eight RJ45 8-wire modular jacks wired as per EIA/TIA 568B in a white outlet faceplate. The number of terminated cables at each outlet shall be according to floor plan drawings. Jacks shall be blue in color.
 - b. Data outlets with one to four cables shall have 4 port angled faceplates and data outlets with five to eight cables shall have 8 port angled faceplates.
 - c. The modular jacks shall be rated for Category 6 performance in the configuration installed.
 - d. The faceplate will be clearly labeled with outlet number, and each jack will be labeled with jack number. All labels will be typed or preprinted and shall be securely affixed to the faceplate.
 - e. Dust covers shall be placed in the vacant slots and the color of the dust covers the same as the faceplates.
 - f. Manufacturer: SYSTIMAX® (College Standard)
6. Data/Fiber Outlets
 - a. The standard data/fiber outlet shall consist of two (2) Category 6 four-pair cables, each terminated on a separate Category 6 rated RJ45 8-position jack following T-568 B wiring standards. The color of the jacks will be blue. The outlet shall also contain (1), two optic, multimode fiber cable. Both ends of the fiber station cable shall be terminated on Corning, duplex, Unicam, LC type connectors suitable for existing type multimode fiber cable.
 - b. The modular jacks shall be rated for Category 6 performance in the configuration installed.
 - c. The faceplate will be clearly labeled with outlet number, and each jack and connector will be labeled per University numbering scheme. All labels will be typed or preprinted and shall be securely affixed to the faceplate.

- d. Dust covers shall be placed in the vacant slots and the color of the dust covers the same as the faceplates.
 - e. The Category 6 copper cables will be blue in color and terminated on the blue jacks mounted in the outlet. The other end of the cables will be terminated in the telecom room on a rack mounted ADC data jack patch panel designated for the termination of all blue cables. See paragraph 2.21, A2f for data patch panel.
 - f. Fiber cables to the outlets shall be terminated in the telecommunications room in a fiber terminal unit, Corning Closet Housing (CCH) with the building entrance and riser fiber cables.
 - g. Manufacturer: Category 6 Copper Cables, SYSTIMAX®,
Fiber Cable, Corning LANscape® Cable
7. Voice Only Outlets – Wall Phones and Emergency Telephones
- a. b. The voice only outlet designated for wall phone or emergency telephone shall consist of one (1) Category 6 four-pair cable terminated on a Category 6 rated RJ45 8-position jack following T-568 B wiring standards.
 - c. The Category 6 modular jack shall be mounted in a metal faceplate suitable for securing a wall mounted telephone.
 - d. Wall phone outlets shall be placed at 44 inches above the finished floor unless otherwise noted to make the maximum height to the top of the telephone 48 inches above the finished floor.
 - e. Wall phone outlets shall be equipped with a duplex mud-ring around the standard dual gang outlet box recessed in the wall. Wall outlets not recessed into wall shall have an appropriate wall bracket to allow installation of Wall Phone Instrument.
 - f. The Category 6, copper cable shall be white in color and terminated on the white jack mounted in the faceplate. The other end of the cable will be terminated in the telecom room on a rack mounted ADC data jack patch panel designated for the termination of all white cables.
 - h. Manufacturer: SYSTIMAX® (University Standard)
8. Voice Only Outlets Emergency Phones
- a. Voice circuits for Emergency Phones will be provided over a separate copper cable network for non-switched voice services.
 - b. Each voice outlet shall be wired with one OSP Category 6 cable terminated on a RJ45 wire modular jack assembly. Some voice cables may be hardwired instead of an outlet depending on the equipment manufacturer's requirements.

2.8 FACEPLATES

A. Materials

- 1. Provide SYSTIMAX® flush, wall-mounted faceplate to house work area jacks. The faceplate shall fit over a standard NEMA electrical box fitted with a plaster ring cover and shall be office white in color. See paragraph 2.15 Station Outlets for faceplate requirements.
- 2. Provide blanking inserts in all unused faceplate ports. The blanking inserts shall be the same color as the faceplates.

