

Conejo Recreation and Park District

Alex Fiore
Teen Center
and
Goebel
Adult Center
Improvements



Specifications
9/20/2021

TABLE OF CONTENTS

DIVISION 01 - GENERAL REQUIREMENTS

- 01 4525 Testing, Adjusting, and Balancing For HVAC
- 01 5713 Temporary Erosion and Sediment Control

DIVISION 02 - EXISTING CONDITIONS

- 02 4100 Demolition
- 02 4119 Selective Structure Demolition

DIVISION 03 - CONCRETE

- 03 0000 Concrete Work-General
- 03 0516 Underslab Vapor Barrier - Stego
- 03 1000 Concrete Forming and Accessories
- 03 2000 Concrete Reinforcing
- 03 3000 Cast-in-Place Concrete
- 03 3511 Concrete Floor Finishes

DIVISION 04 - MASONRY

- 04 2000 Unit Masonry

DIVISION 05 - METALS

- 05 5000 Metal Fabrications
- 05 7513 Decorative Metal Perforated Panels

DIVISION 06 - WOOD, PLASTICS, AND COMPOSITES

- 06 1000 Rough Carpentry
- 06 2000 Finish Carpentry
- 06 4100 Architectural Wood Casework
- 06 8316 Fiberglass Reinforced Paneling

DIVISION 08 - OPENINGS

- 08 0671 Door Hardware Schedule
- 08 1213 Hollow Metal Frames
- 08 1400 Wood Doors

DIVISION 09 - FINISHES

- 09 0561 Common Work Results for Flooring Preparation
- 09 0562 Remedial Floor Coating
- 09 2116 Gypsum Board Assemblies
- 09 3000 Tiling
- 09 5100 Acoustical Ceilings
- 09 6429 Wood Strip and Plank Flooring
- 09 6500 Resilient Flooring
- 09 6813 Tile Carpeting

Job Name: Alex Fiore Teen Center and Goebel Adult Center
Job Number: 1642-01-RC19

09 7819 Plastic Laminate Faced Paneling
09 9113 Exterior Painting
09 9123 Interior Painting
09 9750 Anti-Graffiti Coating

DIVISION 10 - SPECIALTIES

10 2113.17 Phenolic Toilet Compartments
10 2233 Accordion Folding Partitions
10 2239 Folding Panel Partitions
10 2800 Toilet, Bath, and Laundry Accessories

DIVISION 11 - EQUIPMENT

11 4000 Foodservice Equipment
11 4001 Custom Fabricated Foodservice Equipment
11 6833 Athletic Equipment

DIVISION 12 - FURNISHINGS

12 3600 Countertops

DIVISION 13 - SPECIAL CONSTRUCTION

13 3000 Shipping Container Sheds
13 3123 Pre-Engineered Fabric Tension Structures

DIVISION 21 - FIRE SUPPRESSION

21 1300 Fire Sprinkler System

DIVISION 22 - PLUMBING

22 0500 Common Work Results for Plumbing
22 0513 Basic Plumbing Materials and Methods
22 0553 Plumbing Identification
22 0700 Plumbing Insulation
22 1000 Plumbing

**DIVISION 23 - HEATING, VENTILATING, AND
AIR-CONDITIONING (HVAC)**

23 0500 COMMON WORK RESULTS FOR HVAC
23 0513 Basic HVAC Materials and Methods
23 0700 HVAC Insulation
23 3000 Air Distribution
23 3813 Kitchen Ventilation System
23 8000 Heating, Ventilating and Air Conditioning Equipment

DIVISION 26 - ELECTRICAL

26 0126 Test and Acceptance Requirements
26 0500 Common Work Results for Electrical
26 0513 Basic Electrical Materials and Methods

Job Name: Alex Fiore Teen Center and Goebel Adult Center
Job Number: 1642-01-RC19

26 0516	Medium-Voltage Cables, Splices and Terminations
26 0519	Low-Voltage Wires (600 VOLT AC)
26 0526	Grounding and Bonding
26 0533	Raceways, Boxes, Fittings, and Supports
26 0800	Electrical Systems Commissioning
26 0923	Lighting Control Systems
26 2416	Panelboards and Signal Terminal Cabinets
26 5010	Solid State (LED) Lighting
26 5617	Parking Lot LED Lighting

DIVISION 31 - EARTHWORK

31 1000	Site Clearing
31 2200	Grading
31 2316	Excavation
31 2316.13	Trenching
31 2323	Fill

DIVISION 32 - EXTERIOR IMPROVEMENTS

32 1123	Aggregate Base Courses
32 1300	Skate Park Structure Concrete Paving
32 1301	Shotcrete
32 1313	Concrete Paving
32 1413	Precast Concrete Unit Paving
32 1816.13	Playground Protective Surfacing
32 1820.00	Basketball Court Surfacing
32 3119	Decorative Metal Fences and Gates
32 3300	Site Furnishings
32 4000	Landscape Cobble
32 8423	Irrigation System
32 9223	Sodding
32 9300	Plants

DIVISION 33 - UTILITIES

33 0110.58	Disinfection of Water Utility Piping Systems
33 1416	Site Water Utility Distribution Piping
33 3113	Site Sanitary Sewerage Gravity Piping
33 4211	Stormwater Gravity Piping

SECTION 01 4525

TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 – GENERAL

1.01 SUMMARY

A. SECTION INCLUDES

1. This Section specifies the requirements for test and balance of HVAC and related systems.

B. RELATED REQUIREMENTS

1. Section 23 0513: Basic HVAC Materials and Methods.
2. Section 23 3000: Air Distribution.
3. Section 23 8000: Heating, Ventilating and Air Conditioning Equipment.

PART 2 – PRODUCTS (Not used)

PART 3 – EXECUTION

3.01 DEFINITIONS AND APPLICABLE PUBLICATIONS

A. For the purposes of this Section definitions are as indicated in applicable publications of AABC, NEBB, TABB, ASHRAE, ANSI and SMACNA.

1. TAB: Testing, Adjusting and Balancing.
2. TABB: Testing, Adjusting and Balancing Bureau.
3. AABC: Associated Air Balance Council.
4. NEBB: National Environmental Balancing Bureau.
5. ASHRAE: American Society of Heating, Refrigerating and Air-Conditioning Engineers.
6. ANSI: American National Standards Institute.
7. SMACNA: Sheet Metal and Air Conditioning Contractors' National Association.
8. OAR: OWNER'S Authorized Representative

3.02 QUALITY ASSURANCE

A. The General Contractor shall contract directly with the test and balance agency. Tests performed by testing agencies contracted with the system's subcontractor will not be accepted. The qualifications of the agency shall comply with Article 3.02, Quality Assurance. The agency shall be responsible for furnishing labor, instruments, and tools required to test, adjust, and balance the heating, ventilating, and air conditioning (HVAC) systems and related plumbing systems, as described and/or as indicated in the Contract Documents.

B. CONTRACTOR shall obtain services of an independent, qualified testing agency acceptable to Architect to perform testing and balancing Work as specified and as follows:

1. Agency shall be currently certified by either the Associated Air Balance Council (AABC), the National Environmental Balancing Bureau (NEBB), or the Testing, Adjusting and Balancing Bureau (TABB). NEBB or TABB certification shall be for Air and Hydronic Testing, Adjusting and Balancing and Sound and Vibration Measurement.
2. Work shall be in accordance with the latest edition of the AABC, NEBB, or TABB National Standards. Where the requirements of the two standards are different, the more stringent requirements shall prevail. Also, if the Contract Documents impose a more stringent standard, then the Contract Documents shall prevail.

- C. Performance Criteria: Work of this Section shall be performed in accordance with approved Testing, Adjusting, and Balancing agenda.
- D. Test Equipment Criteria: Basic instrumentation requirements and accuracy/calibration required by Section Two of the AABC, Section II of the NEBB, or TABB Procedural Standards for Testing, Adjusting and Balancing of Environmental Systems.
- E. Verification: The Test and Balance Agency shall recheck 10 percent (minimum 10) of the measurements listed in the report. The locations shall be selected by PROJECT INSPECTOR or OAR. The recheck will be witnessed by PROJECT INSPECTOR or OAR. If 20 percent of the measurements that are retested differ from the report and are also out of the specified range, an additional 10 percent will be tested. If 20 percent fall outside the specified range, the report will be considered invalid and all test and balance work shall be repeated.
- F. Due to more stringent acoustical requirements in the educational environment, the Test and Balance Agency shall recheck the air systems where the sound level is higher than the specified requirements and demonstrate compliance with the methodology specified in this document with emphasis on fan speed adjustment and balancing for optimum acoustical performance. The recheck will be witnessed by PROJECT INSPECTOR or OAR. When there are multiple air systems, a system selected by PROJECT INSPECTOR or OAR shall be rechecked. If this system is found to be not in compliance, a second system shall be checked. If the second system is also found to be not in compliance, the report will be considered invalid, and all test and balance work shall be repeated.

3.03

SUBMITTALS

- A. Submit name of agency to perform the Work. Include in the submittal the certified qualifications of all persons responsible for supervising and performing actual Work of this Section. Agency shall submit a minimum of five commercial or industrial HVAC system TAB projects of similar type, size, and degree of difficulty completed within the last two years. Agency shall provide name and telephone number of contact person for each listed project.
- B. Submit, for approval, 6 copies of the Agenda as indicated in Article 3.06 to test and balance all mechanical and relevant plumbing systems.
- C. Preliminary Report: Review the Contract Documents, examine Work installations and submit a written report to ARCHITECT, PROJECT INSPECTOR and OAR indicating deficiencies in Work precluding proper testing and balancing of the Work.
- D. Final TAB Report: Submit the final TAB report for review by ARCHITECT, PROJECT INSPECTOR, and OAR outlining the conditions and Work completed on each HVAC system. All outlets, devices, HVAC equipment, etc. shall be identified, along with a numbering system corresponding to report unit identification.
- E. Submit an AABC "National Project Performance Guaranty" or "NEBB Quality Assurance Certification", assuring the Project systems were tested, adjusted, and balanced in accordance with the Specifications and AABC, NEBB, or TABB National Standards.
- F. CAD drawings: Submit single line, multi-color CAD drawings indicating outside return and supply air, volume control boxes, each outlet and inlet, room numbers, duct sizes at traverse locations, temperatures and pressures, systems balanced, components changed, and CONTRACTOR installed access points. In addition, drawings shall identify controls, equipment settings, including manual damper quadrant positions, manual valve indicators, fan speed control levers, and similar controls, and devices shall be marked on the drawings to show final settings. CAD files shall be submitted on CD-ROM upon final submittal of TAB report. Reports shall identify discrepancies between completed

Work and the Contract Documents affecting the performance and longevity of the system.

3.04 GENERAL SCOPE OF WORK

- A. The general scope of Work shall include but not be limited to the following:
 - 1. Measure airflow rates of HVAC systems and make adjustments to achieve design airflow rates, tabulate results, and submit reports.
 - 2. Measure sound levels in each conditioned space, tabulate results, and submit reports.
 - 3. Measure ambient sound levels of outdoor HVAC units and system components such as chillers and cooling towers, tabulate results, and submit reports.
 - 6. Reports shall contain sufficient data for the system designer to evaluate system performance and solve installation problems such as system pressure profiles and pressure drops across system components

3.05 SPECIFIC SCOPE OF WORK

- A. The specific scope of Work shall include the following HVAC system components as indicated on the Drawings:
 - 1. Supply, Return, Relief and Exhaust Fans.
 - 2. All Supply and Return Ductwork.
 - 3. All associated Air Terminal Devices, i.e. Supply Diffusers, Return Registers, etc.
 - 4. Exhaust Duct Systems.

3.06 TESTING, ADJUSTING, AND BALANCING AGENDA

- A. Provide proposed materials, methods, procedures, forms, diagrams, and reports for test and balance Work.
- B. Agenda to be completed by the test and balance agency and submitted to ARCHITECT, PROJECT INSPECTOR, and OAR for review and approval.
- C. Agenda shall include one complete set of AABC, NEBB, or TABB publications listed in Sub-paragraph 3.02.B.2, applicable publications, or, in case of other test and balance agencies and or organizations, comparable publications to establish an approved, systematic, and uniform set of procedures.
- D. Agenda shall also include the following detailed narrative procedures, system diagrams, and forms for test results:
 - 1. Specific standard procedures required and proposed for each system of the Work.
 - 2. Specified test forms for recording each procedure and for recording sound and vibration measurements.
 - 3. Systems diagrams for each air, water, and steam system. Diagrams may be single line.
- E. In addition to information recorded for standard AABC, NEBB, or TABB procedures, the following information is required:
 - 1. Fan data.
 - 2. System number, location, manufacturer, model, and serial number.
 - 3. Fan wheel type and size.
 - 4. Motor horse power, type, and rpm.
 - 5. Sheave size, type, number of grooves, and open turns on Variable Pitch Sheave.
 - 6. Number and size of belts, motor and fan shaft sizes, center-to-center of shafts in inches, and adjustment available motor data, including nameplate data, actual

- amps, rated, and actual motor rpm, volts, phase, hp, kW, starter heater size, and capacity.
7. Fan design airflow and service (supply, return, outdoor air or exhaust).
 8. Fan static pressure, suction/discharge, static profile, and static control point.
- F. The following traverse data is required:
1. Traverse location, size of duct (inside dimensions), and area of duct in square feet.
 2. Column for each hole traversed/lines for each reading.
 3. Barometric pressure.
 4. Temperature/Static pressure in the duct.
 5. Actual CFM corrected to SCFM.
 6. Notes.
- G. The following air distribution data is required:
1. Room identification.
 2. Outlet or intake balance sequence number.
 3. Size of outlet or inlet.
 4. AK Factor.
 5. Design and Actual FPM and CFM.
 6. Notes.
- Q. The following sound test data is required:
1. Area or location.
 2. Sound level in dB(A) as specified in Article 3.19.
 3. Sound level at the center band frequencies of eight non-weighted octaves with equipment on and off for 5 rooms selected by the OAR/PROJECT INSPECTOR.
 4. Plot of corrected sound-level reading on Noise Criteria (NC) curve for the measurements in Q 3 above.
- R. The following vibration test data is required:
1. Equipment identification number.
 2. Vibration levels at all accessible bearings, motors, fans, pumps, casings, and isolators.
 3. Measurements in mils deflection and velocity in inches per second.
 4. Each measurement taken in horizontal, vertical, and axial planes as accessible.
- T. The following airflow station data is required:
1. Station identification number.
 2. Nameplate data including effective area.
 3. Differential test pressure or velocity.
 4. Calculated CFM.
 5. Actual CFM (from Pitot-tube traverse form).
 6. Read out CFM.
 7. Notes

3.07

PROCEDURES

- A. Schedule the Work of this Section in order for test and balance activities to be completed prior to the date of Substantial Completion. CONTRACTOR shall place all heating, ventilating, and air conditioning equipment into operation during each day and until all HVAC adjusting, balancing, testing, demonstrations, and instructions on systems are completed. Agency shall prepare and submit reports within ten (10) days from completion of the Work of this Section to allow sufficient time for corrective measures to be completed before Substantial Completion of the Work. When an individual building or portion thereof is ready for occupancy, all equipment relative to such portion of Work shall be put into service, tested, and balanced.
- B. Prior to the date of Substantial Completion, and upon completion of test and balance Work, place all exhaust fans in operation, force all air handling units, and air conditioning units into a 100 percent outdoor air economizer mode with heating and cooling locked out and flush the building continuously for a period of fourteen (14) days.
- C. Coordinate test and balance procedures with any phased Project requirements so test and balance procedures on each phased portion of the Work will be completed prior to completion of said designated phase.

3.08

FIELD EXAMINATION

- A. Before the commencement of test and balance Work, CONTRACTOR shall ascertain that following conditions are fulfilled:
 - 1. Ensure that all water heating and water cooling systems have been flushed, cleaned, and filled and high points vented.
 - 2. Boilers (steam and hot water) are filled.
 - 3. Refrigerant systems are fully charged with specified refrigerant.
 - 4. Over-voltage and current protection have been provided for motors.
 - 5. Equipment has been labeled as required.
 - 6. Curves and descriptive data on each piece of equipment to be tested and adjusted are available as required.
 - 7. Operations and maintenance manuals have been supplied.
 - 8. Controls manufacturer and boiler-burner representatives shall be available for consultation and supervision of adjustments during tests.
 - 9. Verify that heating and cooling coil fins are cleaned, combed and air filters clean, and installed.
 - 10. Verify that duct systems are clean of debris and leakage is minimized, access doors are closed and duct end caps are in place, and fire and volume dampers are in place and open.
 - 11. Automatic control systems are completed and operating.
 - 12. Start up and initial commissioning of all HVAC equipment except fans shall be by the manufacturer.
- B. In addition to the above, CONTRACTOR shall establish a specific, coordinated plan which details how each area of existing building will be balanced during the various phases of the Work. The evaluation shall address, at a minimum, the following concerns:
 - 1. OWNER operations.
 - 2. Building safety and security policies. Prior to any fire safety or security systems shutdown at any time during the Work, CONTRACTOR shall first advise and coordinate with OWNER to ensure all concerned parties are notified.
 - 3. Protecting furniture, computers, photocopiers, and other office equipment.
 - 4. Protecting room fixtures and equipment.

5. Concerns specific and unique to building related issues.
6. Downtime required for each Air Handling Unit including projected time to return each portion of the building back to its normal occupancy temperature and humidity.
7. Shutdown and reactivation of the fire alarm system to avoid accidental alarms during test and balance and related Work.

3.09 TEST AND BALANCE

A. For each heating, ventilating, or air conditioning system the following shall be performed, recorded, and submitted in an approved format for review. Make, type, and model of unit, and location of each piece of equipment shall be included in the report. Readings shall include but not be limited to following:

1. Air Systems:
 - a. General
 - 1) Verify all ductwork, dampers, grilles, registers, and diffusers have been installed per design and set in the full open position. Agency shall perform the following TAB procedures in accordance with AABC or NEBB National Standards. Where the requirements of the two standards are different, the more stringent requirements shall prevail. Also, if the Contract Documents impose a more stringent standard then the Contract Documents shall prevail.
 - b. Zone, Branch, and Main Ducts:
 - 1) Adjust ducts to within design CFM requirements by means of Pitot-tube duct traverse.
 - c. Supply Fans:
 - 1) Fan Speeds: Test and adjust fan RPM to achieve maximum or design CFM. CONTRACTOR shall provide new belt pulleys when required.
 - 2) Current and Voltage: Test and record motor voltage and amperage, and compare data with the nameplate limits. Ensure fan motor is not in or above the service factor as published by the motor manufacturer.
 - 3) Pitot-Tube Traverse: Perform a Pitot-tube traverse of main supply and return ducts, record total CFM.
 - 4) Outside Air: Test and adjust the outside air using Pitot-tube traverse.
 - 5) Static Pressure: Test and record system static profile of each supply fan.
 - 6) Current and Voltage: Test and record motor voltage and amperage, and compare data with the nameplate limits. Ensure fan motor is not in or above the service factor as published by the motor manufacturer.
 - d. Return, Relief, and Exhaust Fans:
 - 1) Fan Speeds: Test and adjust fan RPM to achieve maximum or design CFM. CONTRACTOR shall provide new belt pulleys where required.
 - 2) Pitot-Tube Traverse: Perform a Pitot-tube traverse of the main return ducts to obtain total CFM.

3. Static Pressure: Test and record system static profile of each fan.
- e. VAV Systems:
 - 1) Set volume regulators on all terminal boxes to meet design maximum and minimum CFM requirements.
 - 2) Identification: Identify the type, location, and size of each terminal box. This information shall be recorded on terminal box data sheets.
- f. Diffusers, Registers and Grilles:
 - 1) Tolerances: Test and balance each diffuser, grille, and register to within 5 percent of design requirements.
 - 2) Identification: Identify the type, location, and size of each grille, diffuser, and register. This information shall be recorded on air outlet data sheets.
- h. Duct Leakage Testing:
 - 1) On existing ductwork, agency shall calculate duct leakage by traversing the unit and reading associated diffusers.
 - 2) On new installations each and every section of the entire air distribution system (all supply, return, exhaust, and relief ductwork) shall be tested at 1.5 times design static pressure. All ducts shall demonstrate 5 percent leakage maximum (per CBC).
- j. System Pressure Profiles:
 - 1) Prepare pressure profiles from fan (supply, return, and exhaust) or air handling unit to extremities of system.
 - 2) As a minimum, show pressure at each floor, main branch, and airflow measuring device.
 - 3) Make pitot-tube traverses of all trunk lines and major branch lines where required for analysis of distribution system. Airflow measuring devices installed in ductwork, if available, may be utilized.
 - 4) Record residual pressures at inlets of volume controlled terminals at ends of system.
 - 5) Show actual pressures at all static pressure control points utilized for constant or variable flow systems.
- k. Fan speed adjustments and balancing for optimum acoustical performance:
 - 1) As the very first step, the speed of all fans (supply, return, and exhaust inside packaged equipment or air handling units) shall be adjusted to deliver the required fan total air quantity with all volume dampers and other flow rate control devices fully open. Adjustments shall be made with the outdoor air intake dampers, return air dampers, and relief air dampers in the minimum outdoor air position. The adjustments shall be made again in the 100 percent outdoor air position in systems with 100 percent outdoor air economizers.
 - 2) The above adjustment shall be done with wet cooling coils, where cooling coils are provided.

- 3) The airflow rates at each branch duct shall be adjusted as the second step with air with all volume dampers and other flow rate control devices fully open.
- 4) The airflow rates at each air inlet and outlet shall be adjusted as the final step. The volume damper in the branch duct shall be used for balancing. Opposed blade dampers at air inlets and outlets where provided shall only be used for fine adjustments and shall not be closed beyond 60 percent open or when the dampers start to generate audible noise.
- 5) CONTRACTOR shall provide the labor and materials for all dampers, pulleys, and belt changes required for balancing. The design documents indicate the worst-case scenario with safety factors in fan static pressures for contingency. Properly coordinated and installed air systems may require a lower static pressure and a reduction in fan speed.

3.10 VERIFICATION OF HVAC CONTROLS

- A. Agency shall verify in conjunction with CONTRACTOR all control components are installed in accordance with the intent of the Contract Documents and are functioning according to the design intent, including all electrical interlocks, damper sequences, air and water resets, fire stats, and other safety devices.
- B. CONTRACTOR shall verify all control components are calibrated and set for design operating conditions and intent.

3.11 TEMPERATURE TESTING

- A. To verify system control and operation, agency shall perform a series of three temperature tests taken at approximately two hour intervals in each separately controlled zone. The resulting temperatures shall not vary more than two degrees Fahrenheit from the thermostat or control set point during the tests. Outside temperature and humidity shall also be recorded during the testing periods.

3.12 BUILDING/ZONE PRESSURIZATION

- A. Agency shall test and adjust building/zone pressurization by setting the design flows to meet the required flow direction and pressure differentials. Positive/Negative area(s) supply air shall be set to design flow and exhaust air rates adjusted to obtain the required pressure differential(s).

3.13 FIRE AND SMOKE DAMPER TESTING

- A. This work is to be performed by OWNER and State Fire Marshall. Do not include in agency scope of work.

3.14 LIFE SAFETY CONTROLS TESTING

- A. This work is to be performed by OWNER and State Fire Marshall. Do not include in agency scope of Work.

3.15 FINAL TABULATION

- A. After heating, ventilating, and air conditioning components are satisfactorily tested and balanced, entire system shall be put into operation and all pressures, temperatures, gpm, cfm, velocities, etc., shall be recorded and checked against design schedules. Design requirements shall be listed on reports and final tabulation shall be within a tolerance of plus or minus five percent of design requirements.
- B. Readings at various locations as described herein will be made every hour for four (4) hours, during normal working hours for three (3) days. Boilers, forced air furnaces, and chillers shall be started up far enough in advance to meet design conditions during period of testing.

3.16 VIBRATION TESTING

- A. Furnish instruments and perform vibration measurements if specified in Division 23. Provide measurements for all rotating HVAC equipment half horsepower and larger, including reciprocating/centrifugal/screw/scroll compressors, pumps, fans, and motors.
- B. Record initial and final measurements for each unit of equipment on test forms. Where vibration readings exceed allowable tolerance and efforts to make corrections have proved unsuccessful, forward a separate report to ARCHITECT.

3.17 SOUND TESTING

- A. Perform and record sound measurements as specified in this Section and in Section 23 0548: HVAC Sound, Vibration and Seismic Control. Take additional readings if required by ARCHITECT.
- B. Measuring equipment and methods shall comply with the current requirements of the AABC, NEBB, TABB and ANSI S12.60. Take measurements with a calibrated Type 1 sound level meter and octave band analyzer.
- C. Sound reference levels, formulae, and coefficients shall be according to ASHRAE Handbook: HVAC Applications, Chapter on Sound and Vibration Control.
- D. Where sound pressure levels are specified as noise criteria or room criteria in Section 23 0548: HVAC Sound, Vibration and Seismic Control determine compliance with the Contract Documents as follows:
 - 1. Reduce background noise as much as possible by shutting off unrelated audible equipment.
 - 2. Measure octave band sound pressure levels with specified equipment "off".
 - 3. Measure octave band sound pressure levels with specified equipment "on".
 - 4. Use difference in corresponding readings to determine sound pressure due to equipment. Sound pressure level, due to equipment equals sound pressure level with equipment "on" minus factor.

DIFF.:	0	1	2	3	4	5	9-10 or More
FACTOR:	10	7	4	3	2	1	0
 - 5. Plot octave bands of sound pressure level due to equipment for typical rooms, on a graph, which also shows, noise criteria (NC) curves.
- E. Where sound levels are required in dbA, measure sound levels using the A-frequency-weighting of meter. Single value readings will be used instead of octave band analysis.
- F. Measure sound levels at each octave band as NC or RC (room criteria) if indicated in the Drawings or other Spec Sections. Where measured sound levels exceed specified level, CONTRACTOR shall take all remedial action and necessary sound tests shall be repeated. Sound tests after remedial action shall be in octave band in NC or RC for the room and also at each diffuser, grille, or register in occupied areas. Sound levels shall be measured approximately five feet above floor on a line approximately 45 degrees to center of opening, on the A- and C-frequency-weighting of the measuring instrument.
- G. Measure and record sound levels in decibels for each room per current ANSI S12.60.
- H. Report shall include ambient sound levels, taken without air-handling equipment operating, of rooms in which above openings are located. A report shall also be made of any noise caused by mechanical vibration.

END OF SECTION

Section 01 5713

Temporary Erosion and Sediment Control

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Prevention of erosion due to construction activities.
- B. Prevention of sedimentation of waterways, open drainage ways, and storm and sanitary sewers due to construction activities.
- C. Restoration of areas eroded due to insufficient preventive measures.
- D. Storm water pollution prevention and control related to construction activities.
- E. Performance bond.
- F. Compensation of CRPD for fines levied by authorities having jurisdiction due to non-compliance by Contractor.

1.02 RELATED REQUIREMENTS

- A. Section 31 1000 - Site Clearing: Limits on clearing; disposition of vegetative clearing debris.
- B. Section 31 2200 - Grading: Temporary and permanent grade changes for erosion control.

1.03 PERFORMANCE REQUIREMENTS

- A. Develop and follow an Erosion and Sedimentation Prevention Plan and submit periodic inspection reports.
- B. Do not begin clearing, grading, or other work involving disturbance of ground surface cover until applicable permits have been obtained; furnish all documentation required to obtain applicable permits.
- C. Provide to CRPD a Performance Bond covering erosion and sedimentation preventive measures only, in an amount equal to 100 percent of the cost of erosion and sedimentation control work.
- D. Timing: Put preventive measures in place as soon as possible after disturbance of surface cover and before precipitation occurs.
- E. Storm Water Runoff: Control increased storm water runoff due to disturbance of surface cover due to construction activities for this project.
 - 1. Prevent runoff into storm and sanitary sewer systems, including open drainage channels, in excess of actual capacity or amount allowed by authorities having jurisdiction, whichever is less.
 - 2. Anticipate runoff volume due to the most extreme short term and 24-hour rainfall events that might occur in 25 years.
- F. Erosion On Site: Minimize wind, water, and vehicular erosion of soil on project site due to construction activities for this project.
 - 1. Control movement of sediment and soil from temporary stockpiles of soil.
 - 2. Prevent development of ruts due to equipment and vehicular traffic.
 - 3. If erosion occurs due to non-compliance with these requirements, restore eroded areas at no cost to CRPD.
- G. Erosion Off Site: Prevent erosion of soil and deposition of sediment on other properties caused by water leaving the project site due to construction activities for this project.
 - 1. Prevent windblown soil from leaving the project site.
 - 2. Prevent tracking of mud onto public roads outside site.

3. Prevent mud and sediment from flowing onto sidewalks and pavements.
 4. If erosion occurs due to non-compliance with these requirements, restore eroded areas at no cost to CRPD.
- H. Sedimentation of Waterways On Site: Prevent sedimentation of waterways on the project site, including rivers, streams, lakes, ponds, open drainage ways, storm sewers, and sanitary sewers.
1. If sedimentation occurs, install or correct preventive measures immediately at no cost to CRPD; remove deposited sediments; comply with requirements of authorities having jurisdiction.
 2. If sediment basins are used as temporary preventive measures, pump dry and remove deposited sediment after each storm.
- I. Sedimentation of Waterways Off Site: Prevent sedimentation of waterways off the project site, including rivers, streams, lakes, ponds, open drainage ways, storm sewers, and sanitary sewers.
1. If sedimentation occurs, install or correct preventive measures immediately at no cost to CRPD; remove deposited sediments; comply with requirements of authorities having jurisdiction.
- J. Open Water: Prevent standing water that could become stagnant.
- K. Maintenance: Maintain temporary preventive measures until permanent measures have been established.

1.04 SUBMITTALS

- A. See Article 9 of General Conditions - Submittals, for submittal procedures.
- B. Erosion and Sedimentation Control Plan:
1. Include:
 - a. Site plan identifying soils and vegetation, existing erosion problems, and areas vulnerable to erosion due to topography, soils, vegetation, or drainage.
 - b. Site plan showing grading; new improvements; temporary roads, traffic accesses, and other temporary construction; and proposed preventive measures.
 - c. Where extensive areas of soil will be disturbed, include storm water flow and volume calculations, soil loss predictions, and proposed preventive measures.
 - d. Schedule of temporary preventive measures, in relation to ground disturbing activities.
 - e. Other information required by law.
 - f. Format required by law is acceptable, provided any additional information specified is also included.
 2. Obtain the approval of the Plan by authorities having jurisdiction.
 3. Obtain the approval of the Plan by CRPD.
- C. Inspection Reports: Submit report of each inspection; identify each preventive measure, indicate condition, and specify maintenance or repair required and accomplished.

PART 2 PRODUCTS

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine site and identify existing features that contribute to erosion resistance; maintain such existing features to greatest extent possible.

3.02 PREPARATION

- A. Schedule work so that soil surfaces are left exposed for the minimum amount of time.

3.03 MAINTENANCE

- A. Inspect preventive measures weekly, within 24 hours after the end of any storm that produces 0.5 inches or more rainfall at the project site, and daily during prolonged rainfall.
- B. Repair deficiencies immediately.
- C. Clean out temporary sediment control structures weekly and relocate soil on site.
- D. Place sediment in appropriate locations on site; do not remove from site.

3.04 CLEAN UP

- A. Remove temporary measures after permanent measures have been installed, unless permitted to remain by Architect.
- B. Clean out temporary sediment control structures that are to remain as permanent measures.
- C. Where removal of temporary measures would leave exposed soil, shape surface to an acceptable grade and finish to match adjacent ground surfaces.

End of Section 01 5713

Section 02 4100

Demolition

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Selective demolition of built site elements.
- B. Selective demolition of building elements for alteration purposes.
- C. Abandonment and removal of existing utilities and utility structures.

1.02 RELATED REQUIREMENTS

- A. General Conditions - Article 5: Existence of Utilities at the Site
- B. General Conditions - Article 18: Diversion of Recycled Waste Materials.
- C. General Conditions - Article 19: Removal of Hazardous Waste.
- D. General Conditions - Article 27: Protection of Work and Property.
- E. Section 31 1000 - Site Clearing: Vegetation and existing debris removal.
- F. Section 31 2323 - Fill: Filling holes, pits, and excavations generated as a result of removal operations.
- G. Section 32 9300 - Plants: Relocation of existing trees, shrubs, and other plants.
- H. Section 32 9300 - Plants: Pruning of existing trees to remain.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Fill Material: As specified in Section 31 2323 - Fill.

PART 3 EXECUTION

3.01 GENERAL PROCEDURES AND PROJECT CONDITIONS

- A. Comply with applicable codes and regulations for demolition operations and safety of adjacent structures and the public.
 - 1. Obtain required permits.
 - 2. Take precautions to prevent catastrophic or uncontrolled collapse of structures to be removed; do not allow worker or public access within range of potential collapse of unstable structures.
 - 3. Provide, erect, and maintain temporary barriers and security devices.
 - 4. Conduct operations to minimize effects on and interference with adjacent structures and occupants.
 - 5. Do not close or obstruct roadways or sidewalks without permit.
 - 6. Conduct operations to minimize obstruction of public and private entrances and exits; do not obstruct required exits at any time; protect persons using entrances and exits from removal operations.
 - 7. Obtain written permission from owners of adjacent properties when demolition equipment will traverse, infringe upon or limit access to their property.
- B. Do not begin removal until receipt of notification to proceed from CRPD.
- C. Protect existing structures and other elements that are not to be removed.
 - 1. Provide bracing and shoring.
 - 2. Prevent movement or settlement of adjacent structures.
 - 3. Stop work immediately if adjacent structures appear to be in danger.

3.02 TREE PROTECTION

- A. Comply with the tree protection notes on the drawings.

3.03 EXISTING UTILITIES

- A. Coordinate work with utility companies; notify before starting work and comply with their requirements; obtain required permits.
- B. Protect existing utilities to remain from damage.
- C. Do not disrupt public utilities without permit from authority having jurisdiction.
- D. Do not close, shut off, or disrupt existing life safety systems that are in use without at least 7 days prior written notification to CRPD.
- E. Do not close, shut off, or disrupt existing utility branches or take-offs that are in use without at least 3 days prior written notification to CRPD.
- F. Locate and mark utilities to remain; mark using highly visible tags or flags, with identification of utility type; protect from damage due to subsequent construction, using substantial barricades if necessary.
- G. Remove exposed piping, valves, meters, equipment, supports, and foundations of disconnected and abandoned utilities.

3.04 SELECTIVE DEMOLITION FOR ALTERATIONS

- A. Drawings showing existing construction and utilities are based on casual field observation and existing record documents only.
 - 1. Verify that construction and utility arrangements are as indicated.
 - 2. Report discrepancies to Architect or Owner before disturbing existing installation.
 - 3. Beginning of demolition work constitutes acceptance of existing conditions that would be apparent upon examination prior to starting demolition.
- B. Remove existing work as indicated and as required to accomplish new work.
 - 1. Remove items indicated on drawings.
- C. Protect existing work to remain.
 - 1. Prevent movement of structure; provide shoring and bracing if necessary.
 - 2. Perform cutting to accomplish removals neatly and as specified for cutting new work.
 - 3. Repair adjacent construction and finishes damaged during removal work.
 - 4. Patch as specified for patching new work.

3.05 DEBRIS AND WASTE REMOVAL

- A. Remove debris, junk, and trash from site.
- B. Leave site in clean condition, ready for subsequent work.
- C. Clean up spillage and wind-blown debris from public and private lands.

End of Section 02 4100

Section 02 4119
Selective Structure Demolition

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Selective demolition of building elements for alterations purposes.
- B. Media blasting of exterior surfaces in preparation for subsequent finish work.

1.02 RELATED SECTIONS

- A. General Conditions - Article 5: Existence of Utilities at the Site
- B. General Conditions - Article 18: Diversion of Recycled Waste Materials.
- C. General Conditions - Article 19: Removal of Hazardous Waste.
- D. General Conditions - Article 27: Protection of Work and Property.
- E. Section 01 5000 - Construction Facilities and Temporary Controls: Site fences, security, protective barriers, and waste removal.
- F. Section 01 7135 - Restoration of Improvements
- G. Section 01 7329 - Cutting and Patching
- H. Section 02 4113 - Selective Site Demolition
- I. Section 09 2513 - Acrylic Plastering
- J. Section 09 9000 - Paints and Coatings

1.03 REFERENCES

- A. NFPA 241 - Standard for Safeguarding Construction, Alteration, and Demolition Operations; 2004.

1.04 SUBMITTALS

- A. See Section 3 - Submittals
- B. Site Plan: Showing:
 - 1. Vegetation to be protected.
 - 2. Areas for temporary construction and field offices.
 - 3. Areas for temporary and permanent placement of removed materials.
- C. Project Record Documents: Accurately record actual locations of capped and active utilities and subsurface construction.

1.05 PROJECT CONDITIONS

- A. Minimize production of dust due to demolition operations; do not use water if that will result in ice, flooding, sedimentation of public waterways or storm sewers, or other pollution.

PART 3 EXECUTION

2.01 GENERAL PROCEDURES AND PROJECT CONDITIONS

- A. Comply with applicable codes and regulations for demolition operations and safety of adjacent structures and the public.
 - 1. Obtain required permits.
 - 2. Comply with applicable requirements of NFPA 241.
 - 3. Use of explosives is not permitted.

4. Take precautions to prevent catastrophic or uncontrolled collapse of structures to be removed; do not allow worker or public access within range of potential collapse of unstable structures.
 5. Provide, erect, and maintain temporary barriers and security devices.
 6. Use physical barriers to prevent access to areas that could be hazardous to workers or the public.
 7. Conduct operations to minimize effects on and interference with adjacent structures and occupants.
 8. Do not close or obstruct roadways or sidewalks without permit.
 9. Conduct operations to minimize obstruction of public and private entrances and exits; do not obstruct required exits at any time; protect persons using entrances and exits from removal operations.
 10. Obtain written permission from owners of adjacent properties when demolition equipment will traverse, infringe upon or limit access to their property.
- B. Do not begin removal until receipt of notification to proceed from CRPD.
- C. Protect existing structures and other elements that are not to be removed.
1. Provide bracing and shoring.
 2. Prevent movement or settlement of adjacent structures.
 3. Stop work immediately if adjacent structures appear to be in danger.
- D. If hazardous materials are discovered during removal operations, stop work and notify Architect and CRPD; hazardous materials include regulated asbestos containing materials, lead, PCB's, and mercury.

2.02 EXISTING UTILITIES

- A. Coordinate work with utility companies; notify before starting work and comply with their requirements; obtain required permits.
- B. Protect existing utilities to remain from damage.
- C. Do not disrupt public utilities without permit from authority having jurisdiction.
- D. Do not close, shut off, or disrupt existing life safety systems that are in use without at least 7 days prior written notification to CRPD.
- E. Do not close, shut off, or disrupt existing utility branches or take-offs that are in use without at least 3 days prior written notification to CRPD.
- F. Locate and mark utilities to remain; mark using highly visible tags or flags, with identification of utility type; protect from damage due to subsequent construction, using substantial barricades if necessary.
- G. Remove exposed piping, valves, meters, equipment, supports, and foundations of disconnected and abandoned utilities.

2.03 SELECTIVE DEMOLITION FOR ALTERATIONS

- A. Drawings showing existing construction and utilities are based on casual field observation and existing record documents only.
1. Verify that construction and utility arrangements are as shown.
 2. Report discrepancies to Architect before disturbing existing installation.
 3. Beginning of demolition work constitutes acceptance of existing conditions.
- B. Separate areas in which demolition is being conducted from other areas that are still occupied.

1. Provide, erect, and maintain temporary dustproof partitions of construction specified in Section 01 5000 in locations indicated on drawings.
- C. Maintain weatherproof exterior building enclosure except for interruptions required for replacement or modifications; take care to prevent water and humidity damage.
- D. Remove existing work as indicated and as required to accomplish new work.
 1. Remove items indicated on drawings.
 2. If rotted wood, corroded metals, or deteriorated masonry or concrete are uncovered in the work not indicated to be removed, notify Architect and CRPD.
- E. Services (Including but not limited to HVAC, Plumbing, Fire Protection, Electrical, and Telecommunications): Remove existing systems and equipment as indicated.
 1. Maintain existing active systems that are to remain in operation; maintain access to equipment and operational components.
 2. Where existing active systems serve occupied facilities but are to be replaced with new services, maintain existing systems in service until new systems are complete and ready for service.
 3. Verify that abandoned services serve only abandoned facilities before removal.
 4. Remove abandoned pipe, ducts, conduits, and equipment, including those above accessible ceilings; remove back to source of supply where possible, otherwise cap stub and tag with identification.
- F. Media Blasting
 1. Remove existing finishes of exterior surfaces to remain to receive subsequent finishes including but not limited to paint or acrylic plaster.
 2. Protect adjacent surfaces to remain.
- G. Protect existing work to remain.
 1. Prevent movement of structure; provide shoring and bracing if necessary.
 2. Perform cutting to accomplish removals neatly and as specified for cutting new work.
 3. Repair adjacent construction and finishes damaged during removal work.
 4. Patch as specified for patching new work.

2.04 DEBRIS AND WASTE REMOVAL

- A. Remove debris, junk, and trash from site.
- B. Remove from site all materials not to be reused on site; comply with requirements of Section 01 7419 - Waste Management.
- C. Leave site in clean condition, ready for subsequent work.
- D. Clean up spillage and wind-blown debris from public and private lands.

Section 03 0000
Concrete Work-General

THIS SECTION PROVIDED BY STRUCTURAL ENGINEER
End of Section 03 0000

Section 03 0516

Underslab Vapor Barrier - Stego

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Sheet vapor barrier under new concrete slabs on grade.

1.02 RELATED REQUIREMENTS

- A. Section 02 4119 - Selective Structure Demolition
- B. Section 03 1000 - Concrete Forming and Accessories: Forms and accessories for formwork.
- C. Section 03 2000 - Concrete Reinforcing.
- D. Section 03 3000 - Cast-in-Place Concrete: Preparation of subgrade, granular fill, placement of concrete.

1.03 REFERENCE STANDARDS

- A. ASTM E1643 - Standard Practice for Selection, Design, Installation and Inspection of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs; 2011.
- B. ASTM E1745 - Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs; 2011.

1.04 SUBMITTALS

- A. See Section 01 3300 - Submittals, for submittal procedures.
- B. Product Data: Submit manufacturers' data on manufactured products.
 - 1. Manufacturer's samples and literature.
 - 2. Manufacturer's installation instructions for placement, seaming, penetration prevention and repair, and perimeter seal per ASTM E1643.
 - 3. Summary of test results per paragraph 9.3 of ASTM E1745.
 - 4. Provide third party documentation that all testing was performed on a single production roll per ASTM E1745 Section 8.1
- C. Test Data: Submit report of tests showing compliance with specified requirements.
- D. Manufacturer's Installation Instructions: Indicate installation procedures and interface required with adjacent construction.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Underslab Vapor Barrier:
 - 1. Water Vapor Permeance: Not more than 0.010 perms, maximum [grains/(ft² ? hr ? inHg)] as tested in accordance with mandatory conditioning tests per ASTM E1745 Section 7.1 (7.1.1-7.1.5).
 - 2. Complying with ASTM E1745 Class A.
 - 3. Thickness: 15 mils.
 - 4. Manufacturers:
 - a. Stego Industries LLC; Stego Wrap Vapor Barrier (15-mil) Basis of Design: www.stegoindustries.com.
 - b. Perminator 15 mils, polyolefin by W.R. Meadows.
 - c. Moistop Ultra 15 mils, polyolefin by Fortifiber
 - d. VaporBlock 15 mils, polyethylene by Raven Industries.

- B. Accessory Products: Vapor barrier manufacturer's recommended tapes, adhesive, mastic, etc., for sealing seams and penetrations in vapor barrier and forming/screeding accessories to prevent undue penetrations of the membrane.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that surface over which vapor barrier is to be installed is complete and ready before proceeding with installation of vapor barrier.

3.02 INSTALLATION

- A. Install vapor barrier in accordance with manufacturer's instructions and ASTM E1643.
 - 1. Unroll vapor barrier with the longest dimension parallel with the direction of the concrete placement and face laps away from the expected direction of the placement whenever possible.
 - 2. Extend vapor barrier to the perimeter of the slab. If practicable, terminate it at the top of the slab, otherwise (a) at a point acceptable to the structural engineer or (b) where obstructed by impediments, such as dowels, water stops, or any other site condition requiring early termination of the vapor barrier. At the point of termination, seal vapor barrier to the foundation wall, grade beam or slab itself.
 - 3. Apply seam tape/textured tape/double-sided tape to a clean and dry vapor barrier.
 - 4. Seal all penetrations (including pipes) per manufacturer's instructions.
 - 5. Avoid the use of stakes driven through vapor barrier by utilizing screed and forming systems that will not leave punctures in the vapor barrier.
 - 6. Repair damaged areas with vapor barrier material of similar (or better) permeance, puncture and tensile.
- B. Lap joints minimum 6 inches and seal with manufacturer's tape.
- C. Seal joints, seams and penetrations watertight with manufacturer's recommended products and follow manufacturer's written instructions.
- D. No penetration of vapor barrier is allowed except for reinforcing steel and permanent utilities.
- E. Repair damaged vapor retarder before covering with other materials.
- F. Where installing in existing building tie into existing vapor barrier if possible.

End of Section 03 0516

Section 03 1000

Concrete Forming and Accessories

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Formwork for cast-in-place concrete, with shoring, bracing and anchorage.
- B. Installation of items to be embedded in concrete, such as anchor bolts, inserts, embeds, and sleeves.
- C. Openings for other work.
- D. Form accessories.
- E. Form stripping.

1.02 RELATED REQUIREMENTS

- A. Section 03 2000 - Concrete Reinforcing.
- B. Section 03 3000 - Cast-in-Place Concrete.
- C. Section 05 1200 - Structural Steel Framing: Placement of embedded steel anchors and plates in cast-in-place concrete.

1.03 REFERENCE STANDARDS

- A. ACI 117 - Standard Specifications for Tolerances for Concrete Construction and Materials; 2010.
- B. ACI 301 - Specifications for Structural Concrete; 2010 (Errata 2012).
- C. ACI 318 - Building Code Requirements for Structural Concrete and Commentary; 2011.
- D. ACI 347R - Guide to Formwork for Concrete; 2014.
- E. PS 1 - Structural Plywood; 2009.

1.04 SUBMITTALS

- A. See General Conditions - Article 9, for submittal procedures.
- B. Product Data: Provide data on void form materials and installation requirements.
- C. Shop Drawings: Indicate pertinent dimensions, materials, bracing, and arrangement of joints and ties. Review and approval will not include form strength and adequacy.
- D. Keep an accurate record of the dates of removal of forms, form shores and reshores, and furnish copies to the SEOR.

1.05 QUALITY ASSURANCE

- A. Construct forms according to ACI 347, "Guide to Formwork for Concrete," and conforming to tolerances of ACI 117, "Standard Specifications for Tolerances for Concrete Construction and Materials"

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver prefabricated forms and installation instructions in manufacturer's packaging.
- B. Store prefabricated forms off ground in ventilated and protected manner to prevent deterioration from moisture.

PART 2 PRODUCTS

2.01 FORMWORK - GENERAL

- A. Provide concrete forms, accessories, shoring, and bracing as required to accomplish cast-in-place concrete work.
- B. Design and construct concrete that complies with design with respect to shape, lines, and dimensions.
- C. Comply with applicable state and local codes with respect to design, fabrication, erection, and removal of formwork.
- D. Comply with relevant portions of ACI 347R, ACI 301, and ACI 318.

2.02 WOOD FORM MATERIALS

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

2.03 FORMWORK ACCESSORIES

- A. Form Release Agent: Capable of releasing forms from hardened concrete without staining or discoloring concrete or forming bugholes and other surface defects, compatible with concrete and form materials, and not requiring removal for satisfactory bonding of coatings to be applied.
 - 1. VOC Content: In compliance with applicable local, State, and federal regulations.
 - 2. Products:
 - a. SpecChem, LLC; Bio Strip WB (water-based): www.specchemllc.com/#sle.
 - b. W. R. Meadows, Inc; Duogard: www.wrmeadows.com/#sle.
- B. Dowel Sleeves: Plastic sleeve and nailable plastic base for smooth, round, steel load-transfer dowels.
- C. Filler Strips for Chamfered Corners: Rigid plastic type; ____ by ____ inch size; maximum possible lengths. Provide _____ manufactured by _____.
- D. Nails, Spikes, Lag Bolts, Through Bolts, Anchorages: Sized as required, of sufficient strength and character to maintain formwork in place while placing concrete.
- E. Embedded Anchor Shapes, Plates, Angles and Bars: As specified in Section 05 1200.

PART 3 EXECUTION

3.01 EXAMINATION

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

3.02 EARTH FORMS

- A. Earth forms are not permitted.

3.03 ERECTION - FORMWORK

- A. Erect formwork, shoring and bracing to achieve design requirements, in accordance with requirements of ACI 301.
- B. Provide bracing to ensure stability of formwork. Shore or strengthen formwork subject to overstressing by construction loads.
- C. Arrange and assemble formwork to permit dismantling and stripping. Do not damage concrete during stripping. Permit removal of remaining principal shores.

- D. Form Joints: Align joints and make watertight. Keep form joints to a minimum. Fill joints to produce smooth surfaces, intersections, and arises. Use polymer foam or equivalent fillers at joints and where forms abut or overlap existing concrete to prevent leakage of mortar.
- E. Coordinate this section with other sections of work that require attachment of components to formwork.

3.04 APPLICATION - FORM RELEASE AGENT

- A. Apply form release agent on formwork in accordance with manufacturer's recommendations.
- B. Do not apply form release agent where concrete surfaces will receive special finishes or applied coverings that are affected by agent. Soak inside surfaces of untreated forms with clean water. Keep surfaces coated prior to placement of concrete.

3.05 INSERTS, EMBEDDED PARTS, AND OPENINGS

- A. Provide formed openings where required for items to be embedded in passing through concrete work.
- B. Locate and set in place items that will be cast directly into concrete.
- C. Coordinate with work of other sections in forming and placing openings, slots, reglets, recesses, sleeves, bolts, anchors, other inserts, and components of other work.
- D. Install accessories in accordance with manufacturer's instructions, so they are straight, level, and plumb. Ensure items are not disturbed during concrete placement.

3.06 FORMWORK TOLERANCES

- A. Construct formwork to maintain tolerances required by ACI 117, unless otherwise indicated.

3.07 FIELD QUALITY CONTROL

- A. Do not reuse wood formwork more than 3 times for concrete surfaces to be exposed to view. Do not patch formwork.

3.08 FORM REMOVAL

- A. Do not remove forms or bracing until concrete has gained sufficient strength to carry its own weight and all superimposed loads as determined by testing field cured cylinders, but not sooner than specified in ACI 347 Section 3.6.2.3. Load supporting forms may be removed when concrete has attained 75 percent of required 28 day compressive strength, but no sooner than 3 days, provided construction is reshored. Vertical formwork for cast in place concrete walls may be removed no sooner than 1 day following concrete placement, provided that the contractor can demonstrate that no sloughing or sagging of concrete will occur.
 - 1. Reshore structural members as specified per ACI 347.
 - 2. Remove formwork progressively so unbalanced loads are not imposed on the structure.
 - 3. Avoid damage to concrete surfaces during removal.
 - 4. Remove formwork in same sequence as concrete placement to achieve similar concrete surface coloration.
- B. Loosen forms carefully. Do not wedge pry bars, hammers, or tools against finish concrete surfaces scheduled for exposure to view.