B. Manufacturer: SYSTIMAX®

2.9 COPPER CABLE TERMINATION BLOCKS

A. Materials

- 1. Terminate Category 6, station cables designated for non-switched voice services (Non-VOIP) on 110-A1-100 pair termination blocks. Termination blocks shall be wall mounted adjacent to copper entrance cable, protected terminal with wire management system between terminals. See paragraph 2.15, A8 for voice cable termination requirements on termination blocks.

- B. Manufacturer: SYSTIMAX (University Standard)

2.10 DATA NETWORK PATCH PANELS

A. Materials

1. Data jack patch panels shall be rated Category 6 and covered under the SYSTIMAX® structured cabling system extended warranty.
 - a. 19 inch rack mounting as noted on drawings.
 - b. Wired to T 568 B wiring scheme.
 - c. UL certified.
 - d. Equipped with wire retention clips as specified in the in the systimax® cabling program.
- B. A 48 port patch panel shall be for terminating blue data cables as specified in paragraphs 2.15 A4, A5, and A6. The size of this patch panel shall be 48 port to accommodate the blue data cables. Manufacturer: SYSTIMAX® University's Standard

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION

- A. All installation work shall be performed according to published industry guidelines, rules, and regulations. All Structured Cabling System products shall be installed according to manufacturer procedures.
- B. All pathways shall avoid electromagnetic interference (EMI). Cable that is distributed in partially-enclosed metallic pathways shall be routed with the following minimum clearances:
 1. Four (4) feet from motors or transformers.
 2. One (1) foot from conduit and cables used for electrical power and distribution.
 3. Six (6) inches from fluorescent lighting.
- C. Pathways shall cross perpendicular to fluorescent lighting and electrical power cables and conduit.

3.2 CONDUIT

- A. All conduit shall be routed parallel and perpendicular to walls.
- B. All conduit shall be installed in accordance with NEMA "Standard of Installation" and shall meet applicable local and national building and electrical codes or regulations.
- C. New Conduit runs shall not exceed 100 feet or have more than two 90 degree bends without utilizing appropriately sized pull boxes. No change in direction shall occur in pull boxes. All conduits are to enter and exit pull boxes in the end (short) walls.
- D. No communications outlet boxes shall be "daisy-chained." Each communications outlet shall be served by a separate 1¼ inch (minimum) conduit.
- E. In rooms with a drop or false ceiling, communications outlets shall be served by a one and one-fourth (1¼) inch conduit equipped with a 90 degree sweep stubbed six inches above the false ceiling, angled toward the cable tray or open access area, and shall be equipped with a compression fitting and plastic bushing. All stubs shall be marked "Comm."
- F. All conduits shall be equipped with an approved water or barrier seal in building access points.

- G. All conduits entering a building from outside shall be plugged with reusable blank plugs for empty conduits and with split round plugs for conduits with cable. These plugs shall be neoprene or rubber compression type.
- H. All conduits leaving the entrance room for other portions of the building will be fire-stopped after the installation of cable.
- I. All conduits are to be concealed unless installed in exposed ceiling areas as indicated on the drawings. No conduits shall be left exposed in public areas.

3.3 HANGERS AND CABLE TIES

- A. In suspended ceiling and raised floor areas where walker duct, cable trays, or conduit are not available, station wiring shall be bundled with elcro type ties at 5 foot intervals or less.
- B. Tie wraps shall not be over tightened to the point of deforming or crimping the cable sheath.
- C. Hangers supporting the cable bundling shall be attached to the existing building structure and framework.
- D. Hangers must be installed to provide at least 6 inches of clear vertical space between the cable bundling and the ceiling tiles.
- E. Hangers shall be spaced at 5-foot intervals to prevent cables from sagging or buckling.

3.4 RACEWAYS

- A. Raceways must be routed at right angles to nearby structures or wall corners, and shall be neatly installed and trimmed to fit into and around other existing moldings or pathways such as the ceiling area.
- B. Raceways shall be placed vertically only in corners of rooms and horizontal raceway placed at baseboard height to extend the cable run to the actual outlet location.
- C. Raceways shall be routed to avoid interference, using standard sections and a minimum number of field-cut sections.
- D. Raceways shall be routed to avoid interference with removal and installation of lighting fixtures and devices of other systems that require servicing or operation.
- E. Sharp burrs or edges shall be removed from raceways.
- F. Completed raceways shall have no cracks or openings at coupled sections.
- G. Raceway supports:
 - 1. Overhead Supports: Raceway shall be supported from concrete ceiling or ceiling beams, at five (5) feet maximum span intervals, using 3/8 inch threaded rods with c-hangers.
- H. Strict adherence to the CEC/NEC NFPA 101 is required for any raceway penetrations of fire-rated walls. See section 07840 for UL system numbers and to construction drawings for details.
- I. Radius fittings shall be provided for turns and offsets to accommodate obstructions or elevation changes and maintain minimum cable bending radii.