End of Section 03 1000

Section 03 2000
Concrete Reinforcing

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Reinforcing Steel for Concrete Foundations
- B. Reinforcing Steel for Concrete Slabs on Grade
- C. Supports and accessories for steel reinforcement.

1.02 RELATED REQUIREMENTS

- A. Drawings and general provisions of the Contract, Including General and Supplementary Conditions Division 01 Specification Sections, apply to this Section.
- B. Section 03 1000 - Concrete Forming and Accessories.
- C. Section 03 3000 - Cast-in-Place Concrete.

1.03 REFERENCE STANDARDS

- A. ACI 301 - Specifications for Structural Concrete; 2010 (Errata 2012).
- B. ACI 315 - Manual of Standard practice for Detailing Reinforced Concrete Structures; 2011.
- C. ACI 318 - Building Code Requirements for Structural Concrete and Commentary; 2011.
- D. ACI SP-66 - ACI Detailing Manual; 2004.
- E. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon Steel Bars for Concrete Reinforcement; 2015.
- F. ASTM A706/A706M - Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement; 2014.
- G. AWS D1.4/D1.4M - Structural Welding Code - Reinforcing Steel; 2011.
- H. CRSI (DA4) - Manual of Standard Practice; 2009.
- I. CRSI (P1) - Placing Reinforcing Bars; 2011.

1.04 SUBMITTALS

- A. See Section 01 3300 - Submittal Procedures, for submittal procedures
- B. Shop Drawings: Comply with requirements of ACI SP-66. Include the following:
 - 1. complete bar layout
 - 2. representative sections
 - 3. details for congested conditions
 - 4. proposed layout where vertical and horizontal bars intersect
 - 5. bar schedules
 - 6. typical bending diagrams and offsets
 - 7. shapes of bent bars
 - 8. spacing of bars
 - 9. splice lengths and locations
- C. Reports: Submit certified copies of mill test report of reinforcement materials analysis.

1.05 QUALITY ASSURANCE

- A. Comply with the pertinent provisions of 01 43 00 "Quality Requirements."
- B. Perform work of this section in accordance with ACI 301.

1.06 DELIVERY STORAGE AND HANDLING

- A. Comply with pertinent provisions of Division 01 Section 01 6000 "Product Requirements," delivering materials in a timely manner to ensure uninterrupted progress.
- B. Bundle bars, tag with identification, and transport and store so as not to damage any material. Use metal tags indicating size, length and other marking shown on placement drawings. Maintain tags after bundles are broken
- C. Avoid exposure to dirt, moisture or conditions harmful to reinforcement.

1.07 EXTRA MATERIAL

- A. Provide an allowance of an additional 10% of the total reinforcing steel tonnage in addition to the quantities shown on the drawings. This additional steel shall be installed in sizes and locations as directed by the structural engineer.

PART 2 PRODUCTS

2.01 REINFORCEMENT

- A. Reinforcing Steel: ASTM A615/A615M, Grade 60 (60,000 psi).
 - 1. Deformed billet-steel bars.
 - 2. Unfinished.
 - 3. Only to be used for conditions where bars will not be welded.
- B. Reinforcing Steel: ASTM A706/A706M, Grade 60 (60,000 psi) deformed low-alloy steel bars.
 - 1. Unfinished.
 - 2. Used in all cases where welding of bars is required.
- C. Reinforcement Accessories:
 - 1. Tie Wire: ASTM A82, Annealed copper bearing steel, minimum 16 gage, 0.0508 inch.
 - 2. Chairs, Bolsters, Bar Supports, Spacers: Sized and shaped for adequate support of reinforcement during concrete placement. Standard manufactured products shall conform to the Concrete Reinforcing Institute, "Manual of Stand Practice," latest edition.
 - 3. Use dense precast concrete supports with embedded wire ties for reinforcement placed on grade. Elsewhere, use wire bar supports.
- D. Welding electrodes: AWS D1.4, Table 5.1 and 5.3, low hydrogen electrodes, E8018 for Grade 60 Steel.

2.02 Re-bar Splicing:

- A. Coupler Systems: Mechanical devices for splicing reinforcing bars conforming to the requirements of ACI 318-14 Section 25.5.7.1; capable of developing 1.25fy of the steel reinforcing yield strength in tension and compression.

All mechanical splices in Special Structural Walls, Special Moment Frames and Concrete Diaphragms shall be Type 2 conforming to the requirements of ACI 318-11 Section 18.2.7.1-18.2.7.2 & 25.5.7.1; capable of developing 1.25fy of the steel reinforcing yield strength in tension and compression and develop the specified tensile strength of the spliced bars.

- 1. Products:
 - a. Dayton Superior Corporation; Bar Lock Coupler System: www.daytonsuperior.com (ICC-ESR 2481).
 - b. Lenton Lock Couplers (IAPMO-ES 129).
- B. Dowel Bar Splicer with Dowel-Ins: Mechanical devices for connecting dowels; capable of developing full steel reinforcing design strength in tension and compression.

1. Products:
 - a. Dayton Superior Corporation; _____: www.daytonsuperior.com/#sle.
 - b. Lenton Form Savers (IAPMO-ES 129).

2.03 FABRICATION

- A. Fabricate concrete reinforcing in accordance with CRSI (DA4) - Manual of Standard Practice.
- B. Bending and Forming
 1. Fabricate bars of the indicated sizes and bend and form to required shapes and lengths by methods not injurious to materials
 2. Do not heat reinforcement for bending
 3. Bend bars No. 6 size and larger in the shop only.
 4. Bars with unscheduled kinks or bends are subject to rejection.
 5. Use only tested and approved bar materials
- C. Locate reinforcing splices not indicated on drawings at point of minimum stress. Review locations of splices with SEOR.

PART 3 EXECUTION

3.01 PLACEMENT

- A. Before placing bars, and again before concrete is placed, clean bars of loose rust and/or mill scale, dirt, oil, or any other coating that may be deleterious or could reduce bond with the concrete.
- B. Securing in place:
 1. Accurately place bars and wire tie in precise position where bars cross.
 2. Bend ends of wire ties away from the forms.
 3. Wire tie bars to the corners of ties and stirrups.
 4. Support bars according to the Concrete Reinforcing Steel Institute (CRSI) "Placing Reinforcing Bars," using approved accessories and chairs.
 5. Place precast concrete cubes with embedded wire ties to supporting reinforcing steel bars in concrete placed on grade and in footings.
 6. Take adequate precautions to ensure that reinforcing bar position and spacing is maintained during concrete placement.
- C. Do not displace or damage vapor barrier.
- D. Maintain concrete cover around reinforcing as follows:
 1. Refer to Drawings for cover requirements
- E. Splices:
 1. Do not splice reinforcing bars at the points of maximum stress except where indicated.
 2. Lap splices as shown or required to develop the full strength or stress of the bars.
 3. Stagger splices in horizontal wall bars at least 48" longitudinally in alternate bars and opposite faces.

3.02 FIELD QUALITY CONTROL

- A. Comply with all pertinent provisions of Division 01 Section 01 40 00 "Quality Requirements".
- B. Supervision: Perform Work to this Section under supervision of a capable superintendent.
- C. An independent testing agency, as specified in Section 01 40 00, shall inspect installed reinforcement for conformance to contract documents before concrete placement.

End of Section 03 2000

Section 03 3000
Cast-in-Place Concrete

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Section Includes cast-in-place concrete, concrete materials, mixture design, placement procedures and finishes for the following:
- B. Joint devices associated with concrete work.
- C. Miscellaneous concrete elements, including equipment pads, equipment pits, light pole bases, flagpole bases, thrust blocks, and manholes.
- D. Concrete curing.
- E. Concrete Foundations
- F. Concrete Seatwalls.

1.02 RELATED REQUIREMENTS

- A. Drawings and general provisions of the Contract, Including General and Supplementary Conditions Division 01 Specification Sections, apply to this Section
- B. Section 03 2000 - Concrete Reinforcing.
- C. Section 32 3300 - Site Furnishings: Seatwalls.

1.03 REFERENCE STANDARDS

- A. ACI 117 - Standard Specifications for Tolerances for Concrete Construction and Materials; 2010.
- B. ACI 211.1 - Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete; 1991 (Reapproved 2009).
- C. ACI 301 - Specifications for Structural Concrete; 2010 (Errata 2012).
- D. ACI 302.1R - Guide for Concrete Floor and Slab Construction; 2004 (Errata 2007).
- E. ACI 304R - Guide for Measuring, Mixing, Transporting, and Placing Concrete; 2000.
- F. ACI 305R - Hot Weather Concreting; 2010.
- G. ACI 306R - Cold Weather Concreting; 2010.
- H. ACI 308R - Guide to Curing Concrete; 2001 (Reapproved 2008).
- I. ACI 309R - Guide for Consolidation of Concrete
- J. ACI 318 - Building Code Requirements for Structural Concrete and Commentary; 2011.
- K. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon Steel Bars for Concrete Reinforcement; 2015.
- L. ASTM A706/A706M - Standard Specification for Deformed and Plain Low-Alloy Steel Bars for Concrete Reinforcement; 2015.
- M. ASTM C33/C33M - Standard Specification for Concrete Aggregates; 2016.
- N. ASTM C39/C39M - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens; 2015a.
- O. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete; 2015.
- P. ASTM C109/C109M - Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or (50-mm) Cube Specimens); 2013.

- Q. ASTM C143/C143M - Standard Test Method for Slump of Hydraulic-Cement Concrete; 2012.
- R. ASTM C171 - Standard Specification for Sheet Materials for Curing Concrete; 2007.
- S. ASTM C260/C260M - Standard Specification for Air-Entraining Admixtures for Concrete; 2010a.
- T. ASTM C494/C494M - Standard Specification for Chemical Admixtures for Concrete; 2013.
- U. ASTM C618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete; 2015.
- V. ASTM C685/C685M - Standard Specification for Concrete Made by Volumetric Batching and Continuous Mixing; 2014.
- W. ASTM C1602/C1602M - Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete; 2012

1.04 SUBMITTALS

- A. See Section 01 3300 - Submittals for submittal procedures.
- B. Product Data: Comply with the pertinent provisions of Section 01 60 00 " Product Requirements." Submit manufacturers' data on manufactured products showing compliance with specified requirements and installation instructions.
 - 1. Material Certificates: For Each of the following, signed by the manufacturer(s)
 - a. Cementitious materials
 - b. Admixtures
 - c. Curing compounds
 - 2. Material Test Reports: For the following, from a qualified testing agency, indicating compliance with the requirements:
 - a. Aggregates
- C. Mix Design: Submit proposed concrete mix design(s). For each concrete mixture:
 - 1. Indicate Intended Locations for use
 - 2. Indicate proposed mix design complies with requirements of ACI 301, Section 4 - Concrete Mixtures.
 - 3. Indicate proposed mix design complies with requirements of ACI 318, Chapter 5 - Concrete Quality, Mixing and Placing.
 - a. Mixes shall be based on existing approved compressive strength test data for concrete mixes in accordance with ACI 318 Section 5.3.1.1 and requirements below:
 - 1) Strength Requirements: Design mixes for structural concrete for minimum 28-day compressive strengths required by Drawings and Specifications. The trial batch strength for each mix shall exceed indicated or specified strength by 750 psi or a lesser amount based on the standard deviations of strength test records according to ACI 318.
 - 2) Normal Weight Concrete Mix Design: Design all mixes for workability and durability of concrete. Control the mixes in accordance with the CBC, ACI 318 Section 5.2, ACI 211.1, Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete, and Chapter 4, ACI 318, Building Code Requirements for Reinforced Concrete. Make adjustments in cement content required for concrete strengths at Contractor's expense and do not exceed 0.50 (or as indicated on concrete general notes of approved plans) absolute water-cement or cement plus fly ash ratio by weight. Do not use calcium chloride or any admix containing such material. Admixtures containing a

- material releasing nitrates in solution are limited to 0.06 percent by weight for the chloride ion.
- 3) Maximum Aggregate Sizes: Not exceeding 3/4 of minimum clear space between bars and between bars and forms, nor larger than 1/5 of least dimensions between the forms.
Design the mixes with 1" maximum size, except maximum 1-1/2" size for foundations as submitted by the contractor and approved by the Architect and Structural Engineer of Record.
 - 4) Pumped Concrete: Design Concrete mixes specifically for pump placing with dry loose volume of fine aggregates not more than 47 percent of total aggregates.
 - 5) ACI 318 Section 5.3.1.1 with test records. Where a testing laboratory acceptable to the enforcement agency has records of compressive strength tests, a standard deviation shall be established. Test records from which a standard deviation is calculated shall:
 - (a) Represent materials, quality control procedures and conditions similar to those expected, and changes in materials and proportions within the test records shall not have been more restricted than those for proposed work.
 - (b) Represent concrete produced to meet a specified strength or strengths $f'c$ within 1,000 psi of that specified for proposed work.
 - (c) Must consist of at least 30 consecutive tests or two groups of consecutive tests totaling at least 30 tests as defined in ACI 318 Section 5.3.1.1, except as provided in ACI 318 Section 5.3.1.2.
4. Include alternate mix designs when characteristics of materials, project conditions, weather, test results, or other circumstances warrant adjustments.
- D. Samples for Pigment Color Selection: Submit manufacturer's complete sample chip set, including pigment number and required dosage rate for each color.
 - E. Verification Samples: Submit sample chips of specified colors indicating pigment numbers and required dosage rates, for subsequent comparison to installed concrete.
 - F. Test Reports: Submit report for each test or series of tests specified.
 - G. Manufacturer's Installation Instructions: For concrete accessories, indicate installation procedures and interface required with adjacent construction.
 - H. Delivery Tickets: With each transit truck provide delivery ticket, signed by an authorized representative from the batch plan, containing all information required by ASTM C94, as well as time batched, type of brand of cement, cement content, maximum size of aggregate and total water content.

1.05 QUALITY ASSURANCE

- A. Comply with the pertinent provisions of 01 40 00 "Quality Requirements."
- B. Qualifications
 1. Installer Qualifications: And experienced installer who has completed concrete work similar in material, design, and extend to that indicated for this project and whose work has resulted in construction with a record of successful in-service performance. Adequate numbers of trained and experienced personnell shall be used.

2. **Manufacturer Qualifications:** The production facility supplying hydraulic cement concrete shall have a current Certification of Ready Mixed Concrete Production Facilities from the National Ready Mixed Concrete Association, or equivalent.
 3. **Concrete Testing and Inspection Services:** The owner shall engage a qualified Independent Testing Agency to perform evaluation test and special inspections per Structural Notes on Drawings and as required per the code. Personnel conducting test shall be qualified as ACI Concrete Field Testing Technician, Grade 1 according to ACI CP-1 or an equivalent program.
- C. Perform work of this section in accordance with ACI 301 and ACI 318.
1. Maintain one copy of each document on site.
- D. **Source Quality Control:** Refer to the following paragraphs for specific procedures. Concrete materials which, by previous tests or actual service, have shown conformance may be used without testing when so approved by SEOR. Testing laboratory shall perform the following conformance testing
1. **Cementitious Material Test:** The concrete supplier shall furnish to the enforcement agency certification from the cement manufacturer that the cement proposed for use on the project has been manufactured and tested in compliance with the requirements of ACI 318-11 Section 3.2.1 and the ASTM standards listed in the materials section of this Specification.
 2. **Aggregates for Normal Weight Concrete:** Test the aggregate before and after concrete mix is designed and whenever character of aggregate varies or source of material is changed in accordance with ASTM C33 and CBC. Include a sieve analysis. Obtain samples of aggregates at the dry batching or ready-mix concrete plant in accordance with ASTM D75 and perform tests for the properties listed in the following table:

Physical Properties		
Physical Properties, units	Test Method	Minimum Values
Sieve analysis	ASTM C136	Loss after 5 cycles not more than 8 percent of coarse aggregate, nor more than 10 percent of fine aggregate
Organic impurities	ASTM C40	Fine aggregate not darker than reference standard color
Soundness	ASTM C88	
Abrasion	ASTM C131	Weight loss not more than 10.5 percent after 100 revolutions, 42 percent after 500 revolutions
Deleterious materials	ASTM C33, C330	
Materials finer than No. 200 sieve	ASTM C117	Not over 1 percent for gravel, 1.5 percent for crushed aggregate
Reactivity potential	ASTM C227, C289, C342	Ratio of silica released to reduction in alkalinity not to exceed 1.0.
Sand equivalent	ASTM D2419	California sand equivalent values operating range not below 71 percent

3. **Concrete Batch Plant Inspections:** Conform to CBC and ACI. Continuous batch plant inspection is required for structural concrete, performed by a specially qualified inspector.

- E. Compliance with Regulations: All materials shall comply with the current rules and regulations of the local air quality management district, with the rules regarding volatile organic compounds, and with FDA rules and regulations for dangerous substances in construction products.
- F. Allowable Tolerances: Construct concrete conforming to the tolerances specified in ACI 117 "Recommended Tolerances for Concrete Construction and Materials", as applicable, unless exceeded by the requirements of regulatory agencies or otherwise indicated or specified.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Comply with pertinent provisions of Section 01 60 00, "Product Requirements."
- B. Ready-mix concrete shall be mixed and delivered in accordance with ASTM C 94. Each batch of concrete delivered to the Project site shall be accompanied by a time slip bearing departure time and signature of batch plant supervisor. Concrete shall be placed within 90 minutes after start of mixing. Concrete which has developed initial set shall not be used. Concrete which has partially hardened shall not be used. Deliver all materials in timely manner to ensure uninterrupted progress of the work.
- C. Deliver, store and handle all cement and aggregate materials so as to prevent their deterioration or intrusion by foreign matter. Deteriorated or contaminated materials shall not be furnished.

1.07 JOB CONDITIONS

- A. Cold Weather Requirements:
 - 1. Follow recommendations of ACI 306R when concreting during cold weather.
 - 2. Adequate equipment shall be provided for heating concrete materials and protecting concrete during freezing or near-freezing weather. Surfaces, in which concrete is to come in contact with, shall be free from frost or ice. No frozen materials or materials containing ice shall be furnished.
 - 3. When placing concrete during freezing or near-freezing weather the mix shall have a temperature of at least 50 degrees F., but not more than 90 degrees F. when cement is added. Concrete shall be maintained at a temperature of at least 50 degrees F. for at least 72 hours after placing or until it has thoroughly hydrated. When necessary, concrete materials shall be heated before mixing. Special precautions shall be provided for protection of transit-mixed concrete.
- B. Hot Weather Requirements:
 - 1. Follow recommendations of ACI 305R when concreting during hot weather.
 - 2. During hot weather, proper attention shall be provided for ingredients, production methods, handling, placing, protection and curing, to prevent excessive concrete temperatures or water evaporation which could impair required strength or durability.

PART 2 PRODUCTS

2.01 FORMWORK

- A. Comply with requirements of Section 03 1000.

2.02 REINFORCEMENT MATERIALS

- A. Comply with requirements of Section 03 2000.

2.03 CONCRETE MATERIALS

- A. Cement: ASTM C150/C150M, Type II - Moderate Portland type, low alkali. Provide Type V where concrete is in contact with soil corrosive to concrete. Use Type III from one batch by a single source for all architecturally exposed concrete.

- B. Fine and Coarse Aggregates: ASTM C 33, C330, and C 227, from approved pits, free from vegetable matter and of opaline, feldspar, or siliceous magnesium substances; all washed, clean, hard, fine-grained sound crushed rock or gravel; not over 5 percent by weight of flat, thin, elongated, friable, or laminated pieces (pieces having major dimension over 5 times average dimension) or more than 2 percent by weight of shale or cherty material. Any suitable individual grading of coarse aggregate may be furnished, provided Grading of Combined Aggregate indicated in following table is obtained.

GRADING OF COMBINED AGGREGATE

Sieve Number or Size in Inches	1-1/2" Maximum (Percent)	1" Maximum (Percent)	3/4" Maximum (Percent)
Passing a 2"	-	-	-
Passing a 1-1/2"	95-100	-	-
Passing a 1"	70-90	90-100	-
Passing a 3/4"	50-80	70-95	90-100
Passing a 3/8"	40-60	45-70	55-75
Passing a No. 4	35-55	35-55	40-60
Passing a No. 8	25-40	27-45	30-46
Passing a No. 16	16-34	20-38	23-40
Passing a No. 30	12-25	12-27	13-28
Passing a No. 50	2-12	5-15	5-15
Passing a No. 100	0-3	0-5	0-5

- C. Water: Water shall be potable and free from deleterious matter or shall otherwise satisfy the requirements of ASTM C1602.
- D. Pozzolan: ASTM C618, Class F or N Fly Ash (Class C Not permitted) subject to the conditions of the CBC, containing two percent or less carbon. Fly ash shall not be used in excess of 15 percent by weight of total cement quantity for structural concrete. Where fly ash replacement is 25% or higher, maximum water-cement ratio shall be 0.45. Fly ash need not be included in lightweight concrete mix designs.
- E. Water: Clean, potable and not detrimental to concrete, complying with ASTM C94 and ASTM C1602

2.04 ADMIXTURES

- A. Admixtures to be used in concrete shall be subject to prior approval by the Structural Engineer. Where more than one admixture is used, they shall be compatible. Use of admixtures shall be consistent throughout Work.
- B. Do not use chemicals that will result in soluble chloride ions in excess of 0.1 percent by weight of cement.
- C. Air Entrainment Admixture: ASTM C260/C260M.
- D. High Range Water Reducing Admixture: ASTM C494/C494M Type F.
1. Super-Plasticizers (High Range Water Reducers): ASTM C494, Type F. Capable of producing concrete which can be placed at 8 11 inch slump without segregation, capable of maintaining slump within 2" of that initially mixed for 2 hours, and of maintaining concrete temperature within 2 degrees F. from time of batching for 2 hours minimum.
- E. Water Reducing and Retarding Admixture: ASTM C494/C494M Type D.

1. Only one brand. When used, are subject to approval of Structural Engineer of Record, and must reduce the mixing water at least 10 percent without entraining air in excess of 2 percent by volume. If the water reducing agent entrains more than 2 percent air, the water reduction shall be at least 12 percent, but in no case shall the water reducing agent entrain air in excess of 4 percent.
- F. Water Reducing Admixture: ASTM C494/C494M Type A.
 1. Only one brand. When used, are subject to approval of Structural Engineer of Record, and must reduce the mixing water at least 10 percent without entraining air in excess of 2 percent by volume. If the water reducing agent entrains more than 2 percent air, the water reduction shall be at least 12 percent, but in no case shall the water reducing agent entrain air in excess of 4 percent.
- G. Waterproofing Admixture: Admixture formulated to reduce permeability to liquid water, with no adverse effect on concrete properties.
 1. A crystalline permeability reducing admixture (PRAH) may be used in accordance with ACI 212.3R-10, where reduced concrete permeability is desired. Trial batches should be performed to ensure that the plastic and hardened properties of concrete meet expectations.
 2. Admixture Composition: Crystalline, functioning by growth of crystals in capillary pores.

2.05 ACCESSORY MATERIALS

- A. Non-Shrink Cementitious Grout: Premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents.
 1. Minimum Compressive Strength at 48 Hours: 2,000 pounds per square inch.
 2. Minimum Compressive Strength at 28 Days, ASTM C109/C109M: 7,000 pounds per square inch.
 3. Non-gas-forming and free of oxidizing catalysts and inorganic accelerators, used as dry or damp pack, or mixed to a 20-second flow (CRC-C 611), without segregation or bleeding at any temperature between 45 degrees F and 100 degrees F.
 4. Low-Slump, Dry Pack Products:
 - a. Drypack: Field mixture of 1 part Portland cement to 2 parts fine aggregate mixed to a damp consistency such that a ball molded in the hands will stick together and hold its shape. In lieu of field mixing, Contractor may use factory mixed drypack material, such as Master Builders "Set Grout." f'c shall be equal to 5,000 psi.
- B. Non-Shrink Epoxy Grout: Moisture-insensitive, two-part; consisting of epoxy resin, non-metallic aggregate, and activator.

2.06 BONDING AND JOINTING PRODUCTS

- A. Bonding Agent: "Weld-Crete," manufactured by Larsen Products Co., P.O. Box 2127, Rockville, MD 20852, Master Builders "Concresive," or equal.
- B. Construction Joint Materials: "Key-Kold" or "Kwik-Joint," of profiles indicated.
- C. Expansion Joint Fillers: Preformed strips, non-extruding and resilient bituminous type, of thickness indicated, conforming to ASTM D 1751 and ASTM D1752.

2.07 CURING MATERIALS

- A. Curing Compound, Naturally Dissipating: Clear, water-based, liquid membrane-forming compound; complying with ASTM C309.
- B. Moisture-Retaining Sheet: ASTM C171.
 1. Curing paper, regular.

2. White-burlap-polyethylene sheet, weighing not less than 3.8 ounces per square yard.

2.08 CONCRETE MIXING

- A. Furnish ready-mixed concrete from an approved commercial off-site plant. Conform to ASTM C 94, except materials, testing, and mix designs as specified herein. Use transit mixer trucks equipped with automatic devices for recording number of revolutions of drum. Comply with CBC Section, 1905.
- B. Admixtures: All approved admixtures shall be introduced into the concrete at the batch plant. Field additions are not acceptable.
- C. Slump: Adjust quantity of water so concrete at point and time of placing does not exceed the slumps per plans when tested according to ASTM C143. Use the minimum water necessary for workability required by part of structure being cast.
- D. For compressive strength, density, fly ash content, slump, and water-cement ratio, refer to the general notes in the plans.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify lines, levels, and dimensions before proceeding with work of this section.

3.02 GENERAL

- A. Time of Placing: Do not place concrete until reinforcement, conduits, outlet boxes, anchors, hangers, sleeves, bolts, and other embedded materials are securely fastened in place. Contact the inspector at least 24 hours before placing concrete; do not place concrete until inspected by the inspector.
- B. Pouring Record: A record shall be kept on the Project site of time and date of placing concrete in each portion of structure. Such record shall be maintained on the Project site until Substantial Completion and shall be available for examination by the SEOR.

3.03 PREPARATION

- A. Earth Subgrade: Dampen 24 hours before placing concrete, but do not muddy. Re-roll where necessary for smoothness and remove loose material.
- B. Verify that forms are clean and free of rust before applying release agent.
- C. Reglets and Rebates:
 1. Form reglets and rebates in concrete to receive flashing, frames and other equipment as detailed and required. Coordinate dimensions and locations required with other related Work.
 2. If concrete slabs on grade adjoin a wall or other perpendicular concrete surface, form a reglet in wall to receive and carry horizontal concrete Work. Reglet shall be full thickness of the slab and shall be 3/4 inch wide, unless otherwise indicated. Requirement does not apply to exterior walks, unless specifically indicated.
- D. Screeds: Install screeds accurately and maintain at required grade or slab elevations after steel reinforcement has been installed, but before starting to place concrete. Install screeds adjacent to walls and in parallel rows not to exceed 8 feet on centers.
- E. Screeds Over Vapor Barrier: Use weighted pad or cradle type screeds and do not drive stakes through the vapor barrier. Check with an instrument level, transit, or laser.
- F. Coordinate placement of embedded items with erection of concrete formwork and placement of form accessories.

- G. 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.
- H. Wetting: Wet wood forms sufficiently to tighten up cracks. Wet other materials sufficiently to reduce absorption and to help maintain concrete workability.
- I. Gravel Fill: Recompact disturbed gravel and bring to correct elevation.
- J. Sand Beds or Subslab Drainage Fill: Recompact disturbed material and bring to correct elevation.
- K. All concrete shall be thoroughly consolidated by suitable means during placement and shall be thoroughly worked around reinforcement and embedded fixtures and into corners of forms.

3.04 PLACING CONCRETE

- A. Sheet Vapor Retarders:
 - 1. Place, protect, and repair sheet vapor retarder according to ASTM E 1643 and manufacturer's written instructions.
 - 2. Lap joints 6 inches and seal with manufacturer's recommended adhesive or tape.
- B. Conveying and Placing:
 - 1. Place concrete in accordance with ACI 304R.
 - 2. Do not place concrete until reinforcing steel and forms or decks have been approved by the Inspector and other authorities having jurisdiction. Concrete shall be placed only under direct observation of the inspector. Do not place concrete outside of regular working hours, unless the inspector has been notified at least 48 hours in advance.
 - 3. Comply with CBC Sections 1905.9 and 1905.10.
 - 4. Concrete shall be conveyed from mixer to location of final placement by methods, which will prevent separation or loss of materials. Place concrete in horizontal layers not more than 18" thick within 90 minutes after water is first added to the batch.
 - 5. In placing concrete in columns, walls or thin sections, provide openings in forms, elephant trunks, tremies or other recognized devices, to prevent segregation and accumulation of partially hydrated concrete on forms or metal reinforcement above level of concrete being placed. Such devices shall be installed so that concrete will be dropped vertically. Unconfined vertical drop of concrete from end of such devices to final placement surface shall not exceed 5-feet for concealed concrete or over 3-feet for exposed concrete.
 - 6. Concrete shall be placed as a continuous operation until placing of panel or section is completed. Top surfaces of vertically formed lifts shall be level.
 - 7. Concrete shall be thoroughly consolidated during placement, and shall be worked around reinforcement and embedded fixtures with mechanical vibrators.
 - 8. Where new concrete is placed against or on old or existing concrete, apply bonding agent to surface of old concrete prior to placement of new concrete.
- C. Compaction and Screeding:
 - 1. Compacting: Compact each layer of the concrete as placed with mechanical vibrators or equivalent equipment. Transmit vibration directly to concrete and in no case through the forms unless approved. Accomplish thorough compaction. Supplement by rodding or spading by hand adjacent to forms. Compact concrete into corners and angles of forms and around reinforcement and embedded fixtures. Recompact deep sections with congestion due to reinforcing steel as required.

2. Operation of Vibrators: Do not horizontally transport concrete in forms with vibrators nor allow vibrators to contact forms or reinforcing. Push vibrators vertically into the preceding layers that are still plastic and slowly withdraw, producing maximum obtainable density in concrete without creating voids or segregation. In no case disturb concrete that has partially set. Vibrate at intervals not exceeding two-thirds the effective visible vibration diameter of the submerged vibrator. Avoid excessive vibration that causes segregation.
 3. Tamp freshly placed concrete with a heavy tamper until at least 3/8 inch of mortar is brought to surface. Concrete shall then be tamped with a light tamper and screeded with a heavy straightedge until depressions and irregularities are eliminated, and surface is true to finish grades or elevations. Remove excess water and debris.
 4. Where slabs are to receive separate cement finish or mortar setting bed, continued tamping to raise mortar to surface is not performed. Laitance shall be removed by brushing with a stiff brush or by light sandblasting to expose clean top surface of coarse aggregate.
- D. Floating and Troweling:
1. After concrete has been placed, struck off, consolidated, and restraightened, concrete shall not be worked further until ready for floating. Restraightening operation is best accomplished by use of 8 foot to 10 foot wide bull float. Power floating operations shall begin when the water sheen has disappeared, and when the mix has stiffened sufficiently to permit proper operation of power-driven float.
 2. Consolidate surface with power-driven floats. Hand floating with wood or cork faced floats shall be used in locations inaccessible to power driven machine. Surface shall be restraightened at this stage with ten foot highway straightedge applied at not less than two different angles.
 3. High spots shall be cut down and low spots filled during this procedure to produce planes checking true under straightedge in any direction. Uniformly slope surfaces to drains where occurs.
 4. Restraightening operation shall be followed by final float pass to uniform, smooth, granular texture.
- E. Joints: Comply with CBC Section 1906.4. Locate joints in concrete only where shown or approved and obtain prior approval for points of stoppage of any pour. Clean and roughen surface of construction joints by removing entire surface and exposing 1/4" of clean coarse aggregate solidly embedded in mortar matrix by chipping, use of an approved retarder agent, or equal. Water and keep hardened concrete wet for not less than 24 hours before placing the next lift or abutting concrete. Cover the horizontal surfaces of existing or previously placed and hardened concrete with a 2" thick layer of fresh concrete of required mix less 50 percent of coarse aggregate just before balance of concrete is placed.
- F. Vertical Elements: Stop placement of concrete in walls and columns 1 1/2" below bottom of beams or supported slabs. Stop placement at sills and heads of wall openings in the same manner. Allow concrete in vertical elements to be in place at least 2 hours and until vertical settlement has ceased before placing concrete for floor framing.
- G. Correction of Segregation: Before placing next layer of concrete, and at the top of each placement for vertical elements, remove all concrete containing excess water or fine aggregate, or showing deficiency of coarse aggregate, and fill the space with compacted concrete of correct proportions. Comply with CBC Section, 1906.4.
- H. Filling, Leveling and Patching:

1. Concrete slabs exhibiting high or low spots and indicated to receive resilient floor covering or soft floor covering, shall have surfaces repaired. High spots shall be honed, or ground with power-driven machines to required tolerances. Low spots shall be filled with latex underlayment, installed in strict accordance with manufacturer's written recommendations.
 2. Holes resulting from form ties or sleeve nuts shall be solidly packed, through exterior walls, by pressure grouting with cement grout, as specified. Grouted holes on exposed surfaces shall be screeded flush and finished to match adjoining surfaces.
- I. Cement Base: Cement base shall be of the height, thickness, and shape detailed. Base shall be reinforced with one inch mesh, 18 gage, zinc-coated wire fabric. Base finish mixture shall be one part Portland cement, 2 parts of fine aggregate and one part pea gravel. Colored cement base shall include a chemically inert mineral oxide pigment in the mix.

3.05 EXPANSION AND CONSTRUCTION JOINTS

A. EXPANSION AND CONSTRUCTION JOINTS

1. Construction Joints: Details and proposed location of construction joints shall be as indicated on the Drawings, located to least impair strength of structure, in accordance with the following:
 - a. Thoroughly clean contact surface by sand blasting entire surface not earlier than 5 days after initial placement.
 - b. A mix containing same proportion of sand and cement provided in concrete plus a maximum of 50 percent of coarse aggregate shall be placed to a depth of at least one inch on horizontal joints. Vertical joints shall be wetted and coated with a neat cement grout immediately before placing of new concrete.
 - c. Should contact surface become coated with earth, sawdust, or deleterious material of any kind after being cleaned, entire surface shall be re-cleaned before applying mix.
2. Expansion Joints: Provide expansion joints where indicated in walks and exterior slabs. Space approximately 20 feet apart, unless otherwise indicated. Joints shall extend entirely through slab with joint filler in one piece for width of walk or slab.
3. Tooled Joints: Slabs, walks and paving shall be marked into areas as indicated with markings made with a V-grooving tool. Marks shall be round-edged, free from burrs or obstructions, with clean cut angles and shall be straight and true. Walks, if not indicated, shall be marked off into rectangles of not more than 12 square feet and shall have a center marking where more than 5 feet wide.

3.06 SLAB JOINTING

- A. Locate joints as indicated on drawings.
- B. Anchor joint fillers and devices to prevent movement during concrete placement.
- C. Isolation Joints: Use preformed joint filler with removable top section for joint sealant, total height equal to thickness of slab, set flush with top of slab.
- D. Saw Cut Contraction Joints: Saw cut joints before concrete begins to cool, within 4 to 12 hours after placing; use 3/16 inch thick blade and cut at least 1 inch deep but not less than one quarter (1/4) the depth of the slab.

3.07 FLOOR FLATNESS AND LEVELNESS TOLERANCES

- A. Maximum Variation of Surface Flatness:
 1. Under Seamless Resilient Flooring: 1/8 inch in 10 feet.
 2. Under Carpeting: 1/4 inch in 10 feet.
 3. Under Wood Sports Flooring: 1/8" in 10 feet.

- B. Correct the slab surface if tolerances are less than specified.
- C. Correct defects by grinding or by removal and replacement of the defective work. Areas requiring corrective work will be identified. Re-measure corrected areas by the same process.

3.08 CONCRETE FINISHING

- A. Soda and Acid Wash: Concrete surfaces to receive plaster, paint or other finish, and which have been formed by oil coated forms, shall be scrubbed with a solution of 1-1/2 pounds of caustic soda to one gallon of water. Surfaces where smooth wood or waste molds have been furnished shall be scrubbed with a solution of 20 percent muriatic acid. Wash with clean water after scrubbing.
- B. Sacking: Exposed concrete curbs, and other similar surfaces shall be sacked by an application of Portland cement grout, floated, and rubbed. Sacking shall not be performed until patching and filling of holes has been completed. Entire sacking operation for any continuous area shall be started and completed within the same day.
 - 1. Mix one part portland cement and 1-1/2 parts fine sand with sufficient water to produce a grout having consistency of thick paint. Wet surface of concrete sufficiently to prevent absorption of water from grout. Apply grout uniformly with a brush or spray gun, then immediately float surface with a cork or other suitable float, scouring wall vigorously.
 - 2. While grout is still plastic, finish surface with a sponge-rubber float, removing excess grout. Allow surface to dry thoroughly, then rub vigorously with dry burlap to completely remove dried grout. No visible film or grout shall remain after rubbing with burlap.
- C. Exposed Formed Concrete: Rub surfaces with a carborundum brick or equal until smooth and free of form marks, offsets, and other defects, and in uniform planes. Wet rubbed surface and then brush coat with cement grout consisting of 1 part light-colored Portland cement to 2 parts fine aggregate and mixed with water to the consistency of thick paint. Cork or wood float grout to fill all pits, air bubbles, and surface holes. Scrape off excess grout and rub surface with burlap or equal to remove all grout film. After grout sets, again coat with same grout, cure, then brick and burlap rub as necessary to eliminate remaining defects and blemishes, and damp cure surfaces for not less than 3 days or longer if required for complete curing of concrete. Finish, clean, and cure each surface as a continuous operation. Produce uniformly plane smooth surfaces free of grout film, grout or rubbing marks, defects, or blemishes after painting or covering with a flexible type finish material. Unless otherwise indicated or specified, apply this finish on exposed formed concrete, exposed concrete at the building foundation, and where indicated or scheduled.
- D. Sandblasting: Exterior concrete surfaces to receive stucco dash coat finish, where plywood or other smooth forms have been furnished, shall be uniformly sand-blasted with sharp quartz sand under sufficient air pressure to remove dirt, form oil and other foreign materials, and roughen surface to provide a proper bond. Such surfaces shall be thoroughly washed with clean water after sandblasting.

3.09 CURING AND PROTECTION

- A. Comply with requirements of ACI 308R. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury.
- B. Maintain concrete with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of concrete.
- C. All curing shall be per CBC Section 1905.11. Keep forms containing concrete in a wet condition until removed. Keep concrete continuously moist for not less than 7 days after

placement. Keep concrete above 50°F and moist with a fine fog water spray until protected by curing media.

- D. Forms containing concrete, top of concrete between forms, and exposed concrete surfaces after removal of forms shall be maintained in a thoroughly wet condition for at least 7 consecutive days after placing. Use the water curing method, curing sheet material, or a clear liquid membrane-forming curing compound except as otherwise specified.
- E. During times of dry or excessive winds, high ambient temperature, low humidity, or other ambient conditions causing rapid drying, use specified evaporation retardant and finishing aid material according to the manufacturers instructions and cure concrete with a fine fog spray of water, or equal, applied both during and after finishing and continued until final curing operations are started.
- F. Within 24 hours after finishing, exterior slabs and paving, and interior slabs to receive cement topping or mortar setting beds, shall be covered with sand to a depth of 2 inches and kept thoroughly wet for 7 days.
 - 1. Instead of sand covering, exterior walks and paving where no other surface treatment is specified, may be cured with clear liquid curing compound immediately installed in accordance with manufacturer's directions.
- G. Where fly ash replacement is 20% or higher, floor slabs shall receive a 3 day moist cure and then 1 coat of approved curing compound. All other surfaces, with the exception of foundations, shall receive a coat of approved curing compound immediately after removal of formwork.

3.10 GROUTING AND DRYPACKING

- A. Install as indicated or required. Where grouting and drypacking is part of the work of other sections, it shall conform to the following requirements, as applicable.
- B. Drypacking: Mix materials thoroughly with minimum amount of water. Install drypack by forcing and rodding to fill voids and provide complete bearing under plates. Finish exposed surfaces smooth and cure with damp burlap or liquid curing compound.
- C. Non-Shrink Grouting:
 - 1. Mixing: Mix the approved non-shrink grout material with sufficient water per manufacturers recommendations.
 - 2. Application: Surfaces to receive the non-shrink grout shall be clean, and shall be moistened thoroughly immediately before placing the mortar. Before grouting, surfaces to be in contact shall be roughened and cleaned thoroughly, all loose particles shall be removed and the surface flushed thoroughly with neat cement grout immediately before the grouting mortar is placed. Place fluid grout from one side only and puddle, chain, or pump for complete filling of voids; do not remove the dams or forms until grout attains initial set. Finish exposed surfaces smooth, and cure as recommended by grout manufacturer.

3.11 FIELD QUALITY CONTROL

- A. Comply with pertinent provisions of Section 014000: Quality Requirements.
- B. Provide free access to concrete operations at project site and cooperate with appointed firm.
- C. Testing/Evaluation of Concrete: Conform to CBC and ACI. Testing Laboratory shall perform following tests. Samples for testing shall be obtained in accordance with ASTM C 172, and shall be taken from as close to point of placement as possible.

1. Compressive Strength Tests: Cast one set of three or more cylinders from each days placing and each 50 cubic yards, or fraction thereof, or not less than once for each 2,000 square feet of surface area for slabs and walls, of each strength of structural concrete. Date cylinders, assign record number, and tag showing the location from which sample was taken. Also record slump test result of sample. Do not make more than two series of tests from any one location or batch of concrete.
 2. Test Cylinders: Samples will be made in accordance with ASTM C172. Cast cylinders according to ASTM C31; 24 hours later, store cylinders under moist curing conditions at about 70 F. Test according to ASTM C39 at 7 and 28 day ages. The remaining cylinder shall be kept in reserve in case tests are unsatisfactory.
- D. Core Tests: Comply with CBC and ACI. If tests show that compressive strength of any concrete falls below required minimum at 28 day age, additional curing and testing of concrete which unsatisfactory test reports represent may be directed. Testing Laboratory shall take and test drilled cores as directed in accordance with ASTM C42. Contractor shall refill core holes with drypack concrete of the same compressive strength required for cored concrete. If core tests results are unsatisfactory, Contractor shall furnish required labor, equipment, and weights, and the Testing Laboratory shall conduct load testing on involved parts of building or structure as directed. Contractor shall bear additional curing and test costs, including Testing Laboratory costs, for concrete not meeting required compressive strength at 28 day age even if testing demonstrates that concrete has eventually attained required minimum compressive strength, and all costs for required corrections or removals and replacements as directed and required for approved construction.
- E. Take one additional test cylinder during cold weather concreting, cured on job site under same conditions as concrete it represents.
- F. Perform one slump test for each set of test cylinders taken, following procedures of ASTM C143/C143M.
- G. Slab Testing: Cooperate with manufacturer of specified moisture vapor reducing admixture (MVRA) to allow access for sampling and testing concrete for compliance with warranty requirements.

3.12 CLEAN UP

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

3.13 PROTECTION

- A. Do not permit traffic over unprotected concrete floor surface until fully cured.

End of Section 03 3000

Section 03 3511
Concrete Floor Finishes

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Surface treatments for concrete floors and slabs.
- B. Liquid densifiers and hardeners.
- C. Polished concrete.

1.02 RELATED REQUIREMENTS

- A. Section 03 3000 - Cast-in-Place Concrete: Finishing of concrete surface to tolerance; floating, troweling, and similar operations; curing.

1.03 REFERENCE STANDARDS

- A. ACI 301 - Specifications for Structural Concrete; 2010 (Errata 2012).
- B. ACI 302.1R - Guide for Concrete Floor and Slab Construction; 2004 (Errata 2007).
- C. ANSI B101.3 - Test Method for Measuring Wet DCOF of Common Hard-Surface Floor Materials; 2012.
- D. ASME B46.1 - Surface Texture (Surface Roughness, Waviness, and Lay); 2009.
- E. ASTM F2508 - Standard Practice for Validation, Calibration, and Certification of Walkway Tribometers Using Reference Surfaces; 2016.
- F. ASTM C779 - Standard Test Method for Abrasion Resistance of Horizontal Concrete Surfaces; 2012.
- G. ASTM C805 - Standard Test Method for Rebound Number of Hardened Concrete; 2013.
- H. ASTM D6886 - Standard Test Method for Determination of the Weight Percent Individual Volatile Organic Compounds in Waterborne Air-Dry Coatings by Gas Chromatography; 2014.
- I. ASTM E1155 - Standard Test Method for Determining F(F) Floor Flatness and F(L) Floor Levelness Numbers; 1996 (Reapproved 2008).
- J. ASTM G152 - Standard Practice for Operating Open Flame Carbon Arc Light Apparatus for Exposure of Nonmetallic Materials; 2013.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate the work with concrete floor placement and concrete floor curing.

1.05 SUBMITTALS

- A. Product Data: Manufacturer's published data on each finishing product, including information on compatibility of different products and limitations.
- B. Maintenance Data: Provide data on maintenance and renewal of applied finishes.
- C. Warranty Documentation: Manufacturer warranty; ensure that forms have been completed in CRPD's name and registered with manufacturer.
- D. Provide letter of certification from concrete floor finish manufacturer for polished concrete system stating that the installer is a certified applicator of the polished concrete system and is familiar with proper procedures and installation requirements required by the manufacturer.
- E. Provide copy of tribometer testing and validation reports per ASTM F2508

1.06 QUALITY ASSURANCE

- A. Perform work in accordance with ACI 302.1R.
- B. Installer Qualifications:
 - 1. Use an experienced installer and adequate number of skilled workmen who are thoroughly trained and experienced in the necessary craft.
 - 2. The special concrete finish manufacturer shall certify applicator.
 - 3. Applicator shall be familiar with the specified requirements and the methods needed for proper performance of work of this section.
- C. Concrete floor finishing sub-contractor to attend pre-installation meeting with concrete placement sub-contractor prior to placement of concrete.

1.07 MOCK-UP

- A. For coatings, construct mock-up area under conditions similar to those that will exist during application, with coatings applied.
- B. Mock-Up Size: Minimum 25 feet square for each specified finish and color.
- C. Locate where directed by Owner.
- D. Mock-up may remain as part of the work.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in manufacturer's sealed packaging, including application instructions.

1.09 PROTECTION

- A. No satisfactory chemical or cleaning procedure is available to remove petroleum stains from the concrete surface. Prevention is therefore essential.
 - 1. All hydraulic powered equipment must be diapered to avoid staining of the concrete.
 - 2. No trade will park vehicles on the inside slab. If necessary to complete their scope of work, drop cloths will be placed under vehicles at all times.
 - 3. No pipe cutting machine will be used on the inside floor slab.
 - 4. Steel will not be placed on interior slab to avoid rust staining.
 - 5. Acids and acidic detergents will not come into contact with slab.
 - 6. All trades are to be informed that the slab must be protected at all times.

1.10 FIELD CONDITIONS

- A. Comply with manufacturers written instructions for cure time, substrate temperature and moisture content, ambient temperature and humidity, ventilation and other conditions affecting topping performance.
- B. Maintain light level equivalent to a minimum 200 W light source at 8 feet above the floor surface over each 20 foot square area of floor being finished.

1.11 WARRANTY

- A. See Section 01 7800 - Closeout Submittals for additional warranty requirements.
- B. Finish Warranty: Provide five-year manufacturer warranty against excessive degradation of finish. Include provision for replacement of units with excessive fading, chalking, or flaking.

PART 2 PRODUCTS

2.01 CONCRETE FLOOR FINISH APPLICATIONS

- A. Liquid Densifier and Hardener:

1. Use at following locations: All locations shown on plans to have exposed concrete floors..
- B. Concrete Stain or Dye:
 1. Use at following locations: At all locations to have polished concrete floor finish, stain to be determined by architect and client..
- C. Polished Finish:
 1. Use at following locations: As indicated on the Finish Plan.

2.02 DENSIFIERS AND HARDENERS AND SEALERS

- A. Liquid Densifier and Hardener: Penetrating chemical compound that reacts with concrete, filling the pores and dustproofing; for application to concrete after set.
 1. Products:
 - a. Ashford Formula; Curecrete Distribution, Inc.: www.ashfordformula.com
 - b. W. R. Meadows, Inc; Liqui-Hard: www.wrmeadows.com/#sle.
 - c. Substitutions: See Section 01 6000 - Product Requirements.

2.03 POLISHED CONCRETE SYSTEM

- A. Polished Concrete System: Materials, equipment, and procedures designed and furnished by a single manufacturer to produce dense polished concrete of the specified sheen.
 1. Acceptable Systems:
 - a. Retroplate99, Advanced Floor Products, Inc.: www.retroplatesystem.com - Basis of Design
 2. Performance Criteria:
 - a. Abrasion Resistance: 400 percent increase per ASTM C779
 - b. Impact Strength: 21 percent increase per ASTM C805
 - c. Ultra Violet Light and Water Spray: ASTM G23-81 - -No Adverse effect of ultra violet and water spray when tested per ASTM G152
 - d. Volatile Organic Compounds: 0 weight percent at measured by ASTM D6886
 3. Patching Material: (allowed at sand holes only) -
 - a. Product as approved by polishing system manufacturer for use with their polishing system.
 - 1) Retroplate99: Quick Mender Repair Polymer by Versaflex
 - 2) Others as approved by manufacturer

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that floor surfaces are acceptable to receive the work of this section.
- B. Verify that flaws in concrete have been patched and joints filled with methods and materials suitable for further finishes.
- C. Concrete must be in place a minimum of 45 days or as directed by the manufacturer before application can begin.
- D. Meeting with concrete installer.
- E. Letter to contractor and owner identifying areas formed not meeting required tolerances for installation.

3.02 TOLERANCES

- A. Measure for F(F) and F(L) tolerances for floors in accordance with ASTM E1155, within 48 hours after slab installation.

- B. Finish concrete to achieve the following tolerances. Where sloping to a drain, omit level criteria.
 - 1. Exposed to view without additional finishing: Ff 30 and Fl 20.
 - 2. Exposed to view with concrete polishing system applied: Ff 40 and Fl 30.
- C. Correct the slab surface if tolerances are less than specified.
- D. Correct defects by grinding or by removal and replacement of the defective work. Areas requiring corrective work will be identified. Re-measure corrected areas by the same process.

3.03 GENERAL

- A. Apply materials in accordance with manufacturer's instructions.

3.04 FLOOR FINISHING

- A. Finish concrete floor surfaces in accordance with ACI 301 and ACI 302.1R.
- B. In areas with floor drains, maintain design floor elevation at walls; slope surfaces uniformly to drains at 1/8 inch per foot nominal.
- C. Slip Resistance:
 - 1. Minimum wet dynamic coefficient of friction: 0.42 when measured per ANSI B101.3
 - 2. Minimum floor roughness of 0.41 micrometers (16 micro inches) when measured per ASME B46.1

3.05 PROTECTION

- A. Protect finished work until fully cured in accordance with manufacturers recommendations.