3.5 FIBER OPTIC TERMINAL PANELS

- A. Rack-mounted fiber panels shall be mounted at the top of the rack.

- B. All cables mounted into fiber optic panels shall be installed and secured as defined by the manufacturer using the tools, materials, and techniques outlined by Corning Cable.
- C. All optics shall be terminated in accordance with Corning LANscape® specifications using Unicam, duplex, LC type connectors.

3.6 CABLE TAGS AND LABELING

- A. The Contractor shall legibly label all voice and data outlets, cable, blocks, frames, and patch panels per construction drawings and owner's representative directions and as defined herein. Outlet faceplates shall be labeled on both sides.
- B. The Contractor shall employ the cable labeling and tagging scheme that meets ANSI-606 specifications and as specified on construction drawings by the engineer.
- C. Construction labels shall be installed on all cables as they are pulled. These labels shall contain the same information as the finished labels. Each station cable shall have a unique number that shall be related to the appropriate faceplate number and jack letter. Typed labels on self-sealing tape shall be used.
- D. A label shall be installed on each conduit attached to a communications wall box and shall be affixed to the end of the conduit near the cable tray. The label shall have a unique number related to the appropriate faceplate number and jack letter.
- E. Labels shall be installed on all station cables within two (2) inches of the end of the outer jacket material within the back box and at the blocks/patch panel. Typed labels on self-sealing tape, with a plastic overlay, shall be used. Each cable shall have a unique number that shall be related to the appropriate faceplate number and jack letter.
- F. Labels shall be installed on all patch panels, blocks, and both the inside and outside of all faceplates. A uniquely numbered label for each faceplate and a unique letter for each jack shall be supplied and installed. The labels shall be machine printed (not embossed) on vinyl tape using a Brothers label maker or equivalent. The labels shall have protective overlays.
- G. Labels shall be numbered according to the drawings and per paragraph 2.13, A7.
- H. Ground Bars
 - 1. The master ground bar shall be labeled as such.
 - 2. Each subsidiary ground bar shall be labeled as such and have a unique identifier.
 - 3. All ground bars shall have a warning label that states, "If this connector or cable is loose or shall be removed, please call the ACIT Manager."
 - 4. Each ground cable shall be labeled with a unique identifier.

3.7 STATION OUTLETS

- A. Station outlets shall be located so that the cable from the outlet to the telecom room is less than 90 meters (295 feet). Immediately notify the owner's representative if the cable can not be installed within the distance limitations due to field conditions.
- B. Station outlets shall be mounted securely at work area locations.
- C. Station outlets shall be located so that the cable required to reach the desktop equipment is no more than 16 feet long.
- D. Station outlets shall not be "daisy-chained."
- E. Outlets shall be mounted as follows:

1. Wall phone: 44 inches above the finished floor.
2. Standard data outlet: 15 inches above the finished floor unless otherwise noted on drawings. Coordinate height of telecom outlets to match height of electrical outlets.
3. Wall-mounted video outlet: 15 inches above the finished floor unless otherwise noted on drawings. Coordinate height of telecom outlets to match height of electrical outlets.
4. Counter top: 6 inches above the counter top.

F. Modular Furniture Telecommunications Outlets

1. The Contractor shall provide and install all components and labor necessary to completely install, test, and document voice and data telecommunications outlets at each modular furniture workstation location.
2. The Contractor shall coordinate the telecommunications and electrical installation so that the modular furniture is served from the joint signal/power floor boxes or joint power pole in a consistent manner. The Contractor shall provide and install all fittings, flex conduit, adapter plates, and telecommunications cable and components necessary to install Category 6 station cable from the telecommunications room through the ceiling, floor box, or pole, into the furniture raceway, and to the final user outlet location (including jacks, adapters, and faceplates).