3.06 CONCRETE POLISHING

- A. Execute using materials, equipment, and procedures specified by manufacturer, using manufacturer approved installer.
- B. Final Polished Sheen: **Semigloss finish; other sheens are included as comparison to illustrate required sheen; final sheen is before addition of any sealer or coating, regardless of whether that is also specified or not.**
 - 1. Satin Finish: Level 1 - Hard Shell, Satin Sheen (400 grit) - Reflecting images from side lighting.
 - 2. Semi-Gloss Finish: Level 2 - Hard Shell, Medium Sheen (800 grit) - Reflecting overhead and side images from 35 to 45 feet away.
 - 3. High Gloss Finish: Level 3 - Light Reflective Mirror Finish (1800 grit) - Finish that looks wet and shows mirror-like reflections of side and overhead images.
- C. Protect finished surface as required and as recommended by manufacturer of polishing system.
- D. Final Grind Level: **Heavy Aggregate; other grind levels are included as comparison to illustrate required grind level.**
 - 1. Cream - No Exposed Aggregate.
 - 2. Salt and Pepper - Exposed Sand and small aggregate.
 - 3. Heavy Aggregate - 1/4" to 1/2" exposed aggregate.
 - a. Special Aggregate (to be applied to concrete during concrete pour):
 - 1) Broken Glass - Three (3) different colors. Colors as selected by Architect.

End of Section 03 3511

Section 04 2000

Unit Masonry

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Concrete block for built-in BBQ counter and built-in prep counter.
- B. Mortar and grout.
- C. Reinforcement and anchorage.
- D. Accessories
- E. Block sealer

1.02 RELATED REQUIREMENTS

- A. Section 03 2000 - Concrete Reinforcing: Reinforcing steel for grouted masonry.
- B. Section 03 3000 - Cast-in-Place Concrete: Concrete footings
- C. Section 05 5000 - Metal Fabrications: Fabricated steel items. Signage.
- D. Section 32 3119 - Decorative Metal Fences and Gates: Screen Fence.

1.03 REFERENCE STANDARDS

- A. ASTM C1019 - Standard Test Method for Sampling and Testing Grout; 2013.
- B. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon Steel Bars for Concrete Reinforcement; 2015.
- C. ASTM C90 - Standard Specification for Loadbearing Concrete Masonry Units; 2014.
- D. ASTM C140/C140M - Standard Test Methods of Sampling and Testing Concrete Masonry Units and Related Units; 2014.
- E. ASTM C150/C150M - Standard Specification for Portland Cement; 2016.
- F. ASTM C207 - Standard Specification for Hydrated Lime for Masonry Purposes; 2006 (Reapproved 2011).
- G. ASTM C270 - Standard Specification for Mortar for Unit Masonry; 2014a.
- H. ASTM C404 - Standard Specification for Aggregates for Masonry Grout; 2011.
- I. ASTM C476 - Standard Specification for Grout for Masonry; 2010.
- J. ASTM C979/C979M - Standard Specification for Pigments for Integrally Colored Concrete; 2010.
- K. TMS 402/602 - Building Code Requirements and Specification for Masonry Structures; 2016.

1.04 SUBMITTALS

- A. See Section 01 3300 - Submittals, for submittal procedures.
- B. Product Data: Provide data for masonry units, fabricated wire reinforcement, mortar, and masonry accessories.
- C. Samples: Submit four chip samples indicative of decorative block units to illustrate color, texture, and extremes of color range.

1.05 QUALITY ASSURANCE

- A. Comply with provisions of ACI 530/530.1/ERTA, except where exceeded by requirements of Contract Documents.

- B. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section with minimum three years of documented experience.
- C. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, handle, and store masonry units by means that will prevent mechanical damage and contamination by other materials.

PART 2 PRODUCTS

2.01 CONCRETE MASONRY UNITS

- A. Concrete Block: Comply with referenced standards, contract drawings, and as follows:
 - 1. Block Size: Standard units with nominal face dimensions of 16 by 4 inches and nominal depth of 8 inches.
 - 2. Load-Bearing Units: ASTM C90, medium weight.
 - a. Exposed Faces: Manufacturer's standard color and texture.

2.02 MORTAR AND GROUT MATERIALS

- A. Mortar
 - 1. Provide mortar conforming to the following parameters
 - a. Conform to ASTM C270
 - b. Comply with Section 2103.2 of the 2019 CBC
 - c. Type S Mortar
 - d. 2,000 psi minimum 28 day compressive strength
 - e. Color: Tan color as selected from a standard list of manufacturer's colors.
- B. Grout
 - 1. Provide grout conforming to the following parameters
 - a. Conform to ASTM C476
 - b. Comply with Section 2103.3 of the 2019 CBC
 - c. 2,000 psi minimum 28 day compressive strength. Determine compressive strength of grout in accordance with ASTM C1019.
 - d. Do not use admixtures unless accepted by the Engineer of Record. Field addition of admixtures is not permitted in self-consolidating grout.
- C. Portland Cement: ASTM C150/C150M, Type I; color as required to produce approved color sample.
 - 1. Hydrated Lime: ASTM C207, Type S.
 - 2. Grout Aggregate: ASTM C404.
- D. Pigments for Colored Mortar: Pure, concentrated mineral pigments specifically intended for mixing into mortar and complying with ASTM C979/C979M.
- E. Water: Clean and potable.

2.03 REINFORCEMENT AND ANCHORAGE

2.04 MORTAR AND GROUT MIXING

- A. Mortar for Unit Masonry: ASTM C270, using the Proportion Specification.
 - 1. Exterior, loadbearing masonry: Type N.

- B. Grout: ASTM C476; consistency required to fill completely volumes indicated for grouting; fine grout for spaces with smallest horizontal dimension of 2 inches or less; coarse grout for spaces with smallest horizontal dimension greater than 2 inches.
- C. Admixtures: Add to mixture at manufacturer's recommended rate and in accordance with manufacturer's instructions; mix uniformly.
- D. Mixing: Use mechanical batch mixer and comply with referenced standards.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field conditions are acceptable and are ready to receive masonry.
- B. Verify that related items provided under other sections are properly sized and located.

3.02 PREPARATION

- A. Direct and coordinate placement of fabricated metal components, metal fence posts, pipe and tube railings, dimensional lettering, and electrical components supplied for installation under other sections.

3.03 COURSING

- A. Maintain masonry courses to uniform dimension. Form vertical and horizontal joints of uniform thickness.
- B. Concrete Masonry Units:
 - 1. Bond: _____.
 - 2. Coursing: One unit and one mortar joint to equal 8 inches.
 - 3. Mortar Joints: Flush.

3.04 PLACING AND BONDING

- A. Lay hollow masonry units with face shell bedding on head and bed joints.
- B. Buttering corners of joints or excessive furrowing of mortar joints is not permitted.
- C. Remove excess mortar and mortar smears as work progresses.
- D. Interlock intersections and external corners.
- E. Do not shift or tap masonry units after mortar has achieved initial set. Where adjustment must be made, remove mortar and replace.
- F. Perform job site cutting of masonry units with proper tools to provide straight, clean, unchipped edges. Prevent broken masonry unit corners or edges.

3.05 REINFORCEMENT AND ANCHORAGE - GENERAL

- A. Unless otherwise indicated on drawings or specified under specific wall type, install horizontal joint reinforcement 16 inches on center.
- B. Embed longitudinal wires of joint reinforcement in mortar joint with at least 5/8 inch mortar cover on each side.
- C. Lap joint reinforcement ends minimum 6 inches.

3.06 GROUTED COMPONENTS

3.07 CONTROL AND EXPANSION JOINTS

- A. Do not continue horizontal joint reinforcement through control or expansion joints.
- B. Install preformed control joint device in continuous lengths. Seal butt and corner joints in accordance with manufacturer's instructions.

- C. Size control joints as indicated on drawings; if not indicated, 3/4 inch wide and deep.

3.08 BUILT-IN WORK

- A. As work progresses, install built-in metal door frames and other items to be built into the work and furnished under other sections.
- B. Install built-in items plumb, level, and true to line.

3.09 TOLERANCES

- A. Maximum Variation From Unit to Adjacent Unit: 1/16 inch.
- B. Maximum Variation from Plane of Wall: 1/4 inch in 10 ft and 1/2 inch in 20 ft or more.
- C. Maximum Variation from Level Coursing: 1/8 inch in 3 ft and 1/4 inch in 10 ft; 1/2 inch in 30 ft.

3.10 CLEANING

- A. Remove excess mortar and mortar droppings.
- B. Replace defective mortar. Match adjacent work.
- C. Clean soiled surfaces with cleaning solution.

3.11 PROTECTION

- A. Without damaging completed work, provide protective boards at exposed external corners that are subject to damage by construction activities.

End of Section 04 2000

Section 05 5000
Metal Fabrications

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Shop fabricated steel items, including:
 - 1. Handrails.
 - 2. Bent plate coping.
 - 3. Coping and edging at skate plaza

1.02 RELATED REQUIREMENTS

- A. Section 03 3000 - Cast-in-Place Concrete: Placement of metal fabrications in concrete.
- B. Section 06 1000 - Rough Carpentry
- C. Section 12 3600 - Countertops
- D. Section 09 9113 - Exterior Painting: Paint finish.
- E. Section 32 1300 - Skate Park Structure Concrete Paving
- F. Section 32 1301 - Shotcrete

1.03 PRICE AND PAYMENT PROCEDURES

- A. See General Conditions, Article 41, for payment procedures.

1.04 REFERENCE STANDARDS

- A. Steel: Meet requirements of AISC "Specifications of Architecturally Exposed Structural Steel," latest edition.
- B. Welding: Meet requirements of AWS "Structural Welding Code," D1.1, latest edition.
- C. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2014.
- D. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2012.
- E. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2015.
- F. ASTM A283/A283M - Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates; 2013.
- G. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes; 2013.
- H. ASTM A501/A501M - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing; 2014.
- I. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2015.
- J. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2015.
- K. AWS D1.2/D1.2M - Structural Welding Code - Aluminum; 2008.
- L. IAS AC172 - Accreditation Criteria for Fabricator Inspection Programs for Structural Steel; International Accreditation Service, Inc; 2011.
- M. SSPC-Paint 15 - Steel Joist Shop Primer/Metal Building Primer; 1999 (Ed. 2004).

- N. SSPC-Paint 20 - Zinc-Rich Primers (Type I, "Inorganic," and Type II, "Organic"); 2002 (Ed. 2004).
- O. SSPC-SP 2 - Hand Tool Cleaning; 1982 (Ed. 2004).

1.05 SUBMITTALS

- A. See General Conditions - Article 9, for submittal procedures.
- B. Shop Drawings:
 - 1. Submit shop drawings for all custom fabricated items under this section. Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners and accessories. Indicate welded connections using standard AWS welding symbols.
 - 2. Verification: Verify all measurements at the job. Show dimension, sizes, thickness, gauges, finishes, joining, attachments, and relationship of work to adjoining construction. Where items must fit and coordinate with finished surfaces and/or constructed spaces, take measurements at site and not from drawings.
 - 3. Coordination: Coordinate with work of Cast-In-Place Concrete Section.

1.06 QUALITY ASSURANCE

- A. Fabricator Qualifications: A qualified steel fabricator that is accredited by IAS AC172.
- B. Qualification of Fabricators: Experienced in fabrication of miscellaneous metals.
- C. Qualifications of Welders: Welding shall be done only by certified welding operators currently qualified, according to AWS D1.1.
- D. Qualifications of Workmen: Provide at least one person who shall be present at all times during execution of this portion of the Work, and who shall be thoroughly familiar with the type of materials being installed, the referenced standards, the requirements of the Work, and who shall direct all work performed under this Section. Welds indicated may be made in shop or field with approval.

1.07 DELIVERY, STORAGE AND HANDLING

- A. Coordination: Coordinate with work of Cast-In-Place Concrete Section.
- B. Storage of Materials: Materials which are stored at the project site shall be above ground on platforms, skids, or other supports. Protect steel form corrosion. Store other material in a weather-tight and dry place until ready for use.
- C. Protection:
 - 1. Use all means necessary to protect miscellaneous metal before, during and after installation and to protect the installed work and materials of all other trades.
 - 2. Protect any adjacent materials or areas below form damage due to weld splatter of sparks during field welding.
- D. Replacements: In the event of damage, immediately make all repairs and replacements necessary to the approval of the Owner's Representative and at no additional cost to the Owner.

1.08 JOB CONDITIONS

- A. Examine existing conditions in which the work is to be installed. Notify Owner's Representative if conditions are unacceptable to begin work.
- B. Do not proceed with the work until unsatisfactory conditions have been corrected.

1.09 COORDINATION

- A. Templates and Built-ins: Furnish all anchors, fastenings, sleeves, setting templates and layouts affecting or installed in the work of other trades.

- B. Delivery: Where items must be incorporated or built into adjacent work, deliver to trade responsible for such work in sufficient time that progress of work is not delayed. Be responsible for proper location of such items.
- C. Approved sample(s) shall be used as the standard of workmanship and shall remain on site until work has been completed and approved by the Owner's Representative.

PART 2 PRODUCTS

2.01 MATERIALS - STEEL

- A. Steel Sections: ASTM A36/A36M.
- B. Steel Tubing: ASTM A501/A501M hot-formed structural tubing.
- C. Plates: ASTM A283/A283M.
- D. Pipe: ASTM A53/A53M, Grade B Schedule 40, hot-dip galvanized finish.
- E. Welding Materials: AWS D1.1/D1.1M; type required for materials being welded.
- F. Welding Rods: E-70 Series low hydrogen unless otherwise noted on drawings.
- G. Shop and Touch-Up Primer: SSPC-Paint 15, complying with VOC limitations of authorities having jurisdiction.
- H. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20, Type I - Inorganic, complying with VOC limitations of authorities having jurisdiction.
- I. Grout: Non-shrinking Master Builder's "Embedco", Conrad Sovig's "metel-Mxs Grout", Sonneborn's "Ferrolith G Redi-Mixed Grout" or approved equal.
- J. All other materials, not specifically described but required for a complete and proper installation for miscellaneous metals, shall be new, first quality of their respective kinds and subject to the approval of the Owner's Representative.

2.02 FABRICATION

- A. Fit and shop assemble items in largest practical sections, for delivery to site.
- B. Fabricate items with joints tightly fitted and secured.
- C. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.
- D. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.
- E. All bent plate coping on stairs and walls shall be 1/4-inch x 2-inch x 2-inch and must have 1/4-inch radius at bend.
- F. Coping shall be located and fabricated as indicated on the Drawings.

2.03 FINISHES - STEEL

- A. Fabricated steel items shall have the following finishes:
 - 1. Handrails: hot-dip galvanized, natural grey.
- B. Prime paint steel items.
 - 1. Exceptions: Do not prime surfaces in direct contact with concrete, where field welding is required, and items to be covered with sprayed fireproofing.
- C. Prepare surfaces to be primed in accordance with SSPC-SP2.
- D. Clean surfaces of rust, scale, grease, and foreign matter prior to finishing.

- E. Prime Painting: Two coats.
- F. Galvanizing of Structural Steel Members: Galvanize after fabrication to ASTM A123/A123M requirements.
- G. Galvanizing of Non-structural Items: Galvanize after fabrication to ASTM A123/A123M requirements.

2.04 FABRICATION TOLERANCES

- A. Squareness: 1/8 inch maximum difference in diagonal measurements.
- B. Maximum Offset Between Faces: 1/16 inch.
- C. Maximum Misalignment of Adjacent Members: 1/16 inch.
- D. Maximum Bow: 1/8 inch in 48 inches.
- E. Maximum Deviation From Plane: 1/16 inch in 48 inches.

PART 3 EXECUTION

3.01 EXISTING CONDITIONS

- A. Inspection: Prior to all work of this Section, carefully inspect the installed work of all other trades and verify that all such work is complete to the point where this installation may properly commence.
- B. Discrepancies: In the event of discrepancy, immediately notify the Owner's Representative.

3.02 COORDINATION

- A. General: Install metal fabrications in strict accordance with the Drawings, the approved Shop Drawings, and all pertinent codes, regulations and standards.
- B. Delivery: Insure timely delivery of all metal fabrications that must be installed in other work so as not to delay that work.

3.03 EXAMINATION

- A. Verify that field conditions are acceptable and are ready to receive work.

3.04 PREPARATION

- A. Clean and strip primed steel items to bare metal where site welding is required.

3.05 INSTALLATION

- A. General:
 - 1. Install metal fabrications in strict accordance with the drawings, the approved Shop Drawings, and all pertinent codes, regulations and standards.
 - 2. Obtain Owner's Representative review prior to site cutting or making adjustments which are not part of scheduled work.
 - 3. Install items square and level, accurately fitted and free from distortion or defects.
 - 4. Align all metal fabrications as shown on the Drawings, and where vertical or horizontal members are shown, align them straight, plumb and level within a tolerance of 1 in 500.
 - 5. Make provisions for erection stresses by temporary bracing. Keep work in alignment.
 - 6. Replace items damaged in course of installation.
 - 7. Perform field welding in accordance with AWS D1.1
 - 8. After installation, grind and touch-up field welds.
- B. Provide for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.

- C. After erection, prime welds, abrasions, and surfaces not shop primed or galvanized, except surfaces to be in contact with concrete.
- D. Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with same material as used for shop painting. Apply or brush or spray to provide minimum dry film thickness of 0.051 mm (2.0 mils).
- E. At all galvanized products, clean all damaged areas and re-coat using specified galvanizing coating per manufacturer's criteria.

3.06 WORKMANSHIP

- A. Layout: Set all work plumb, true, rigid, and neatly trimmed out. Miter corners and angles of exposed molding and frames unless otherwise noted.
- B. Fitting: Fit exposed connections accurately together to form tight hairline joints.
- C. Labor: Employ only workmen specifically skilled in such work.

3.07 FABRICATION

- A. Shop assemble in largest practicable dimensions, making members true to length so assembling may be done without fillers.
- B. Provide all surfaces free of file marks, dents, hammer marks, wire edges or any unsightly surface defects.
- C. STEEL PIPE COPING: Roll pipe to conform to top radius curve of each bowl and ledge as shown on drawings. Refer to drawings for relational tolerance to concrete surface and other steel.

3.08 ATTACHMENTS AND REINFORCEMENTS

- A. Do all cutting, shearing, drilling, punching, threading, tapping, etc., required for site metalwork or for attachment of adjacent work. If applicable, drill or punch holes; do not use cutting torch.

3.09 OTHER CONNECTIONS

- A. Make all permanent connections in ferrous metal surfaces using welds where at all possible; do not use bolts or screws.

3.10 WELDING

- A. Preparation: Remove all rust, paint, scale and other foreign matter. Wire-brush all flame-cut edges. Clamp members as required and alternate welds, all as necessary to prevent warping or misalignment.
- B. Exposed Welds: Uniformly grind smooth (no tolerance) all welds normally exposed to view and feel in the finished work.
- C. Faulty and Defective Welding: Chip out and replace all welding showing cracks, slag inclusion, lack of fusion, bad undercut or other defects ascertained by visual or other means of inspection. Replace and re-weld at no cost to Owner.
- D. Field Welding:
 - 1. Procedure: Comply with AWS code of manual shielded metal-arc welding, appearance and quality of welds made, and methods used in correcting welding work. Cold Spray Galvanize when complete.
 - 2. Protection: Protect all adjacent surfaces from damage due to weld sparks, spatter, or tramp metal.

3.11 SURFACE TREATMENT AND PROTECTIVE COATINGS

- A. Cleaning:
 - 1. Thoroughly clean all mill scale, rust, dirt, grease and other foreign matter from ferrous metal prior to any galvanizing, or painting.
 - 2. Conditions that are too severe to be removed by hand cleaning, shall be cleaned using appropriate methods for solvent cleaning, power tool cleaning and brush-off blast cleaning.
- B. Exterior Ferrous Metal:
 - 1. Grind smooth all welds, burrs, and rough surfaces. Clean all coping from grease.
 - 2. Shop coat iron metal items; using anti-rust primer (red color).
 - 3. All welds to be painted with primer after appropriate connections and grinding has taken place. Touch-up all scratched primer prior to shotcrete application.

3.12 CLEAN-UP

- A. Keep all areas of work clean, neat and orderly at all times. Keep paved areas clean during installation.
- B. Clean up and remove all debris from the entire work area prior to Final Acceptance to satisfaction of Owner's Representative.

3.13 TOLERANCES

- A. Maximum Variation From Plumb: 1/4 inch per story, non-cumulative.
- B. Maximum Offset From True Alignment: 1/4 inch.
- C. Maximum Out-of-Position: 1/4 inch.

Section 05 7513

Decorative Metal Perforated Panels

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Freestanding decorative metal screen wall and gates.
- B. Decorative metal panels mounted to existing building fascia.

1.02 SUBMITTALS

- A. See Article 9 of the General Conditions - Submittals, for submittal procedures.
- B. Product Data: Supplier's data sheets on each product to be used, including:
 - 1. Preparation instructions and recommendations.
 - 2. Storage and handling requirements and recommendations.
 - 3. Description of materials, components, fabrication and finishes.
- C. Shop Drawings: Supplier's shop drawings, including plans, elevations, sections and details indicating materials, components, sizes, dimensions, tolerances, hardware, fasteners, finishes, options, accessories and installation methods. Provide details of attaching metal panels to supports.
- D. Closeout Submittals: Supplier's maintenance and cleaning instructions and warranty.

1.03 QUALITY ASSURANCE

- A. All metal work contained in this section shall be provided by the same fabricator, including panels, frames, posts, structural supports, and mounting systems.
- B. Engineering:
 - 1. Wall screen to be engineered by supplier for standard loading criteria and geometry layout.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Delivery and Acceptance Requirements: Deliver materials in manufacturer's original packaging with corresponding labels and identifying information.
 - 1. Unload, store, and erect panels in a manner to prevent bending, warping, twisting, and surface damage.
- B. Storage and Handling Requirements
 - 1. Store panels vertically, covered with appropriate weathertight and ventilated covering. Store panels to ensure dryness. Do not store panels in contact with other materials that might cause staining, denting, or other surface damage.
 - 2. Do not stack pallets. Panels that are stacked need to be protected from each successive panel above and below.
 - 3. Avoid overhandling and excessively moving panels in order maintain protective packaging.

PART 2 - PRODUCTS

2.01 MANUFACTURER

- A. Artisan Panels, Inc.; 714-351-3234, sales@artisanpanels.com
- B. Substitutions: See requirements in Contract Documents.

2.02 PRODUCT

- A. Laser cut decorative perforated metal panels.

1. Size per plans.
2. 1/8" thick steel.
3. Laser cut patterns per drawings:
 - a. Pattern A: Twine, Color: Black/White Vein
 - b. Pattern C: Retro, Color: Star Dust Silver
4. Mount as indicated on drawings.

2.03 MATERIALS

- A. Fasteners for Anchoring Metal Panels to Other Construction: Select fasteners of type, grade and class required to produce connections suitable for anchoring metal panels to other types of construction indicated and capable of withstanding design loads.
- B. Fasteners for Interconnecting Metal Panel Components: Use fasteners fabricated from same basic metal as fastened metal, unless otherwise indicated. Do not use metals that are corrosive or non-compatible with materials joined. Avoid fastening dissimilar materials, separate with isolating hardware where necessary.
- C. Brackets, Flanges and Anchors: Same metal and finish as supported metal panels, unless otherwise indicated.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Do not begin installation until substrates have been properly prepared.
- B. Installer to verify field measurements are acceptable to suit assembly tolerances.
- C. Installer to verify supports and anchors are correctly positioned and set.

3.02 PREPARATION

- A. Provide items required to be cast into concrete or embedded in masonry with setting templates.
- B. Installer to take field measurements after permanent end terminations are in place and prior to preparation of shop drawings and fabrication, to ensure fitting of work.
- C. Prepare surfaces using the methods recommended by the supplier for achieving the best result for the substrate under the Project conditions.

3.03 INSTALLATION

- A. Install metal panels in accordance with supplier's instructions.
- B. Install metal panels plumb, level, square, true to line and rigid. Fit exposed connections together to form tight, hairline joints.
- C. On sloped surfaces, provide spacers, or other mechanism as recommended by manufacturer to achieve level installation. Adjacent panels shall be level at top.
- D. Adjust metal panels before anchoring to ensure alignment at abutting joints.
- E. Use supplier's supplied hardware for panel-to-panel connections.
- F. Attach metal panels securely in place using anchorage devices and fasteners as indicated by shop drawings.
- G. Corrosion Resistance: Separate incompatible materials to prevent galvanic corrosion.

3.04 ADJUSTING

- A. Touch-up, repair, or replace damaged products before Substantial Completion. Manufacturer to provide proper coating for repainting any exposed steel surfaces.

- B. Return items that cannot be refinished in field.

3.05 CLEANING

- A. Clean metal panels with water and light detergent promptly after installation in accordance with supplier's instructions.
- B. Do not use harsh cleaning materials or methods that will damage finish.
- C. Do not use abrasive cleaners.

3.06 PROTECTION

- A. Protect finishes of metal panels from damage during construction period with temporary protective coverings approved by metal panel supplier. Remove protective coverings at the time of Substantial Completion.
- B. Replace defective or damaged components. Restore finishes damaged during installation and construction period so no evidence remains of correction work.
- C. Touch-up, repair or replace damaged products before Substantial Completion. Return items that cannot be refinished in field to shop; make required alterations and refinish entire unit or provide new unit.

End of Section 05 7513

Section 06 1000
Rough Carpentry

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Structural dimension lumber framing.
- B. Nonstructural dimension lumber framing.
- C. Sheathing.
- D. Concealed wood blocking, nailers, and supports.

1.02 RELATED REQUIREMENTS

- A. Section 07 6200 - Sheet Metal Flashing and Trim: Sill flashings.

1.03 SUBMITTALS

- A. See Section 01 3300 - Submittals for submittal procedures.
- B. Product Data: Provide technical data on insulated sheathing, wood preservative materials, and application instructions.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

- A. Dimension Lumber: Comply with PS 20 and requirements of specified grading agencies.
 - 1. Species: Douglas Fir-Larch, unless otherwise indicated.