- G. Labels shall be numbered according to a scheme developed in consultation with the owner's representative.

3.8 FACEPLATES

- A. The faceplates shall have their jack positions labeled per paragraphs 2.13, A7 and 3.12G.

3.9 COPPER CABLE TERMINATION BLOCKS

- A. All voice terminal blocks shall be clearly and neatly labeled with outlet (jack) or pair assignments.
- B. All outlets shall be numbered sequentially in the telecom room using a numbering assignment as shown on the drawings.
- C. All riser, tie, and data terminals shall be numbered using pre-printed identification strips. The engineer of record shall determine numbering methodology unless otherwise noted.
- D. All terminal locations shall be approved prior to installation.
- E. All work on terminals shall be accomplished using tools and support hardware designed for the SYSTIMAX and Corning systems and following procedures identified by the manufacturers.

3.10 WIRE MANAGERS

- A. Both vertical and horizontal wire managers shall be placed on each equipment rack in the telecommunications room as shown on construction drawings details. Wire managers are to provide a clear and unobstructed pathway to route jumper wires.

3.11 DATA NETWORK PATCH PANELS

- A. All data station cables shall be terminated on 48 port, category 6, rack mounted jack patch panel. All data station cables shall be terminated to T 568 B wire scheme. Data station cables are to be routed from the entry point in telecommunications room along the ladder racking in a neat and orderly way, bundled together and protected from damage or distortion.

END OF SECTION

SECTION 16725

TELECOMMUNICATIONS CABLE

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Copper Station Cable
- B. Fiber Station Cable

1.2 RELATED SECTIONS

- A. Contract Terms and Conditions
- B. Section 16710 – Telecommunications General Requirements
- C. Section 16715 – Acceptance Testing
- D. Section 16720 – Basic Materials and Methods
- E. Section 16760 – Telecommunications Grounding and Bonding

1.3 APPLICABLE PUBLICATIONS

- A. As defined in Section 16710 – Telecommunications General Requirements.

1.4 SUBMITTALS

The Contractor shall submit the following materials to the owner's representative prior to the placement of cable:

- A. Product data, including both product construction and performance specifications, for each type and configuration of cable to be supplied. Proof of Structured Cabling System certification.
- B. Copies of signed optical cable reel tests.

PART 2 - MATERIALS

2.1 COPPER STATION CABLE (CATEGORY 6, PLENUM)

A. Material

1. Application: Use for voice and data applications to interconnect services from workstation to the wiring closet in a plenum or non-plenum rated space.
2. Compliance: UL 444, UL 910, UL 1666 ISO/IEC 11801-1995, ANSI/TIA/EIA 568-B.2, NEC Listed MPP/CMP, Verified to category 6 as defined by EIA/TIA standards intended for use with transmission rates up to and including gigabit Ethernet.
3. Make up: Four unshielded twisted pair, solid annealed bare copper conductors insulated with FEP and covered with a flame retardant PVC jacket.
4. All copper station cable shall be Category 6, Plenum rated.
5. Station cables shall have a color jacket as follows:

- a. White - Voice

b. Blue - Data

B. Manufacturer: SYSTIMAX® Category 6 Cable

2.2 FIBER OPTIC STATION CABLE

A. Materials

1. Application: Intrabuilding backbone and horizontal installations in plenum environments.
2. Compliance: Meet or exceed NEC® OFNP; CSA FT-6
3. General Characteristics:
 - a. Flame retardant jacket
 - b. All-dielectric construction
 - c. 900 µm TBI® buffered fibers
 - d. Standard fiber cable from information outlet to telecommunications room. Either singlemode, multimode, or hybrid cable as noted on drawings.
 - e. Gigabit Ethernet and 10 Gigabit Ethernet performance
4. Singlemode Characteristics:
 - a. 9 µm core and /125 µm cladding.
 - b. Windows 1310 nm, 1383 nm, and 1550 nm.
 - c. Maximum attenuation:
1.0 dB/km @ 1310 nm
1.0 dB/km @ 1383 nm
.75 dB/km @ 1550 nm.
 - d. Serial 10 Gigabit Ethernet Distance: 10,000/40,000
 - e. .275 numerical aperture
 - f. Minimum pulling tension of 600 lbs.
 - g. Equipped with a breakout, furcation, or blocking kit to dress the end of the cable and eliminate the flow of fill compound
5. Multimode Characteristics:
 - a. 62.5/125 µm (core/cladding) dual window (850 and 1300 nanometers)
 - b. Maximum attenuation: 3.0 dB/km @ 850 nm and 1.5 dB/km @ 1300 nm
 - c. Minimum LED Bandwidth: 1500 MHz/km @ 850 and 500 MHz/km @ 1300 nm
 - d. e.. 275 numerical aperture
 - f. Minimum pulling tension of 600 lbs.
 - g. Equipped with a breakout, furcation, or blocking kit to dress the end of the cable and eliminate the flow of fill compound