2.02 ACCESSORIES

- A. Fasteners and Anchors:
 - 1. Metal and Finish: Hot-dipped galvanized steel complying with ASTM A153/A153M for high humidity and preservative-treated wood locations, unfinished steel elsewhere.
 - 2. Drywall Screws: Bugle head, hardened steel, power driven type, length three times thickness of sheathing.
- B. Termite-Resistant Sill Flashing: Self-adhesive membrane; polyethylene film bonded to sealant.
 - 1. Thickness: 40 mil, 0.040 inch.
 - 2. Termite Resistance: 100 percent when tested in accordance with ICC-ES AC380.
- C. Sill Flashing: See Section 07 6200.

PART 3 EXECUTION

3.01 PREPARATION

- A. Where wood framing bears on cementitious foundations, install full width sill flashing continuous over top of foundation, lap ends of flashing minimum of 4 inches and seal.

3.02 INSTALLATION - GENERAL

- A. Select material sizes to minimize waste.
- B. Reuse scrap to the greatest extent possible; clearly separate scrap for use on site as accessory components, including: shims, bracing, and blocking.

3.03 FRAMING INSTALLATION

- A. Set structural members level, plumb, and true to line. Discard pieces with defects that would lower required strength or result in unacceptable appearance of exposed members.

- B. Make provisions for temporary construction loads, and provide temporary bracing sufficient to maintain structure in true alignment and safe condition until completion of erection and installation of permanent bracing.
- C. Install structural members full length without splices unless otherwise specifically detailed.
- D. Comply with member sizes, spacing, and configurations indicated, and fastener size and spacing indicated, but not less than required by applicable codes, AWC (WFCM) Wood Frame Construction Manual, and _____.
- E. Construct double joist headers at floor and ceiling openings and under wall stud partitions that are parallel to floor joists; use metal joist hangers unless otherwise detailed.
- F. Frame wall openings with two or more studs at each jamb; support headers on cripple studs.

3.04 BLOCKING, NAILERS, AND SUPPORTS

- A. Provide framing and blocking members as indicated or as required to support finishes, fixtures, specialty items, and trim.

End of Section 06 1000

Section 06 2000
Finish Carpentry

PART 1 GENERAL

1.01 RELATED REQUIREMENTS

- A. Section 06 1000 - Rough Carpentry: Support framing, grounds, and concealed blocking.
- B. Section 06 4100 - Architectural Wood Casework: Shop fabricated custom cabinet work.
- C. Section 09 9113 - Exterior Painting: Painting of finish carpentry items.

1.02 REFERENCE STANDARDS

- A. ANSI A208.1 - American National Standard for Particleboard; 2009.
- B. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2015a.
- C. NHLA G-101 - Rules for the Measurement & Inspection of Hardwood & Cypress; 2011.

1.03 SUBMITTALS

- A. See Section 01 3300 - Submittals for submittal procedures.
- B. Samples: Submit two samples of wood trim 12 inch long.

1.04 REGULATORY REQUIREMENTS

- A. Conform to applicable code for fire retardant requirements.

1.05 PROJECT CONDITIONS

- A. Sequence installation to ensure utility connections are achieved in an orderly and expeditious manner.
- B. Coordinate the work with installation of associated and adjacent components.

PART 2 PRODUCTS

2.01 FINISH CARPENTRY ITEMS

2.02 LUMBER MATERIALS

- A. Hardwood Lumber: Birch species, smooth sawn, maximum moisture content of 6 percent; with vertical grain, of quality suitable for transparent finish.
 - 1. Grading: In accordance with NHLA G-101 Grading Rules; www.nhla.org.

2.03 PLASTIC LAMINATE MATERIALS

2.04 FABRICATION

- A. Shop assemble work for delivery to site, permitting passage through building openings.
- B. When necessary to cut and fit on site, provide materials with ample allowance for cutting. Provide trim for scribing and site cutting.
- C. Apply plastic laminate finish in full uninterrupted sheets consistent with manufactured sizes. Fit corners and joints hairline; secure with concealed fasteners. Slightly bevel arises. Locate counter butt joints minimum 2 feet from sink cut-outs.

2.05 SHOP FINISHING

- A. Sand work smooth and set exposed nails and screws.
- B. Apply wood filler in exposed nail and screw indentations.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify adequacy of backing and support framing.
- B. Verify mechanical, electrical, and building items affecting work of this section are placed and ready to receive this work.

3.02 INSTALLATION

- A. Set and secure materials and components in place, plumb and level.
- B. Carefully scribe work abutting other components, with maximum gaps of 1/32 inch. Do not use additional overlay trim to conceal larger gaps.

3.03 PREPARATION FOR SITE FINISHING

- A. Set exposed fasteners. Apply wood filler in exposed fastener indentations. Sand work smooth.

End of Section 06 2000

Section 06 4100

Architectural Wood Casework

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Specially fabricated cabinet units.
- B. Hardware.

1.02 REFERENCE STANDARDS

- A. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards; 2014.
- B. NEMA LD 3 - High-Pressure Decorative Laminates; 2005.
- C. WI (CCP) - Certified Compliance Program (CCP); current edition at www.woodworkinstitute.com/certification.
- D. WI (MCP) - Monitored Compliance Program (MCP); current edition at www.woodworkinstitute.com/certification.
- E. ASTM D 1037 - 99 Standard Test Methods for Evaluating Properties of Wood-Base Fiber and Particle Panel Materials

1.03 SUBMITTALS

- A. See Section 01 3300 - Submittals for submittal procedures.
- B. Shop Drawings: Indicate materials, component profiles and elevations, assembly methods, joint details, fastening methods, accessory listings, hardware location and schedule of finishes. Shop Drawings shall have WI, Certified Compliance Label affixed to first page of drawing set.
- C. Product Data: Provide data for hardware accessories. Provide MSDS Sheets for all composite wood and agrifiber products, adhesives, and sealants used.
- D. Samples: Submit actual sample items of proposed pulls, hinges, shelf standards, locksets, and plastic laminates, demonstrating hardware design, quality, and finish.

1.04 QUALITY ASSURANCE

- A. Perform work in accordance with WI Manual of Millwork, Custom quality, unless other quality is indicated for specific items. The millwork supplier shall issue a W.I. Certificate Compliance Certificate indicating the grade of millwork products to be furnished for this job and certifying that they will fully meet all the requirements of the grade specified. Each unit of casework shall bear the W.I. Certificate Compliance label. Each plastic laminate countertop shall bear the W.I. Certified Compliance label. Upon the completion of the installation, a W.I. Certified Compliance shall be issued for the installation. The type of construction used must meet the seismic force requirements of Title 24.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Protect units from moisture damage.
- B. Delivery shall only be made when the area of operation is enclosed, all wet work is dry, all overhead work is complete, and the area broom clean.

1.06 FIELD CONDITIONS

- A. During and after installation of custom cabinets, maintain temperature and humidity conditions in building spaces at same levels planned for occupancy.
- B. The HVAC system shall be on and functioning, and the architectural millwork shall be acclimated to these conditions for 72 hours prior to installation.

PART 2 PRODUCTS

2.01 CABINETS

- A. Quality Standard: Custom Grade, in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), unless noted otherwise.

2.02 WOOD-BASED COMPONENTS

- A. Hardwood Faced Plywood: HPVA HP-1; graded in accordance with WI Manual of Millwork, core of lumber; exterior glue ; thickness 3/4";
 - 1. Exposed Open Shelving
 - 2. Semi Exposed Shelving
- B. Particleboard shall not be used
- C. Medium Density Fiberboard (MDF): ANSI A208.2; type as specified in WI Manual of Millwork; composed of wood fibers pressure bonded with moisture resistant formaldehyde free adhesive to suit application; sanded faces; thickness as required.
 - 1. Medex, as manufactured by Sierra Pine or approved equal
 - 2. Located at all casework construction, except as identified above.

2.03 LAMINATE MATERIALS

- A. Manufacturers:
 - 1. Formica Corporation; ____: www.formica.com/#sle.
 - 2. Panolam Industries International, Inc; Nevamar Standard HPL: www.panolam.com/#sle.
 - 3. Wilsonart LLC; ____: www.wilsonart.com/#sle.
 - 4. Or approved equal, prior to bidding
- B. High Pressure Decorative Laminate (HPDL): NEMA LD 3, types as recommended for all exposed applications as scheduled., including doors as indicated
- C. Melamine finish at all semi-exposed cabinet shelving, divisions and faces.
- D. Interior faces of cabinet doors to be faced with the same material as exposed surfaces.

2.04 ACCESSORIES

- A. Adhesive: Type recommended by WI to suit application.
- B. Plastic Edge Banding: Extruded PVC, convex shaped; smooth finish; self locking serrated tongue; of width to match component thickness.
 - 1. Color: As selected by Architect from manufacturer's standard range.
 - 2. Use at all exposed shelf edges.
 - 3. Use at door and drawer edges.
 - 4. All adhesives must meet or exceed the VOC limits of the South Coast Air Quality Management District Rule # 1168 (http://www.aqmd.gov/rules/reg/reg11_tofc.html)
- C. Fasteners: Size and type to suit application.
- D. Bolts, Nuts, Washers, Lags, Pins, and Screws: Of size and type to suit application; galvanized or chrome-plated finish in concealed locations and stainless steel or chrome-plated finish in exposed locations.
- E. Concealed Joint Fasteners: Threaded steel.
- F. Grommets: Standard plastic grommets for cut-outs, in color to match adjacent surface.

2.05 HARDWARE

- A. Adjustable Shelf Supports: Standard side-mounted system using recessed metal shelf standards and coordinated self rests, satin finish, for nominal 9/16 inch spacing adjustments.
 - 1. Standards, SP-1820, manufactured by Sugatsune or approved equal.
 - 2. Supports; SP-15, manufactured by Sugatsune or approved equal.
- B. Drawer and Door Pulls: matte chrome zinc alloy pull handle.
 - 1. Product: EG-36160 MC manufactured by Sugatsune or approved equal
- C. Cabinet Locks: Keyed cylinder, two keys per lock, master keyed, steel with satin finish.
 - 1. Pin tumbler cylinder cam lock, National Lock 8102 Series or approved equal.
 - 2. Keying as selected. All locks shall be installed in a hole shaped the same shape as the cylinder of the lock to eliminate rotation. Round lock cylinders installed in round holes will not be allowed.
 - 3. Cabinet locks are to be installed at the following cabinet doors with the following requirements:
 - a. All locks will be keyed with one master key and one unique key.
 - b. Provide 4 copies of each unique key and a total of eight copies of the master key.
 - c. Bunkroom Lockers: Unique keys for each locker door.
 - d. Kitchen Pantry Cabinets: Unique keys for each separate full height "pantry" cabinet door.
- D. Cabinet Catches and Latches:
 - 1. Product: MC0099 manufactured by Sugatsune
 - 2. Product: 323A92 manufactured by Ives
 - 3. Substitutions: See Section 01600 - Product Requirements.
- E. Drawer Slides:
 - 1. Static Load Capacity: Commercial grade.
 - 2. Mounting: Side mounted.
 - 3. Stops: Integral type.
 - 4. Features: Provide self closing/stay closed type.
 - 5. Manufacturers:
 - a. Accuride International, Inc; Light-Duty Drawer Slides: www accuride.com/#sle.
 - b. Hettich America, LP; _____: www.hettich.com/#sle.
 - c. Knap & Vogt Manufacturing Company; Light-Duty Drawer Slides: www.knapeandvogt.com/#sle.
 - d. Substitutions: See Section 01 6000 - Product Requirements.
- F. Hinges: European style concealed self-closing type, steel with nickel-plated finish.
 - 1. Manufacturers:
 - a. Rockford Process Control, Inc: rockfordprocess.com - 450 series.
 - b. Or approved equal,
 - c. Substitutions: See Section 01 6000 - Product Requirements.
- G. Silencers: Clear vinyl silencers to be installed at each cabinet door
- H. Countertop Cable Grommets:
 - 1. Color: Black, Verify with Architect
 - 2. Diameter: 3"
 - 3. Features: Grommet to include cap
- I. Wardrobe Hook

1. # 582 Double, Aluminum, Manufactured by Ives or approved equal.

2.06 FABRICATION

- A. Cabinets shall be fabricated to Woodwork Institute standards
 1. Grade: Premium
- B. Exceptions to WI standards
 1. Wall Hung Cabinets : Depth 14 inches
 2. Storage, Janitor, Closet and Utility Room Cabinets shall be of the same construction as typical cabinets.
 3. Shelves shall be designed as per schools and libraries, for a 50lb per square foot live load as per table 15-1.
 4. Exterior Edges: Include doors, drawer fronts, and front edge of vertical end panels and leg panels. Exterior edges are to be edged with heavy-duty 3mm PVC edgbanding, color to match door or drawer front.
 5. Locate grommets as directed by Owner. Assume one per workstation
- C. Assembly: Shop assemble cabinets for delivery to site in units easily handled and to permit passage through building openings.
- D. Edging: Fit shelves, doors, and exposed edges with specified edging. Do not use more than one piece for any single length.
- E. Fitting: When necessary to cut and fit on site, provide materials with ample allowance for cutting. Provide matching trim for scribing and site cutting.
- F. Plastic Laminate: Apply plastic laminate finish in full uninterrupted sheets consistent with manufactured sizes. Fit corners and joints hairline; secure with concealed fasteners. Slightly bevel arises. Locate counter butt joints minimum 2 feet from sink cut-outs.
 1. Apply laminate backing sheet to reverse side of plastic laminate finished surfaces.
 2. Cap exposed plastic laminate finish edges with material of same finish and pattern.
- G. Provide cutouts for plumbing fixtures. Verify locations of cutouts from on-site dimensions. Prime paint cut edges.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify adequacy of backing and support framing.
- B. Verify location and sizes of utility rough-in associated with work of this section.

3.02 CASEWORK INSTALLATION

- A. Install work in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS) requirements for grade indicated.
- B. Set and secure custom cabinets in place, assuring that they are rigid, plumb, and level.
- C. Use fixture attachments in concealed locations for wall mounted components.
- D. Use concealed joint fasteners to align and secure adjoining cabinet units.
- E. Carefully scribe casework abutting other components, with maximum gaps of 1/32 inch. Do not use additional overlay trim for this purpose.
- F. Secure cabinets to floor using appropriate angles and anchorages.
- G. Countersink anchorage devices at exposed locations. Conceal with solid wood plugs of species to match surrounding wood; finish flush with surrounding surfaces.

- H. Secure upper cabinets, counter bases, full height cabinets, and counter partitions to floor and wall using appropriate angles and anchorages to obtain seismic restraint per Title 24 Section 2336

3.03 ADJUSTING

- A. Adjust moving or operating parts to function smoothly and correctly.

3.04 CLEANING

- A. Defective work shall be repaired or replaced as directed by the Owner or his representative upon completion of installation.
- B. Shop finished surfaces shall be cleaned, touched-up as required and damaged or unrepairable areas shall be refinished or replaced as directed.
- C. Clean cabinetry free of debris. Installer shall be responsible for the immediate removal of all trash, crating, etc., associated with the cabinet installation.

3.05 SCHEDULES

- A. Finishes to be selected by architect from full line of colors and patterns. (Colors and Patterns are based on Formica Brand as a standard of quality unless otherwise noted.)

End of Section 06 4100

Section 06 8316

Fiberglass Reinforced Paneling

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Fiberglass reinforced plastic panels.
- B. Trim.

1.02 REFERENCE STANDARDS

- A. ASTM D5319 - Standard Specification for Glass-Fiber Reinforced Polyester Wall and Ceiling Panels; 2012.
- B. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2015a.

1.03 SUBMITTALS

- A. See Section 01 3300 - Submittals, for submittal procedures.
- B. Product Data: Provide data on specified products, describing physical and performance characteristics; including sizes, patterns and colors available; and installation instructions.
- C. Samples: Submit two samples 6 by 6 inch in size illustrating material and surface design of panels.
- D. Maintenance Materials: Furnish the following for CRPD's use in maintenance of project.
 - 1. Extra Panels: Quantity equal to 5 percent of total installed.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Store panels flat, indoors, on a clean, dry surface. Remove packaging and allow panels to acclimate to room temperature for 48 hours prior to installation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Fiberglass Reinforced Plastic Panels:
 - 1. Crane Composites, Inc; _____: www.cranecomposites.com/#sle.
 - 2. Marlite, Inc; _____: www.marlite.com/#sle.

2.02 PANEL SYSTEMS

- A. Wall Panels Marlite Symmetrix FRP Subway Tile:
 - 1. Panel Size: 4 by 8 feet.
 - 2. Panel Thickness: 0.10 inch.
 - 3. Surface Design: Embossed.
 - 4. Color: White.
 - 5. Attachment Method: Adhesive only, sealant joints, no trim.
- B. Wall Panels-Alternate 1G Wainscott Cran Composites Design Forest Collection:
 - 1. Panel Size: 4 by 8 feet.
 - 2. Panel Thickness: 0.10 inch.
 - 3. Surface Design: Smooth.
 - 4. Color: As selected by Architect.
 - 5. Attachment Method: Adhesive only, sealant joints, no trim.

2.03 MATERIALS

- A. Panels: Fiberglass reinforced plastic (FRP), complying with ASTM D5319.
 - 1. Surface Burning Characteristics: Maximum flame spread index of 25 and smoke developed index of 450; when system tested in accordance with ASTM E84.
- B. Trim: Vinyl; color coordinating with panel.
- C. Trim: Wainscott alternate aluminum cap
- D. Sealant: Type recommended by panel manufacturer; white.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions and substrate flatness before starting work.
- B. Verify that substrate conditions are ready to receive the work of this section.

3.02 INSTALLATION - WALLS

- A. Install panels in accordance with manufacturer's instructions.
- B. Cut and drill panels with carbide tipped saw blades, drill bits, or snips.
- C. Apply adhesive to the back side of the panel using trowel as recommended by adhesive manufacturer.
- D. Apply panels to wall with seams plumb and pattern aligned with adjoining panels.
- E. Install panels with manufacturer's recommended gap for panel field and corner joints.
- F. Place trim on panel before fastening edges, as required.
- G. Fill channels in trim with sealant before attaching to panel.
- H. Install trim with adhesive and screws or nails, as required.
- I. Seal gaps at floor, ceiling, and between panels with applicable sealant to prevent moisture intrusion.
- J. Remove excess sealant after paneling is installed and prior to curing.

End of Section 06 8316

Section 08 0671
Door Hardware Schedule

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Preliminary schedule of door hardware sets for swinging, sliding, folding, _____, and other door types as indicated on drawings.

1.02 RELATED REQUIREMENTS

- A. Section 08 7100 - Door Hardware: Requirements to comply with in coordination with this section.

1.03 REFERENCE STANDARDS

- A. BHMA A156.18 - American National Standard for Materials and Finishes; 2012.

1.04 PROJECT INFORMATION

- A. Project Name: Alex Fiore Teen Center and Goebel Adult Center.
- B. Architect: RRM Design Group.
- C. Hardware Consultant: _____.
 - 1. Location: _____.
 - 2. Phone Number: _____.

1.05 SUBMITTALS

- A. See Section 01 3300 - Submittals, for submittal procedures.

PART 2 PRODUCTS

2.01 FINISHES

- A. Finishes: Complying with BHMA A156.18.

End of Section 08 0671

Section 08 1213
Hollow Metal Frames

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Frames for doors set flush with wall surface.

1.02 REFERENCE STANDARDS

- A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.
- B. ANSI/SDI A250.8 - Specifications for Standard Steel Doors and Frames (SDI-100); 2014.
- C. ANSI/SDI A250.10 - Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames; 2011.
- D. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2015.
- E. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable; 2015.
- F. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength; 2014.
- G. BHMA A156.115 - American National Standard for Hardware Preparation in Steel Doors and Steel Frames; 2014.
- H. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2009.
- I. NAAMM HMMA 830 - Hardware Selection for Hollow Metal Doors and Frames; 2002.
- J. NAAMM HMMA 831 - Hardware Locations for Hollow Metal Doors and Frames; 2011.

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Door Frame Type: Provide hollow metal door frames with _____.
- B. Steel Sheet: Comply with one or more of the following requirements; galvannealed steel complying with ASTM A653/A653M, cold-rolled steel complying with ASTM A1008/A1008M, or hot-rolled pickled and oiled (HRPO) steel complying with ASTM A1011/A1011M, commercial steel (CS) Type B, for each.
- C. Accessibility: Comply with ICC A117.1 and ADA Standards.
- D. Combined Requirements: If a particular door and frame unit is indicated to comply with more than one type of requirement, comply with the specified requirements for each type; for instance, an exterior frame that is also indicated as being sound-rated must comply with the requirements specified for exterior frames and for sound-rated frames; where two requirements conflict, comply with the most stringent.
- E. Hardware Preparations, Selections and Locations: Comply with BHMA A156.115, NAAMM HMMA 830, NAAMM HMMA 831 or ANSI/SDI A250.8 (SDI-100) in accordance with specified requirements.

2.02 FINISHES

- A. Primer: Rust-inhibiting, complying with ANSI/SDI A250.10, door manufacturer's standard.

2.03 ACCESSORIES

- A. Silencers: Resilient rubber, fitted into drilled hole; provide three on strike side of single door, three on center mullion of pairs, and two on head of pairs without center mullions.

End of Section 08 1213

Section 08 1400

Wood Doors

PART 1 GENERAL

1.01 RELATED REQUIREMENTS

- A. Section 06 2000 - Finish Carpentry.
- B. Section 08 1113 - Hollow Metal Doors and Frames.
- C. Section 08 7100 - Door Hardware.
- D. Section 08 8000 - Glazing.

1.02 REFERENCE STANDARDS

- A. AAMA 1304; Voluntary Specification for Forced Entry Resistance of Side-Hinged Door Systems.
- B. ASTM E283; Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen
- C. ASTM E330; Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Pressure Difference
- D. ASTM E331; Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference
- E. ASTM E547; Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Cyclic Static Air Pressure Difference
- F. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards; 2009.
- G. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies; National Fire Protection Association; 2012.
- H. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies; Current Edition, Including All Revisions.
- I. UL 1784 - Standard for Air Leakage Tests of Door Assemblies; Current Edition, Including All Revisions.

1.03 ADMINISTRATIVE REQUIREMENTS

- A. Coordination: Obtain hardware templates from hardware manufacturer prior to starting fabrication.

1.04 SUBMITTALS

- A. Product Data: Indicate door core materials and construction; veneer species, type and characteristics.
- B. Shop Drawings: Show doors and frames, elevations, sizes, types, swings, undercuts, beveling, blocking for hardware, factory machining, factory finishing, cutouts for glazing and other details.
- C. Specimen warranty.
- D. Samples: Submit two samples of door construction, ____ by ____ inch in size cut from top corner of door.
- E. Samples: For prefinished doors submit two samples of door veneer, 10 x 10 inch in size illustrating color and finish.

- F. Manufacturer's Installation Instructions: Indicate special installation instructions.
- G. Warranty, executed in CRPD's name.

1.05 QUALITY ASSURANCE

- A. Maintain one copy of the specified door quality standard on site for review during installation and finishing.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Package, deliver and store doors in accordance with specified quality standard.
- B. Accept doors on site in manufacturer's packaging. Inspect for damage.
- C. Store in position recommended by manufacturer, elevated minimum 4 inches above grade, with minimum 1/4 inches space between doors.

1.07 WARRANTY

- A. Interior Doors: Provide manufacturer's warranty for 3 years.
- B. Exterior Doors: Provide manufacturer's warranty for 25 years.
- C. Include coverage for delamination of veneer, warping beyond specified installation tolerances, defective materials, and telegraphing core construction.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Wood Veneer Faced Doors:
 - 1. Western Oregon Door: www.oregondoor.com
 - 2. Eggers Industries; Product ____: www.eggersindustries.com.
 - 3. Haley Brothers; Product ____: www.haleybros.com.
 - 4. Marshfield DoorSystems, Inc; Product ____: www.marshfelddoors.com.
 - 5. Or approved equal
 - 6. Substitutions: See Section 01 6000 - Product Requirements.

2.02 DOOR AND FRAME ASSEMBLIES

- A. Door and Frame Assemblies: Factory-fabricated, prepared and machined for hardware.
 - 1. Door and frame pre-assembled; shipped with braces, spreaders, and packaging as required to prevent damage.
 - 2. Sizes: As indicated on drawings.
 - 3. Clearance Between Door and Frame: 1/8 inch, maximum.
 - 4. Clearance Between Bottom of Door and Finished Floor: 3/4 inch, maximum; not less than 1/4 inch clearance to threshold.
 - 5. Provide frame anchors that allow for variation in rough opening size; do not field cut doors or frames to fit.
 - a. In retrofit applications door may be trimmed to fit following manufacturer's recommendations provided trimming will not void certification.
- B. Fire Rated Doors and Frames: Ratings indicated on drawings.
 - 1. Tested in accordance with International Building Code ("positive pressure") or UL 10C or UBC Standard 7-2 ("positive pressure").

- C. Sound Retardant Doors: Minimum STC of 30, calculated in accordance with ASTM E413, tested in accordance with ASTM E1408.
- D. Factory machine doors for hardware other than surface-mounted hardware, in accordance with hardware requirements and dimensions.
- E. Factory fit doors for frame opening dimensions identified on shop drawings, with edge clearances in accordance with specified quality standard.
- F. Provide edge clearances in accordance with the quality standard specified.

2.03 WOOD VENEER FACED DOORS

- A. Quality Level: Custom Grade, in accordance with AWI/AWMAC/WI Architectural Woodwork Standards.
- B. Wood Veneer Faced Doors: 5-ply unless otherwise indicated.
- C. Thickness: 1-3/4 inches, unless otherwise indicated.
- D. Facing: Wood veneer for field transparent finish .
- E. Provide solid core doors at all locations .
 - 1. Smoke and Draft Control Doors (Indicated as "S" on Drawings): In addition to required fire rating, provide door assemblies tested in accordance with UL 1784 with maximum air leakage of 3.0 cfm per sq ft of door opening at 0.10 inch w.g. pressure at both ambient and elevated temperatures; with "S" label; if necessary, provide additional gasketing or edge sealing.
- F. Door Facings
 - 1. Wood Veneer Facing for Transparent Finish: Natural birch, veneer grade as specified by quality standard, plain sliced, book veneer match, running assembly match; unless otherwise indicated.

2.04 ACCESSORIES

- A. Metal Louvers:
 - 1. Material and Finish: Roll formed steel; pre-painted finish to color as selected.
- B. Glazing Stops: Rolled steel channel shape, butted corners; prepared for countersink style screws.

2.05 DOOR CONSTRUCTION

- A. Fabricate doors in accordance with door quality standard specified.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify that opening sizes and tolerances are acceptable.
- C. Do not install doors in frame openings that are not plumb or are out-of-tolerance for size or alignment.

3.02 INSTALLATION

- A. Install doors in accordance with manufacturer's instructions and specified quality standard.
- B. Field-Finished Doors: Trimming to fit is subject to door manufacturer recommendations.
 - 1. Adjust width of non-rated doors by cutting equally on both jamb edges.
 - 2. Trim maximum of 3/4 inch off bottom edges.

- C. Use machine tools to cut or drill for hardware.
- D. Coordinate installation of doors with installation of frames and hardware.
- E. Coordinate installation of glazing.

3.03 TOLERANCES

- A. Conform to specified quality standard for fit and clearance tolerances.
- B. Conform to specified quality standard for telegraphing, warp, and squareness.

3.04 ADJUSTING

- A. Adjust doors for smooth and balanced door movement.

3.05 SCHEDULE

- A. Refer to drawings for schedule - in general:
 - 1. Common Area Interior Doors: Solid core wood veneer
 - 2. Exterior Service Doors: See 08 1113 Hollow Metal Doors and Frames

End of Section 08 1400

Section 09 0561

Common Work Results for Flooring Preparation

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. This section applies to floors identified in Contract Documents that are receiving the following types of floor coverings:
 - 1. Resilient tile and sheet.
 - 2. Thin-set ceramic tile and stone tile.
- B. Removal of existing floor coverings.
- C. Preparation of new and existing concrete floor slabs for installation of floor coverings.
- D. Testing of concrete floor slabs for moisture and alkalinity (pH).
- E. Remediation of concrete floor slabs due to unsatisfactory moisture or alkalinity (pH) conditions.
 - 1. Contractor shall perform all specified remediation of concrete floor slabs. If such remediation is indicated by testing agency's report and is due to a condition not under Contractor's control or could not have been predicted by examination prior to entering into the contract, a contract modification will be issued.
- F. Patching compound.

1.02 RELATED REQUIREMENTS

- A. Section 01 7419 - Construction Waste Management and Disposal: Handling of existing floor coverings removed.
- B. Section 09 6500 - Resilient Flooring: Wood underlayment over wood floors

1.03 REFERENCE STANDARDS

- A. ASTM C109/C109M - Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or (50-mm) Cube Specimens); 2013.
- B. ASTM C472 - Standard Test Methods for Physical Testing of Gypsum, Gypsum Plasters and Gypsum Concrete; 1999 (Reapproved 2014).
- C. ASTM F1869 - Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride; 2011.
- D. RFCI (RWP) - Recommended Work Practices for Removal of Resilient Floor Coverings; Resilient Floor Covering Institute; October 2011.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate scheduling of cleaning and testing, so that preliminary cleaning has been completed for at least 24 hours prior to testing.

1.05 SUBMITTALS

- A. Visual Observation Report: For existing floor coverings to be removed.
- B. Floor Covering and Adhesive Manufacturers' Product Literature: For each specific combination of substrate, floor covering, and adhesive to be used; showing:
 - 1. Moisture and alkalinity (pH) limits and test methods.
 - 2. Manufacturer's required bond/compatibility test procedure.
- C. Testing Agency's Report:
 - 1. Description of areas tested; include floor plans and photographs if helpful.

2. Summary of conditions encountered.
3. Moisture and alkalinity (pH) test reports.
4. Copies of specified test methods.
5. Recommendations for remediation of unsatisfactory surfaces.
6. Submit report to Architect.
7. Submit report not more than two business days after conclusion of testing.

1.06 QUALITY ASSURANCE

- A. Moisture and alkalinity (pH) testing shall be performed by an independent testing agency employed and paid by Contractor.
- B. Contractor may perform adhesive and bond test with Contractor's own personnel or hire a testing agency.
- C. Testing Agency Qualifications: Independent testing agency experienced in the types of testing specified.
 1. Submit evidence of experience consisting of at least 3 test reports of the type required, with project Owner's project contact information.
- D. Contractor's Responsibility Relating to Independent Agency Testing:
 1. Provide access for and cooperate with testing agency.
 2. Confirm date of start of testing at least 10 days prior to actual start.
 3. Allow at least 4 business days on site for testing agency activities.
 4. Achieve and maintain specified ambient conditions.
 5. Notify Architect when specified ambient conditions have been achieved and when testing will start.

1.07 FIELD CONDITIONS

- A. Maintain ambient temperature in spaces where concrete testing is being performed, and for at least 48 hours prior to testing, at not less than 65 degrees F or more than 85 degrees F.
- B. Maintain relative humidity in spaces where concrete testing is being performed, and for at least 48 hours prior to testing, at not less than 40 percent and not more than 60 percent.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Patching Compound: Floor covering manufacturer's recommended product, suitable for conditions, and compatible with adhesive and floor covering. In the absence of any recommendation from flooring manufacturer, provide a product with the following characteristics:
 1. Cementitious moisture-, mildew-, and alkali-resistant compound, compatible with floor, floor covering, and floor covering adhesive, and capable of being feathered to nothing at edges.
 2. Compressive Strength: 3000 psi, minimum, after 28 days, when tested in accordance with ASTM C109/C109M or ASTM C472, whichever is appropriate.
- B. Alternate Flooring Adhesive: Floor covering manufacturer's recommended product, suitable for the moisture and pH conditions present; low-VOC. In the absence of any recommendation from flooring manufacturer, provide a product recommended by adhesive manufacturer as suitable for substrate and floor covering and for conditions present.
- C. Vapor Barrier (Remedial Floor Coating)
 1. Manufacturers:

- a. Halex Corporation: VersaShield MBX; www.versashield4floors.com
2. Warranty: 10 years

PART 3 EXECUTION

3.01 CONCRETE SLAB PREPARATION

- A. Follow recommendations of testing agency.
- B. Perform following operations in the order indicated:
 1. Preliminary cleaning.
 2. Moisture vapor emission tests; 3 tests in the first 1000 square feet and one test in each additional 1000 square feet, unless otherwise indicated or required by flooring manufacturer.
 3. Specified remediation, if required.
 4. Patching, smoothing, and leveling, as required.
 5. Other preparation specified.
 6. Adhesive bond and compatibility test.
 7. Protection.

3.02 REMOVAL OF EXISTING FLOOR COVERINGS

- A. Comply with local, State, and federal regulations and recommendations of RFCI Recommended Work Practices for Removal of Resilient Floor Coverings, as applicable to floor covering being removed.
- B. Dispose of removed materials in accordance with local, State, and federal regulations and as specified.

3.03 MOISTURE VAPOR EMISSION TESTING

- A. Where the floor covering manufacturer's requirements conflict with either the referenced test method or this specification, comply with the manufacturer's requirements.
- B. Where this specification conflicts with the referenced test method, comply with the requirements of this section.
- C. Test in accordance with ASTM F1869 and as follows.
- D. Plastic sheet test and mat bond test may not be substituted for the specified ASTM test method, as those methods do not quantify the moisture content sufficiently.
- E. In the event that test values exceed floor covering manufacturer's limits, perform remediation as indicated. In the absence of manufacturer limits, perform remediation if test values exceed 3 pounds per 1000 square feet per 24 hours.
- F. Report: Report the information required by the test method.

3.04 ADHESIVE BOND AND COMPATIBILITY TESTING

- A. Comply with requirements and recommendations of floor covering manufacturer.

End of Section 09 0561

Section 09 0562

Remedial Floor Coating

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Floor coating for remediation of concrete floor slabs due to unsatisfactory moisture or pH conditions, prior to installation of adhesively applied floor coverings.

1.02 RELATED REQUIREMENTS

- A. Section 09 0561 - Common Work Results for Flooring Preparation: Testing of concrete floor slabs for moisture emission and alkalinity; additional remediation requirements.

1.03 REFERENCE STANDARDS

- A. ASTM D7234 - Standard Test Method for Pull-Off Adhesion Strength of Coatings on Concrete Using Portable Pull-Off Adhesion Testers; 2012.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination: Coordinate the installation of coating with testing specified elsewhere.

1.05 SUBMITTALS

- A. See Section 01 3300 - Submittals for submittal procedures.
- B. Product Data: Manufacturer's published data on each product to be used for remediation.
- C. Manufacturer's qualification statement.
- D. Test reports indicating compliance with specified performance requirements, performed by independent testing agency.
- E. Manufacturer's installation instructions.
- F. Installer's qualification statement, certified by coating manufacturer.

1.06 QUALITY ASSURANCE

- A. Manufacturer Qualifications: At least 10 years' experience in production of moisture emission control coatings, documented by at least 5 project references.
- B. Installer Qualifications: Company specializing in performing work of the type specified in this section, trained by or employed by coating manufacturer, and able to provide at least 3 project references showing at least 3 years' experience installing moisture emission coatings.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, handle, and protect in accordance with manufacturer's instructions and recommendations.
- B. Deliver materials in manufacturer's packaging; include installation instructions.
- C. Keep materials from freezing.

1.08 WARRANTY

- A. Extended Warranty Period: Barrier warranty for 15 years covering performance, concrete adhesion, moisture or alkalinity damage to barrier and installed floor coverings. In the event of barrier failure, manufacture shall cover labor and material cost to replace moisture or alkalinity damaged flooring or coatings, reapply barrier, adhesives, patching compounds and installation accessories.
 - 1. Moisture Vapor Reduction: No upper performance limitations.
 - 2. Alkalinity Control: No upper performance limitations.

3. Manufacturing defects warranties are not acceptable.
- B. Warranty shall not exclude ACI documents, dew point, concrete salts, admixtures, resin and silicate surfaces treatments. Installations on slab surfaces deems acceptance of on site conditions. Barrier manufacturer is responsible for complete review of concrete mix designs, admixtures, sub slab vapor barrier installed and curing methods for written acceptance prior to installations.
- C. Installer: Submit 15 year warranty covering installation defects and improper installations on workmanship.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Concrete Moisture and Alkalinity Barrier: Subject to compliance with requirements, provide either the named product or an equal product by one of the other manufacturers specified.
 1. VAP-1 2000 FS by Koster. (Basis of Design)
 2. Vapor-Guard DC by Advance Moisture Control.
 3. MES 100 by Floor Seal Technology Inc.
 4. Or equal.

2.02 CONCRETE MOISTURE AND ALKALINITY BARRIER

- A. Product:
 1. Fast-setting, one-coat, membrane-forming, moisture vapor control system consisting of a unique combination of epoxy resins and other compounds formulated to prevent floor covering failures on concrete slabs with elevated levels of moisture.
 2. Meets or exceeds the performance requirements in ASTM F3010.
 3. Has no upper limit for water vapor emission from concrete floor slabs. It can be applied to concrete slabs with relative humidity up to 100% RH and it provides protection from sustained exposure to pH 14.
 4. Permeance: 0.056 perms, per ASTM E96/E96M.
 5. VOC : 0 g/L.
 6. Tensile Bond to Concrete: 200 psi per ASTM D7234
- B. Remedial Floor Coating: Single- or multi-layer coating or coating/overlay combination intended by its manufacturer to resist water vapor transmission to degree sufficient to meet flooring manufacturer's emission limits, resistant to the level of pH found, and suitable for adhesion of flooring without further treatment.
 1. Thickness: 1/8 inch, maximum.
 2. Products:
 - a. ARDEX Engineered Cements; ARDEX MC ULTRA with ARDEX FEATHERFINISH: www.ardexamericas.com.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine floor slabs where work is to be performed.
- B. Notify Architect in writing of conditions detrimental to proper or timely installation.
- C. Do not proceed until detrimental conditions have been corrected.
- D. See Section 09 0561 for moisture emission and alkalinity testing.

3.02 INSTALLATION

- A. Install remedial coating over all concrete floor areas where moisture emission and/or alkalinity exceeds the floor covering manufacturer's published limits.
- B. Prepare floor areas to be coated in accordance with coating manufacturer's requirements.
 - 1. Mask and protect adjacent wall and floor surfaces from damage due to this work.
- C. Apply coating using manufacturer's recommended procedures.
- D. Verify that prepared floor slab has moisture emission rate and alkalinity meeting requirements.

End of Section 09 0562

Section 09 2116
Gypsum Board Assemblies

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Acoustic insulation.
- B. Gypsum wallboard.
- C. Joint treatment and accessories.

1.02 RELATED REQUIREMENTS

- A. Section 06 1000 - Rough Carpentry: Building framing and sheathing.
- B. Section 06 1000 - Rough Carpentry: Wood blocking product and execution requirements.
- C. Section 07 2100 - Board and Batt Insulation: Acoustic insulation.
- D. Section 09 3000 - Tiling: Tile backing board.

1.03 REFERENCE STANDARDS

- A. ASTM C475/C475M - Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board; 2015.
- B. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2012.
- C. ASTM C840 - Standard Specification for Application and Finishing of Gypsum Board; 2013.
- D. ASTM C1047 - Standard Specification for Accessories For Gypsum Wallboard and Gypsum Veneer Base; 2014a.
- E. ASTM C1178/C1178M - Standard Specification for Coated Glass Mat Water-Resistant Gypsum Backing Panel; 2013.
- F. ASTM C1396/C1396M - Standard Specification for Gypsum Board; 2014.
- G. ASTM C1658/C1658M - Standard Specification for Glass Mat Gypsum Panels; 2013.
- H. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber; 2012.
- I. GA-216 - Application and Finishing of Gypsum Board; 2013.

1.04 SUBMITTALS

- A. See Section 01 3300 - Submittals for submittal procedures.
- B. Product Data: Provide data on metal framing, gypsum board, accessories, and joint finishing system.

PART 2 PRODUCTS

2.01 BOARD MATERIALS

- A. Manufacturers - Gypsum-Based Board:
 - 1. Georgia-Pacific Gypsum; ____: www.gpgypsum.com/#sle.
 - 2. USG Corporation; ____: www.usg.com/#sle.
 - 3. Substitutions: See Section 01 6000 - Product Requirements.
- B. Gypsum Wallboard: Paper-faced gypsum panels as defined in ASTM C1396/C1396M; sizes to minimize joints in place; ends square cut.
 - 1. Application: Use for vertical surfaces and ceilings, unless otherwise indicated.

2. Glass mat faced gypsum panels, as defined in ASTM C1658/C1658M, suitable for paint finish, of the same core type and thickness may be substituted for paper-faced board.
 3. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
 - a. Mold resistant board is required at all locations.
 4. At Assemblies Indicated with Fire-Resistance Rating: Use type required by indicated tested assembly; if no tested assembly is indicated, use Type X board, UL or WH listed.
 5. Thickness:
 - a. Vertical Surfaces: 5/8 inch.
 - b. Ceilings: 5/8 inch.
 6. Mold Resistant Paper Faced Products:
 - a. CertainTeed Corporation; M2Tech 5/8" Type X Moisture & Mold Resistant Drywall: www.certainteed.com/#sle.
 - b. National Gypsum Company; Gold Bond XP Gypsum Board: www.nationalgypsum.com/#sle.
 - c. USG Corporation; USG Sheetrock Brand EcoSmart Panels Mold Tough Firecode X: www.usg.com/#sle.
 - d. USG Corporation; Sheetrock Brand Mold Tough Gypsum Panels.
 7. Glass Mat Faced Products:
 - a. Georgia-Pacific Gypsum; DensArmor Plus: www.gpgypsum.com/#sle.
 - b. National Gypsum Company; Gold Bond eXP Interior Extreme Gypsum Panel: www.nationalgypsum.com/#sle.
 - c. USG Corporation; USG Sheetrock Brand Glass-Mat Panels Mold Tough.
- C. Backing Board For Non-Wet Areas: Water-resistant gypsum backing board as defined in ASTM C1396/C1396M; sizes to minimum joints in place; ends square cut.
1. Application: Vertical surfaces behind thinset tile, except in wet areas.
 2. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
 3. At Assemblies Indicated with Fire-Resistance Rating: Use type required by indicated tested assembly; if no tested assembly is indicated, use Type X board, UL or WH listed.
 4. Type X Thickness: 5/8 inch.
 5. Regular Board Thickness: 5/8 inch.
 6. Edges: Tapered.
 7. Products:
 - a. Georgia-Pacific Gypsum; DensShield Tile Backer.
 - b. National Gypsum Company; Gold Bond Brand XP Gypsum Board.
 - c. USG Corporation; Sheetrock Brand Mold Tough Gypsum Panels.

2.02 Gypsum Wallboard ACCESSORIES

- A. Acoustic Insulation: ASTM C665; preformed glass fiber, friction fit type, unfaced. Thickness: 5.5" inch.
- B. Finishing Accessories: ASTM C1047, extruded aluminum alloy (6063 T5) or galvanized steel sheet ASTM A924/A924M G90, unless noted otherwise.
 1. Types: As detailed or required for finished appearance.
 2. Products:
 - a. Stockton Products; Extruded Aluminum: www.stocktonproducts.com/#sle.
 - b. Trim-tex, Inc; _____: www.trim-tex.com/#sle.
- C. Joint Materials: ASTM C475/C475M and as recommended by gypsum board manufacturer for project conditions.

1. Fiberglass Tape: 2 inch wide, coated glass fiber tape for joints and corners, except as otherwise indicated.
 2. Joint Compound: Setting type, field-mixed.
- D. High Build Drywall Surfer: Vinyl acrylic latex-based coating for spray application, designed to take the place of skim coating and separate paint primer in achieving Level 5 finish.
1. Products:
 - a. CertainTeed Corporation; Level V Wall and Ceiling Primer/Surfer with M2Tech: www.certainteed.com/#sle.
 - b. USG Corporation; USG Sheetrock Brand Tuff-Hide Primer-Surfer: www.usg.com/#sle.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that project conditions are appropriate for work of this section to commence.

3.02 ACOUSTIC ACCESSORIES INSTALLATION

- A. Acoustic Insulation: Place tightly within spaces, around cut openings, behind and around electrical and mechanical items within partitions, and tight to items passing through partitions.
- B. Acoustic Sealant: Install in accordance with manufacturer's instructions.

3.03 BOARD INSTALLATION

- A. Comply with ASTM C840, GA-216, and manufacturer's instructions. Install to minimize butt end joints, especially in highly visible locations.
- B. Fire-Resistance-Rated Construction: Install gypsum board in strict compliance with requirements of assembly listing.
- C. Installation on Wood Framing: For rated assemblies, comply with requirements of listing authority. For nonrated assemblies, install as follows:
1. Single-Layer Applications: Screw attachment.

3.04 INSTALLATION OF TRIM AND ACCESSORIES

- A. Control Joints: Place control joints consistent with lines of building spaces and as indicated.
- B. Corner Beads: Install at external corners, using longest practical lengths.
- C. Edge Trim: Install at locations where gypsum board abuts dissimilar materials.
- D. Moisture Guard Trim: Install on bottom edge of gypsum board according to manufacturer's instructions and in locations indicated on drawings.

3.05 JOINT TREATMENT

- A. Finish gypsum board in accordance with levels defined in ASTM C840, as follows:
1. Level 5: Walls and ceilings to receive semi-gloss or gloss paint finish and other areas specifically indicated.
 2. Level 4: Walls and ceilings to receive paint finish or wall coverings, unless otherwise indicated.
 3. Level 2: In utility areas, behind cabinetry, and on backing board to receive tile finish.
 4. Level 1: Fire-resistance-rated wall areas above finished ceilings, whether or not accessible in the completed construction.
- B. Tape, fill, and sand exposed joints, edges, and corners to produce smooth surface ready to receive finishes.
1. Feather coats of joint compound so that camber is maximum 1/32 inch.

- C. Where Level 5 finish is indicated, spray apply high build drywall surfacer over entire surface after joints have been properly treated; achieve a flat and tool mark-free finish.

End of Section 09 2116

Section 09 3000

Tiling

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Tile for floor applications.
- B. Tile for wall applications.
- C. Coated glass mat backer board as tile substrate.
- D. Ceramic accessories.

1.02 RELATED REQUIREMENTS

- A. Section 09 2116 - Gypsum Board Assemblies: Tile backer board.

1.03 REFERENCE STANDARDS

- A. ANSI A108/A118/A136.1 - American National Standard Specifications for the Installation of Ceramic Tile (Compendium); 2013.1.
 - 1. ANSI A108.1a - American National Standard Specifications for Installation of Ceramic Tile in the Wet-Set Method, with Portland Cement Mortar; 2014.
 - 2. ANSI A108.1b - American National Standard Specifications for Installation of Ceramic Tile on a Cured Portland Cement Mortar Setting Bed with Dry-Set or Latex-Portland Cement Mortar; 1999 (Reaffirmed 2010).
 - 3. ANSI A108.1c - Specifications for Contractors Option: Installation of Ceramic Tile in the Wet-Set Method with Portland Cement Mortar or Installation of Ceramic Tile on a Cured Portland Cement Mortar Bed with Dry-Set or Latex-Portland Cement; 1999 (Reaffirmed 2010).
 - 4. ANSI A108.2 - American National Standard General Requirements: Materials, Environmental and Workmanship; 2019.
 - 5. ANSI A108.4 - American National Standard Specifications for Installation of Ceramic Tile with Organic Adhesives or Water Cleanable Tile-Setting Epoxy Adhesive; 2009 (Revised).
 - 6. ANSI A108.5 - American National Standard Specifications for Installation of Ceramic Tile with Dry-Set Portland Cement Mortar or Latex-Portland Cement Mortar; 1999 (Reaffirmed 2010).
 - 7. ANSI A108.6 - American National Standard Specifications for Installation of Ceramic Tile with Chemical Resistant, Water Cleanable Tile-Setting and -Grouting Epoxy; 1999 (Reaffirmed 2010).
 - 8. ANSI A108.8 - American National Standard Specifications for Installation of Ceramic Tile with Chemical Resistant Furan Resin Mortar and Grout; 1999 (Reaffirmed 2010).
 - 9. ANSI A108.9 - American National Standard Specifications for Installation of Ceramic Tile with Modified Epoxy Emulsion Mortar/Grout; 1999 (Reaffirmed 2010).
 - 10. ANSI A108.10 - American National Standard Specifications for Installation of Grout in Tilework; 1999 (Reaffirmed 2010).
 - 11. ANSI A108.11 - American National Standard Specifications for Interior Installation of Cementitious Backer Units; 2010 (Reaffirmed 2016).
 - 12. ANSI A108.12 - American National Standard for Installation of Ceramic Tile with EGP (Exterior glue plywood) Latex-Portland Cement Mortar; 1999 (Reaffirmed 2010).

13. ANSI A108.13 - American National Standard for Installation of Load Bearing, Bonded, Waterproof Membranes for Thin-Set Ceramic Tile and Dimension Stone; 2005 (Reaffirmed 2010).
 14. ANSI A108.19 - American National Standard Specifications for Interior Installation of Gauged Porcelain Tiles and Gauged Porcelain Tile Panels/Slabs by the Thin-Bed Method Bonded with Modified Dry-Set Cement Mortar or Improved Modified Dry-Set Cement Mortar; 2017.
 15. ANSI A118.4 - American National Standard Specifications for Modified Dry-Set Cement Mortar; 2012 (Revised).
 16. ANSI A118.7 - American National Standard Specifications for High Performance Cement Grouts for Tile Installation; 2010 (Revised).
- B. ANSI A118.15 - American National Standard Specifications for Improved Modified Dry-Set Cement Mortar; 2012.
1. ANSI A137.1 - American National Standard Specifications for Ceramic Tile; 2013.1.
 2. ASTM C373 - Standard Test Method for Water Absorption, Bulk Density, Apparent Porosity, and Apparent Specific Gravity of Fired Whiteware Products, Ceramic Tiles, and Glass Tiles; 2014a.
- C. ASTM E303 - Standard Test Method for Measuring Surface Frictional Properties Using the British Pendulum Tester; 2013.
- D. SA HB 198 - Standards Australia (SA) HB 198: Guide to the Specification and Testing of Slip Resistance of Pedestrian Surfaces; 2014.
- E. TCNA (HB) - Handbook for Ceramic, Glass, and Stone Tile Installation; 2015.

1.04 SUBMITTALS

- A. See Section 01 3300 - Submittals, for submittal procedures.
- B. Product Data: Provide manufacturers' data sheets on tile, mortar, grout, and accessories. Include instructions for using grouts and adhesives.
- C. Maintenance Data: Include recommended cleaning methods, cleaning materials, and stain removal methods.
- D. Maintenance Materials: Furnish the following for CRPD's use in maintenance of project.
 1. See Section 01 6000 - Product Requirements, for additional provisions.
 2. Extra Tile: 10 square feet of each size, color, and surface finish combination.

1.05 FIELD CONDITIONS

- A. Do not install solvent-based products in an unventilated environment.
- B. Maintain ambient and substrate temperature above 50 degrees F and below 100 degrees F during installation and curing of setting materials.

PART 2 PRODUCTS

2.01 FLOOR TILE

- A. All tile used for flooring, both interior and exterior, shall comply with SA HB 198 and by reference ASTM E303.

2.02 TILE

- A. Manufacturers: All products by the same manufacturer.
 1. As indicated on drawings.
- B. Quarry Tile, Type __: ANSI A137.1, standard grade.

1. Moisture Absorption: Over 3.0 but not more than 5.0 percent as tested in accordance with ASTM C373.
2. Color(s): As indicated on drawings.