B. Manufacturer: Corning MIC® Plenum Cable

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION

- A. All installation work shall be performed according to published industry guidelines, rules, and regulations. If disputes occur, local, state, and national codes have precedence; then College policies and procedures; then standards such as EIA/TIA; then guidelines from firms such as Building Industry Consulting Services International (BICSI), SBC, Verizon, then finally, manufacturer recommendations.

- B. The Contractor shall provide sufficient trained staff to monitor all work undertaken and ensure that the requirements of these specifications are met throughout the installation process.
- C. All tests will be conducted using equipment that has Laboratory or manufacturer certified calibration within six months of the tests. The Contractor shall provide a signed copy of the calibration test results for each item of test equipment with the acceptance documentation.
- D. All installation work will be of the highest quality. The Contractor shall at all times make every effort to conduct all installation work in a manner so as to minimize the impact on the facilities. Whenever possible, all work will be hidden behind finished materials and all surfaces will be returned to their original condition.
- E. The Contractor shall provide and install all pathway and cable support hardware necessary to successfully complete the installation. This includes, but is not limited to, hangers, ladder racks, support brackets, conduit and sleeves, firestop materials, tie-wraps, and access openings such as core drills.
- F. The Contractor shall ensure that only staff fully qualified to work on specific types of materials are allowed to undertake the required installation. Particularly, copper and fiber optic cable placement, termination, splicing, and testing shall only be undertaken by staff who are certified by the selected Structured Cabling System manufacturer.
- G. The Contractor shall provide all hardware, software, and miscellaneous components necessary to provide a complete system.
- H. The Contractor and the owner's representative shall inspect cable for cuts and abrasions that penetrate the outer sheath of the cable to see if it must be replaced or patched. The work will be scheduled so that the voice and data networks will be out of service for a minimum period of time.

3.2 COPPER STATION CABLE

- A. All copper station cables shall be neatly dressed, secured, and concealed throughout the installation. Copper station cables shall be secured with Velcro straps, but shall not deform the cable geometry. The Velcro straps shall be of a plenum-rated material if copper station cable is installed within a plenum ceiling space.
- B. No copper station cables shall be exposed in any rooms with open ceilings. A minimum of one 1 1/4" conduit shall be extended to the cable tray or telecom room.
- C. All copper station cables shall be secured a minimum of six (6) inches above the ceiling T-bar grid. Ceiling grid supports, electrical conduit, water pipes, and HVAC ducting may not be used to support cables. In those areas without adequate support structures, the Contractor shall install "J" hooks or additional ceiling grid hangers on five foot centers. Copper station cables shall not be placed within 24 inches of overhead lights or any other potential source of electrical interference.
- D. In any area in which a fire-rated wall, partition, floor, or ceiling is penetrated, the Contractor shall be responsible for creating the pathway and sealing around all copper station cables and sleeves with a UL classified fire seal sufficient to return the structure to its original rating. Creation of such openings as are necessary for copper station cable passage between locations as shown on the drawings shall be the responsibility of the Contractor. Any opening in a rated structure created by the Contractor that is larger than one inch in diameter shall be equipped with a metal sleeve secured and fire-stopped in place.

- E. In station locations with walls that must be fished, the Contractor shall place a plaster wall retaining ring or metal supporting "ears" around the outlet location to secure the outlet and faceplate. No exposed copper station cable shall be permitted.
- F. In locations where the wall will not be fished and surface-mount raceways are utilized, all raceways must be mechanically secured to the structure a minimum of every four feet, must be routed at right angles to nearby structures or wall corners, and shall be neatly installed and trimmed to fit into and around other existing moldings or pathways such as the ceiling area. Raceways shall be placed vertically only in corners of rooms and horizontal raceway placed at baseboard height to extend the cable run to the actual outlet location.
- G. All copper station cables shall have ten (10) feet of cable slack stored in the BDF/IDF and twelve (12) inches stored above the outlet. Do not store any copper station cable slack in bundled loops. Store copper station cable slack in an extended loop or in a figure 8 configuration to alleviate stress.
- H. The Contractor is responsible for removing, replacing, and repairing ceiling tiles in order to route all cables. Concealed spline ceiling tiles shall not be replaced until installation work in that area has been inspected and reviewed with College representative and the Engineer of Record and approval given to re-fix the ceiling in place.
- I. The voice network copper station cables shall be terminated on Category 6 rated patch panels or wall mounted terminal blocks as specified under Station Outlets in spec section 16720.
- J. The data network copper station cables shall be terminated on Category 6 rated patch panels.
- K. All copper station cables shall be clearly identified at both ends with a cable numbering system per TIA/EIA 606-A. All labels will be securely attached to each end of the copper station cable whenever it enters or leaves a conduit. The copper station cables shall also be labeled at thirty (30) foot intervals when run in accessible areas such as tunnels, manholes, ceilings, etc. All labels shall identify the cable type, size, and counts, as noted on the drawings.
- L. The minimum bending radius of the copper station cables must not be exceeded during cable placement, per manufacturer specifications.

3.3 LABELING REQUIREMENTS

- A. All copper and fiber optic cables shall be labeled per the requirements identified in spec section 16720.

END OF SECTION

SECTION 16760

TELECOMMUNICATIONS GROUNDING AND BONDING

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Related Sections
- B. Applicable Publications
- C. Work Sequencing and Coordination
- D. Telecommunications Submittals
- E. Quality Assurance
- F. Project Record Documents
- G. Qualifications
- H. Regulatory Requirements
- I. Performance Requirements
- J. Materials
- K. Execution

1.2 RELATED SECTIONS

- A. Section 16710 - Telecommunications General Requirements
- B. Section 16715 - Telecommunications Acceptance Testing
- C. Section 16720 - Telecommunications Basic Materials and Methods
- D. Section 16725 - Telecommunications Cable

1.3 APPLICABLE PUBLICATIONS

- A. American National Standards Institute (ANSI) Publication: C2-93 National Electrical Safety Code
- B. Electronic Industries Alliance and Telecommunication Industries Association (EIA/TIA) Publications:
 - 1. EIA/TIA 568 B - Commercial Building Telecommunications Wiring Standard 2001
 - 2. EIA/TIA 569 - Commercial Building Standard for Telecommunications Pathways and Spaces 1998
 - 3. EIA/TIA 607 - Commercial Building Grounding and Bonding Requirements for Telecommunications 1994
- C. Institute of Electrical and Electronic Engineers (IEEE) Publication: 142-1991 Recommended Practice for Grounding of Industrial and Commercial Power Systems

- D. 2001 California Electrical Code (CEC)
- E. Underwriters Laboratories, Inc. (U.L.) Publication:
 - 1. 83-1983 Thermoplastic Insulated Wires
 - 2. 467-84 (R86) Grounding and Bonding

1.4 WORK SEQUENCING AND COORDINATION

- A. The Contractor shall coordinate interconnection to the College's existing grounding and bonding system with the Project Manager/Inspector of Record. All connections to the existing buildings systems should be performed without affecting the existing building grounding system. However, if any out of service activity is required, the work shall be coordinated a minimum of fourteen (14) days in advance with the Project Manager/Inspector of Record.

1.5 SUBMITTALS

The Engineer of Record shall receive the following Contractor submittals:

- A. Product data for:
 - 1. Conductors
 - 2. Connections (all types)
 - 3. Ground Connectors (Crimp Type)
- B. Manufacturer's Instructions: include instructions for storage, handling, protection, examination, preparation and installation of exothermic connectors.

1.6 QUALITY ASSURANCE

- A. All grounding and bonding system work shall be tested and documented as defined in Section 16715 - Telecommunications Acceptance Testing.
- B. For products or workmanship specified by association, trade, Federal, or State Standards, the Contractor shall comply with the requirements of the standard, except when more rigid requirements required by applicable codes or College standards shall apply.
- C. The Contractor shall conform to reference standard by date of issue current on final design documents.

1.7 PROJECT RECORD DOCUMENTS

- A. The Contractor shall accurately record and submit to the Engineer of Record complete data regarding signal ground wire pathways, points of bonding, and point of connection to building grounds.

1.8 REGULATORY REQUIREMENTS

- A. Telecommunications grounding and bonding shall conform to requirements of CEC, NEC, and ANSI C2.

1.9 PERFORMANCE REQUIREMENTS

- A. Point-to-Point Resistance: 0.5 ohms or less.

PART 2 - MATERIALS

2.1 MATERIALS AND EQUIPMENT

- A. Materials and equipment shall conform to the respective standards and to the specifications stated herein. Electrical ratings shall be as indicated. Except where specifically indicated otherwise, the Contractor shall provide only new materials having all legally required approvals and/or labels. Materials shall conform to the requirements of UL 467 where applicable.

2.2 CONDUCTOR, UL 83

- A. Ground and bonding conductors shall be green-insulated, soft-drawn stranded copper conductors, unless otherwise indicated, installed with sufficient slack to avoid breaking due to settlement and movement of conductors or attached points.
- B. System grounding conductors shall be minimum of 3 Ø AWG bare copper, unless otherwise indicated, and shall be continuous with no joints or splices and placed in a 1" conduit.

2.3 CONNECTORS AND TERMINALS

- A. Wire Connectors and Terminals for use with Copper Conductors shall conform to UL 486-A.

2.4 GROUND BUS BARS

- A. Provide ground bar with tapped standard NEMA bolt holes for 2-hole compression connectors, mounting brackets and insulators, sizes as indicated:
 - 1. 1/4" x 4" x 12", Lyncole XIT or approved equal in the BDF.
 - 2. 1/4" x 4" x 5.25", Lyncole XIT or approved equal in all other telecommunication spaces.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. The Contractor shall provide grounding and bonding in accordance with the requirements of NFPA 70, IEEE 142, EIA/TIA 568, EIA/TIA 607, state and local codes, the University standards and to requirements specified herein. Codes shall be complied with as a minimum requirement, with these specifications prevailing when they are more stringent.

3.2 BONDING

- A. Metallic conduits, wireways, metal enclosures of busways, cable boxes, equipment housings, cable racks and all non-current carrying metallic parts of the installed telecommunications services shall be grounded with #6 AWG copper wire. The metallic conduit system shall be used for equipment and enclosure grounding but not as a system ground conductor.
- B. All metallic conduit stub-ups shall be grounded, and where multiple stub-ups are made within an equipment enclosure, they shall be equipped with grounding bushings and bonded together and to the enclosure and the enclosure ground bus.
- C. Each metallic raceway, pipe, duct and other metal object entering the buildings shall be bonded together. The Contractor shall use #6 AWG bare copper conductors.
- D. The Contractor shall bond telecommunications equipment and busbars separately.

3.3 SIGNAL REFERENCE GROUNDING AND BONDING

- A. Each identified telecommunications space within a building shall have a common signal reference ground. The signal reference ground shall conform to the following:
 - 1. Within the building, all communication spaces shall be separately bonded to each other and connected to the primary building ground in accordance with the provisions of EIA/TIA 607. The communication ground shall not ground any other equipment or be connected to any potential high voltage source. All racks, frames, drain wires, and all installed communication equipment shall only be grounded to this common reference ground with a minimum size #6 AWG copper wire.
 - 2. The Building Distribution Frame (BDF) shall be equipped with a telecommunications main grounding bus bar (TMGB) of minimum 1/4" x 4" x 12" dimensions mounted on the telecommunications backboard 6 inches above finished floor. This point of single reference shall be grounded with a minimum #3 Ø AWG ground conductor in a 1 inch diameter conduit to the main building ground. The building ground for signal reference shall be the building service entrance ground.

3.4 FIELD TESTS

- A. As an exception to requirements that may be stated elsewhere in these documents, the Inspector of Record shall be given five (5) working days notice prior to each test. The Contractor shall provide all test equipment and personnel and shall provide written copies of all test results.
- B. Grounding and bonding system conductors and connections shall be inspected for tightness and proper installation.
- C. The Contractor shall provide personnel and test equipment for point-to-point resistance tests before connecting equipment. Perform point-to-point tests to determine the resistance between the main grounding system and the BDF ground bus bar. Investigate and correct point-to-point resistance values that exceed 0.5 ohm. The Contractor shall record resistance measurements at all test point locations.

END OF SECTION

SECTION 16995

ELECTRICAL COMMISSIONING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes: Test equipment requirements, and electrical commissioning requirements.
- B. Related sections:
 - 1. General Conditions
 - 2. Section 01410, Testing & Inspection Services

PART 2 - PRODUCTS

NOT APPLICABLE

PART 3 - EXECUTION

3.1 WORK BY SUBCONTRACTORS

- A. Assist the Commissioning Agent in preparing commissioning procedures by providing data pertaining to electrical and control equipment, and installation procedures.
- B. As part of the required submittals for the Contract, submit the following:
 - 1. Within 3 months of the award of Contract, submit for each electrical system and piece of electrical equipment the manufacturer's startup and installation procedures, including field testing and diagnostic tables requiring completion prior to manufacturer issuing a valid warranty for the installation.
 - 2. Cutsheets and time current curves for circuit breakers rated for over 600 amps, and cutsheets and time current curves for circuit breakers immediately downstream of the circuit breakers rated for over 600 amps.
 - 3. Provide for System Status Table electronic files for Excel spreadsheet (Excel format) listing the location, type and status of each device being commissioned, allowing space for "comments" column. Location, type and status variables to be determined by Commissioning Agent based on specified functions of each device. Devices include, but not limited to:
 - a. Occupancy sensors
 - b. Daylighting (interior photocell) sensors.
 - c. Power and energy metering system.
 - d. Lighting control panels.
- C. Complete phases of work so functional electrical and control systems can be started, tested and calibrated.
- D. Start of commissioning procedures before system completion does not relieve electrical equipment installer from completing electrical systems in accordance with the Contract Documents and the construction schedule.
- E. Ensure that equipment and systems are installed and started in accordance with the Contract Documents and manufacturer's requirements and recommendations.

- F. Assist the Commissioning Agent in functional testing of systems slated for commissioning.

3.2 COMMISSIONING PROCEDURES

- A. Commissioning Procedures by Commissioning Agent:
 - 1. Perform and document electrical and control tests for Electrical commissioning systems through each mode of operation.
 - 2. Commissioning Agent will prepare Commissioning Procedures that will include, in field data collection format, the detailed test procedures, test conditions, and criteria for acceptance of test results.

3.3 COMMISSIONING PROCEDURE CONTENT EXAMPLE

- A. The following is intended as an example of the degree of rigor to be expected from the Commissioning Procedures. It is not intended to represent actual sequence and tests for this project.
- B. Commissioning Procedures for Daylighting Controls:
 - 1. Pre-calibration Testing:
 - a. Verify with digital photometer lighting levels in footcandles for each daylighting zone within each room under the following conditions:
 - 1) Evening hours when no natural lighting is present.
 - 2) Mid-morning when no artificial lighting is present.
 - 3) Mid-day when no artificial lighting is present.
 - 4) Mid-day when artificial lighting is present (daylighting controls disabled).
 - b. Activate daylighting control system with default settings for sensor sensitivity, deadband settings and footcandle range as listed in System Status Table. Verify the following parameters with field observation:
 - 1) Verify that lights go off when light is shined into photocell.
 - 2) Verify that lights come on when there is no light at the photocell.
 - 2. Calibration Setting: With direction from Commissioning Agent, adjust the settings at the daylighting sensor and/or control box as applicable.
 - 3. Post-Calibration Testing:
 - a. Verify with digital photometer lighting levels within room under the following conditions:
 - 1) Evening hours when no natural lighting is present.
 - 2) Mid-morning when artificial lighting is present (daylighting controls enabled).

END OF SECTION