2.03 SETTING MATERIALS

- A. Provide setting and grout materials from same manufacturer.
- B. Manufacturers:
 1. ARDEX Engineered Cements; _____: www.ardexamericas.com/#sle.
 2. LATICRETE International, Inc; _____: www.laticrete.com/#sle.
- C. Latex-Portland Cement Mortar Bond Coat: ANSI A118.4.
 1. Applications: Use this type of bond coat where Large and Heavy Tile (LHT) mortar is indicated.
 2. Products:
 - a. ARDEX Engineered Cements; ARDEX X 5: www.ardexamericas.com/#sle.
 - b. LATICRETE International, Inc; 257 TITANIUM: www.laticrete.com/#sle.

2.04 GROUTS

- A. Provide setting and grout materials from same manufacturer.
- B. Manufacturers:
 1. ARDEX Engineered Cements; _____: www.ardexamericas.com/#sle.
 2. LATICRETE International, Inc; LATICRETE PERMACOLOR Grout: www.laticrete.com/#sle.
- C. High Performance Polymer Modified Grout: ANSI A118.7 polymer modified cement grout.
 1. Applications: Use this type of grout where indicated and where no other type of grout is indicated.
 2. Use sanded grout for joints 1/8 inch wide and larger; use unsanded grout for joints less than 1/8 inch wide.
 3. Color(s): As selected by Architect from manufacturer's full line.
 4. Products:
 - a. ARDEX Engineered Cements; ARDEX FL: www.ardexamericas.com/#sle.
 - b. LATICRETE International, Inc; LATICRETE PERMACOLOR Grout: www.laticrete.com/#sle.

2.05 Maintenance Materials

- A. Tile Sealant: Gunnable, silicone, siliconized acrylic, or urethane sealant; moisture and mildew resistant type.
 1. Applications: Between tile and plumbing fixtures.
 2. Color(s): As selected by Architect from manufacturer's full line.
 3. Products:
 - a. ARDEX Engineered Cements; ARDEX SX: www.ardexamericas.com/#sle.
 - b. LATICRETE International, Inc; LATICRETE LATASIL: www.laticrete.com/#sle.

2.06 ACCESSORY MATERIALS

- A. Underlayment at Floors: Specifically designed for bonding to thin-set setting mortar; not primarily a waterproofing material and having the following characteristics:
 1. Uncoupling Function: Allow for separation between membrane and the mortar adhering tile to the membrane when subjected to excessive substrate movement.
 2. Suitable for installation over green concrete.

3. Type: Thin-Set Mortar Adhered Sheet.
 - a. Products:
 - 1) ARDEX Engineered Cements; ARDEX UI 740 Flexbone:
www.ardexamericas.com/#sle.
 - 2) LATICRETE International, Inc; LATICRETE STRATA MAT:
www.laticrete.com/#sle.
 - 3) LATICRETE International, Inc; LATICRETE 170 Sound and Crack Isolation Mat: www.laticrete.com/#sle.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that subfloor surfaces are smooth and flat within the tolerances specified for that type of work and are ready to receive tile.
- B. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive tile.
- C. Verify that subfloor surfaces are dust free and free of substances that could impair bonding of setting materials to subfloor surfaces.
- D. Cementitious Subfloor Surfaces: Verify that substrates are ready for tiling installation by testing for moisture and alkalinity (pH).
 1. Test in accordance with Section 09 0561.
 2. Obtain instructions if test results are not within limits recommended by tiling material manufacturer and setting material manufacturer.
 3. Follow moisture and alkalinity remediation procedures in Section 09 0561.
- E. Verify that required floor-mounted utilities are in correct location.

3.02 PREPARATION

- A. Protect surrounding work from damage.
- B. Vacuum clean surfaces and damp clean.
- C. Seal substrate surface cracks with filler. Level existing substrate surfaces to acceptable flatness tolerances.
- D. Install backer board in accordance with ANSI A108.11 and board manufacturer's instructions. Tape joints and corners, cover with skim coat of setting material to a feather edge.
- E. Prepare substrate surfaces for adhesive installation in accordance with adhesive manufacturer's instructions.

3.03 INSTALLATION - GENERAL

- A. Install tile, thresholds, and stair treads and grout in accordance with applicable requirements of ANSI A108.1a through ANSI A108.19 , manufacturer's instructions, and TCNA (HB) recommendations.
- B. Request tile pattern. Do not interrupt tile pattern through openings.
- C. Cut and fit tile to penetrations through tile, leaving sealant joint space. Form corners and bases neatly. Align floor joints.
- D. Place tile joints uniform in width, subject to variance in tolerance allowed in tile size. Make grout joints without voids, cracks, excess mortar or excess grout, or too little grout.
- E. Form internal angles square and external angles square.
- F. Sound tile after setting. Replace hollow sounding units.

- G. Keep control and expansion joints free of mortar, grout, and adhesive.
- H. Keep expansion joints free of adhesive or grout. Apply sealant to joints.
- I. Prior to grouting, allow installation to completely cure; minimum of 48 hours.
- J. Grout tile joints unless otherwise indicated. Use standard grout unless otherwise indicated.
- K. At changes in plane and tile-to-tile control joints, use tile sealant instead of grout, with either bond breaker tape or backer rod as appropriate to prevent three-sided bonding.
- L. Apply sealant to junction of tile and dissimilar materials and junction of dissimilar planes.

3.04 INSTALLATION - FLOORS - THIN-SET METHODS

- A. Over interior concrete substrates, install in accordance with TCNA (HB) Method F113, dry-set or latex-Portland cement bond coat, with standard grout, unless otherwise indicated.
 - 1. Use uncoupling membrane under all tile unless other underlayment is indicated.

End of Section 09 3000

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End of Section 09 3000

Section 09 5100
Acoustical Ceilings

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Suspended metal grid ceiling system.
- B. Acoustical units.
- C. Decorative suspended ceiling canopies, cable, and hangers.
- D. Materials specified contribute to the project requirement for LEED certification. Compliance with LEED project requirements are identified by the following sections
 - 1. Specification Section 01 3514.01 - LEED Credit Summary
 - 2. Specification Section 01 3515 - LEED Requirements

1.02 RELATED REQUIREMENTS

- A. Section 28 3100 - Fire Sprinkler Monitoring and Alarm: Fire alarm components in ceiling system.

1.03 REFERENCE STANDARDS

- A. ASTM C635/C635M - Standard Specification for the Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings; 2013a.
- B. ASTM C636/C636M - Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels; 2013.
- C. ASTM E580/E580M - Standard Practice for Installation of Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels in Areas Subject to Earthquake Ground Motions; 2014.
- D. ASTM E1264 - Standard Classification for Acoustical Ceiling Products; 2014.
- E. NFPA 286 - Standard Methods of Fire Tests for Evaluating Contribution of Wall and Ceiling Interior Finish to Room Fire Growth; 2015.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Sequence work to ensure acoustical ceilings are not installed until building is enclosed, sufficient heat is provided, dust generating activities have terminated, and overhead work is completed, tested, and approved.
- B. Do not install acoustical units until after interior wet work is dry.

1.05 SUBMITTALS

- A. See Section 01 3300 - Submittals, for submittal procedures.
- B. Shop Drawings: Indicate layout and details for decorative suspended canopies.
- C. Product Data: Provide data on suspension system components and acoustical units.
- D. Maintenance Materials: Furnish the following for CRPD's use in maintenance of project.
 - 1. See Section 01 6000 - Product Requirements, for additional provisions.
 - 2. Extra Acoustical Units: 120 sq ft of each type and size.
- E. LEED Submittal: Documentation of recycled content and location of manufacture.
- F. Provide LEED submittal forms with the product submittal. Submittals without the LEED forms will be rejected as incomplete. Refer to Specification Section 01 3516 – LEED Submittal Forms.

1.06 QUALITY ASSURANCE

- A. Suspension System Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- B. Acoustical Unit Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

1.07 FIELD CONDITIONS

- A. Maintain uniform temperature of minimum 60 degrees F, and maximum humidity of 40 percent prior to, during, and after acoustical unit installation.
- B. Before installing canopies, permit them to reach room temperature and a stabilized moisture content.

PART 2 PRODUCTS

2.01 ACOUSTICAL UNITS

- A. Manufacturers:
 - 1. Armstrong World Industries, Inc: www.armstrong.com.
 - 2. Substitutions: See Section 01 6000 - Product Requirements.
- B. Acoustical Units - General: ASTM E1264, Class A.
- C. Acoustical Panels Type ____ : Painted mineral fiber, 1 Type III, with the following characteristics:
 - 1. Fire Rating: Class A
 - 2. NRC: 0.55
- D. Acoustical Panels Type ____ :
 - 1. NRC: 0.70

2.02 SUSPENSION SYSTEM(S)

- A. Manufacturers:
 - 1. Armstrong World Industries, Inc: www.armstrong.com.
 - 2. Substitutions: See Section 01 6000 - Product Requirements.
- B. Metal Suspension Systems - General: Complying with ASTM C635/C635M; die cut and interlocking components, with perimeter moldings, hold down clips, stabilizer bars, clips, and splices as required.

2.03 DECORATIVE SUSPENDED CEILING CANOPIES

- A. Canopies :
 - 1. Product: Infusions Accent Canopy, Item # (54051), as manufactured by Armstrong World Industries or approved equal.
 - 2. Surface Texture: Smooth
 - 3. Composition: Light transmitting plastic
 - 4. Color:
 - a. Solid Polycarbonate: TPB = Peace Blue
 - 5. Size: 2 feet x 5 feet
 - 6. Thickness: Light Transmitting Plastic: 1/4 inch
 - 7. Weight: Solid Polycarbonate, 1.8 psf
 - 8. Edge Detail: Square edge
 - 9. Panel Configuration: Concave
 - 10. Arc Radius: 60 degrees

11. Fire Properties: Infusions Canopies have been tested according to NFPA 286 and are equivalent to Class A interior finish as defined in Chapter 8 of the International Building Code.
- B. Installation Hardware
 1. Hanging Kits: Include Hanging Cables and Forming Cables: 1/16 inch diameter 7x7 steel aircraft cable (commercial grade) with integral die cast end.
 2. Wall & Ceiling Kits:
 - a. 7006 - Escutcheon kit
 - b. 7008 - Wall attachment kit

2.04 ACCESSORIES

- A. Support Channels and Hangers: Galvanized steel; size and type to suit application, seismic requirements, and ceiling system flatness requirement specified.
- B. Hanger Wire: 12 gauge, 0.08 inch galvanized steel wire.
- C. Perimeter Moldings: Same metal and finish as grid.
- D. Touch-up Paint: Type and color to match acoustical and grid units.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify that layout of hangers will not interfere with other work.

3.02 INSTALLATION - SUSPENSION SYSTEM

- A. Install suspension system in accordance with ASTM C636/C636M, ASTM E580/E580M, and manufacturer's instructions and as supplemented in this section.
- B. Rigidly secure system, including integral mechanical and electrical components, for maximum deflection of 1:360.
- C. Locate system on room axis according to reflected plan.
- D. Perimeter Molding: Install at intersection of ceiling and vertical surfaces and at junctions with other interruptions.
 1. Use longest practical lengths.
- E. Suspension System, Non-Seismic: Hang suspension system independent of walls, columns, ducts, pipes and conduit. Where carrying members are spliced, avoid visible displacement of face plane of adjacent members.
- F. Where ducts or other equipment prevent the regular spacing of hangers, reinforce the nearest affected hangers and related carrying channels to span the extra distance.
- G. Do not support components on main runners or cross runners if weight causes total dead load to exceed deflection capability.
- H. Support fixture loads using supplementary hangers located within 6 inches of each corner, or support components independently.
- I. Do not eccentrically load system or induce rotation of runners.

3.03 INSTALLATION - ACOUSTICAL UNITS

- A. Install acoustical units in accordance with manufacturer's instructions.
- B. Fit acoustical units in place, free from damaged edges or other defects detrimental to appearance and function.

- C. Fit border trim neatly against abutting surfaces.
- D. Install acoustical units level, in uniform plane, and free from twist, warp, and dents.
- E. Cutting Acoustical Units:
 - 1. Make field cut edges of same profile as factory edges.

3.04 INSTALLATION - DECORATIVE CANOPIES

- A. A. Measure each ceiling area and establish layout of canopies. Comply with reflected ceiling plans. Coordinate panel layout with mechanical, electrical and sprinkler fixtures.
- B. Install canopies in accordance with the most current manufacturer's instructions: LA- 297055 and in compliance with the authorities having jurisdiction.
- C. Clean exposed surfaces of canopies per installation instructions.

3.05 TOLERANCES

- A. Maximum Variation from Flat and Level Surface: 1/8 inch in 10 feet.
- B. Maximum Variation from Plumb of Grid Members Caused by Eccentric Loads: 2 degrees.

End of Section 09 5100

Section 09 6429

Wood Strip and Plank Flooring

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Wood strip and plank flooring, nailed.
- B. Secondary subflooring.
- C. Sheet vapor retarder.

1.02 RELATED REQUIREMENTS

1.03 REFERENCE STANDARDS

- A. ASTM D3676 - Standard Specification for Rubber Cellular Cushion Used for Carpet or Rug Underlay; 2013.
- B. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials; 2014.
- C. MFMA (SPEC) - Guide Specifications for Maple Flooring Systems; current edition.
- D. NWFA (IG) - Installation Guidelines; current edition located at www.nwfa.org.

1.04 SUBMITTALS

- A. See Section 01 3300 - Submittals, for submittal procedures.
- B. Product Data: Provide data for flooring.
- C. Shop Drawings: Indicate floor joint pattern and termination details.
- D. Samples: Submit two samples 12 by 12 inch in size illustrating floor finish, color, and sheen.
- E. Sustainable Design Submittal: Submit VOC content documentation for field-applied adhesives, stains, finish coatings, and sealers.
- F. Installation Instructions: Indicate standard and special installation procedures.
- G. Maintenance Data: Include maintenance procedures and recommended maintenance materials.
- H. Maintenance Materials: Furnish the following for CRPD's use in maintenance of project.
 - 1. See Section 01 6000 - Product Requirements, for additional provisions.
 - 2. Extra Flooring Material: 10 square yards matching installed flooring.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum three years documented experience.
- B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.

1.06 FIELD CONDITIONS

- A. Do not install wood flooring until wet construction work is complete and ambient air at installation space has moisture content stabilized at maximum moisture content of 40 percent.
- B. Provide heat, light, and ventilation prior to installation.
- C. Store materials in area of installation for minimum period of 24 hours prior to installation.
- D. Maintain minimum room temperature of 65 degrees F for a period of two days prior to delivery of materials to installation space, during installation, and after installation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Hardwood Strip and Plank Flooring:
 - 1. Robbins Sport Surfaces; Eclipse SB: www.robbinsfloor.com.
 - 2. Substitutions: Section 01 6000 - Product Requirements.

2.02 MATERIALS

- A. Wood Strip Flooring - Type Eclipse SB Finish and Subfloor :
 - 1. Species: Northern hard maple.
 - 2. Grade: First.
 - 3. Cut: Flat grain.
 - 4. Moisture Content: 7 to 9 percent.
 - 5. Actual Thickness: Finish 25/32 inch; Sub floor system 1 1/4" subfloor system
 - 6. Actual Width: 2-1/4 inches.
 - 7. Edge: Square.
 - 8. End: End matched.
 - 9. Length: Random, minimum of 9 inches.
 - 10. Factory Finish: clear stain.
- B. Flooring Nails: Type recommended by flooring manufacturer.
- C. Subflooring: Eclipse SB Subfloor Panels, Bio-Sport II Pad
- D. Vapor Retarder: Black polyethylene sheet, 6 mil thick; 2 inch wide tape for joint sealing, provided by subfloor manufacturer.

2.03 ACCESSORIES

- A. Wood Base: Same species as flooring; profile as indicated.
- B. Wood Plugs: Round shape, 3/4 inch diameter by 1/8 inch thick, of same species as flooring.
- C. Divider Strip: Angle; mill finish aluminum.
- D. Transition Strip: Same species and finish as flooring material; profiles indicated.
- E. Vent Cove Base provided by subfloor and floor manufacturer
- F. Floor Finish: Polyurethane, to achieve high gloss surface; type recommended by flooring manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting this work.
- B. Verify that concrete subfloor surface is smooth and flat to plus or minus 1/4 inch in 10 feet.
- C. Verify wood subfloor is properly secured, smooth and flat to plus or minus 1/4 inch in 10 feet.
- D. Verify that required floor-mounted utilities are in correct location.

3.02 PREPARATION

- A. Prepare substrate to receive wood flooring in accordance with manufacturer's and NWFA instructions.
- B. Broom clean substrate.

3.03 INSTALLATION

- A. Sheathing Paper: Place over wood subfloor; lap edges and ends 2 inches, staple in place.

B. Wood Flooring:

1. Install in accordance with manufacturer's and NWFA instructions; predrill and blind nail to subfloor.
2. Lay flooring parallel to length of room areas. Verify alignment as work progresses.
3. Arrange flooring with end matched grain set flush and tight.
4. Terminate flooring at centerline of door openings where adjacent floor finish is dissimilar; provide divider strips and transition strips in accordance with flooring manufacturer's recommendations and as indicated.
5. Install edge strips at unprotected or exposed edges, and where flooring terminates.
6. Secure edge strips before installation of flooring with stainless steel screws.
7. Install flooring tight to floor access covers.
8. Provide ____ inch expansion space at fixed walls and other interruptions.

3.04 CLEANING

- A. Clean and polish floor surfaces in accordance with floor finish manufacturer's instructions.

3.05 PROTECTION

- A. Prohibit traffic on floor finish for 48 hours after installation.
- B. Place protective coverings over finished floors; do not remove coverings until Date of Substantial Completion.

End of Section 09 6429

Section 09 6500
Resilient Flooring

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Resilient tile flooring.
- B. Resilient base.
- C. Installation accessories.

1.02 RELATED REQUIREMENTS

- A. Section 09 0561 - Common Work Results for Flooring Preparation: Concrete slab moisture and alkalinity testing and remediation procedures.

1.03 REFERENCE STANDARDS

- A. ASTM F1700 - Standard Specification for Solid Vinyl Tile; 2013a.
- B. ASTM F1861 - Standard Specification for Resilient Wall Base; 2008 (Reapproved 2012).
- C. BAAQMD 8-51 - Bay Area Air Quality Management District Regulation 8, Rule 51, Adhesive and Sealant Products; www.baaqmd.gov; 2002.
- D. SCAQMD 1168 - South Coast Air Quality Management District Rule No.1168; current edition; www.aqmd.gov.

1.04 SUBMITTALS

- A. See Section 01 3300 - Submittals, for submittal procedures.
- B. Product Data: Provide data on specified products, describing physical and performance characteristics; including sizes, patterns and colors available; and installation instructions.
- C. Selection Samples: Submit manufacturer's complete set of color samples for Architect's initial selection.
- D. Sustainable Design Submittal: Submit VOC content documentation for flooring and adhesives.
- E. Concrete Subfloor Test Report: Submit a copy of the moisture and alkalinity (pH) test reports.
- F. Maintenance Materials: Furnish the following for CRPD's use in maintenance of project.
 - 1. See Section 01 6000 - Product Requirements, for additional provisions.
 - 2. Extra Flooring Material: 10% of total square feet of each type and color.
 - 3. Extra Wall Base: 10% of total linear feet of each type and color.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Upon receipt, immediately remove any shrink-wrap and check materials for damage and the correct style, color, quantity and run numbers.
- B. Store all materials off of the floor in an acclimatized, weather-tight space.
- C. Maintain temperature in storage area between 55 degrees F and 90 degrees F.

1.06 FIELD CONDITIONS

- A. Maintain temperature in storage area between 55 degrees F and 90 degrees F.
- B. Store materials for not less than 48 hours prior to installation in area of installation at a temperature of 70 degrees F to achieve temperature stability. Thereafter, maintain conditions above 55 degrees F.

PART 2 PRODUCTS

2.01 TILE FLOORING

- A. Vinyl Tile - Type ____: Solid vinyl with color and pattern throughout thickness.
 - 1. Minimum Requirements: Comply with ASTM F1700, of Class corresponding to type specified.
 - 2. Total Thickness: 0.125 inch.

2.02 RESILIENT BASE

- A. Resilient Base - Type ____: ASTM F1861, Type TS rubber, vulcanized thermoset; style as scheduled.
 - 1. Manufacturers:
 - a. Burke Flooring; ____: www.burkeflooring.com/#sle.
 - b. Roppe Corporation; Contours Profiled Wall Base System: www.roppe.com/#sle.
 - 2. Height: 4 inch.
 - 3. Thickness: 0.125 inch.
 - 4. Finish: Satin.

2.03 ACCESSORIES

- A. Subfloor Filler: White premix latex; type recommended by adhesive material manufacturer.
- B. Primers, Adhesives, and Seam Sealer: Waterproof; types recommended by flooring manufacturer.
 - 1. Provide only products having lower volatile organic compound (VOC) content than required by the more stringent of the South Coast Air Quality Management District Rule No.1168 and the Bay Area Air Quality Management District Regulation 8, Rule 51.
- C. Adhesive for Vinyl Flooring:
 - 1. Manufacturers:
 - a. H.B. Fuller Construction Products, Inc; TEC Flexera Premium Universal Adhesive: www.tecspecialty.com/#sle.
- D. Moldings, Transition and Edge Strips: Same material as flooring.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that surfaces are flat to tolerances acceptable to flooring manufacturer, free of cracks that might telegraph through flooring, clean, dry, and free of curing compounds, surface hardeners, and other chemicals that might interfere with bonding of flooring to substrate.
- B. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive resilient base.
- C. Cementitious Subfloor Surfaces: Verify that substrates are ready for resilient flooring installation by testing for moisture and alkalinity (pH).
 - 1. Obtain instructions if test results are not within limits recommended by resilient flooring manufacturer and adhesive materials manufacturer.

3.02 PREPARATION

- A. Remove subfloor ridges and bumps. Fill minor low spots, cracks, joints, holes, and other defects with subfloor filler to achieve smooth, flat, hard surface.
- B. Prohibit traffic until filler is fully cured.

3.03 Installation - General

- A. Starting installation constitutes acceptance of subfloor conditions.
- B. Install in accordance with manufacturer's written instructions.

3.04 Installation - Tile Flooring

- A. Mix tile from container to ensure shade variations are consistent when tile is placed, unless otherwise indicated in manufacturer's installation instructions.

3.05 Installation - Resilient Base

- A. Fit joints tightly and make vertical. Maintain minimum dimension of 18 inches between joints.
- B. Install base on solid backing. Bond tightly to wall and floor surfaces.

3.06 CLEANING

- A. Remove excess adhesive from floor, base, and wall surfaces without damage.
- B. Clean in accordance with manufacturer's written instructions.

3.07 PROTECTION

- A. Prohibit traffic on resilient flooring for 48 hours after installation.

End of Section 09 6500

Section 09 6813

Tile Carpeting

FIRE STATION SPEC

PART 1 GENERAL

2.01 SECTION INCLUDES

- A. Carpet tile, fully adhered.
- B. Matching roll carpet for direct glue installation on as needed.

2.02 RELATED REQUIREMENTS

2.03 REFERENCE STANDARDS

- A. ASTM E648 - Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source; 2014c.
- B. ASTM E662 - Standard Test Method for Specific Optical Density of Smoke Generated by Solid Materials; 2013b.
- C. CAL Title 24 P2 - California Code of Regulations, Title 24, Part 2 (California Building Code); 2016.
- D. NFPA 253 - Standard Method of Test for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source; 2015.

2.04 SUBMITTALS

- A. See Section 01 3300 - Submittals, for submittal procedures.
- B. Product Data: Provide data on specified products, describing physical and performance characteristics; sizes, patterns, colors available, and method of installation.
- C. Samples: Submit two carpet tiles illustrating color and pattern design for each carpet color selected.
- D. Submit two, 3" inch long samples of edge strip, base cap, stair nosing, and _____.
- E. Maintenance Materials: Furnish the following for CRPD's use in maintenance of project.
 - 1. See Section 01 6000 - Product Requirements, for additional provisions.
 - 2. Extra Carpet Tiles: Quantity equal to 5 percent of total installed of each color and pattern installed.
 - 3. Extra Roll Carpet: 12 sq ft of each type, color, and pattern installed.

2.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing specified carpet tile with minimum three years documented experience.
- B. Installer Qualifications: Company specializing in installing carpet tile with minimum three years documented experience and approved by carpet tile manufacturer.

2.06 FIELD CONDITIONS

- A. Store materials in area of installation for minimum period of 24 hours prior to installation.

PART 2 PRODUCTS

3.01 MANUFACTURERS

- A. Tile Carpeting:
 - 1. Interface, Inc; Broome Street: www.interface.com/#sle.
 - 2. Substitutions: See Section 01 6000 - Product Requirements.

3.02 MATERIALS

- A. All carpet tile shall be compliant with the provisions of CAL Title 24 P2 chapter 11B-302.2 Carpet.
 - 1. Carpet or carpet tile shall be securely attached and shall have a firm cushion, pad, or backing, or no cushion or pad.
 - 2. Carpet or carpet tile shall have a level loop, textured loop, level cut pile, or level cut/uncut pile texture.
 - 3. Pile height shall be 1/2 inch maximum.
 - 4. Exposed edges of carpet shall be fastened to floor surfaces, and shall have trim on the entire length of the exposed edge.
 - 5. Carpet trim shall comply with CBC 11B-303.
- B. Tile Carpeting: Tufted, manufactured in one color dye lot.
 - 1. Product: Broome Street manufactured by Interface, Inc..
 - 2. Tile Size: 50x50cm inch, nominal.
 - 3. Color: Selected By Owner.
 - 4. Pattern: _____.
 - 5. Style: Faculty IV.
 - 6. Flammability: Class I when tested in accordance with ASTM E648 or NFPA 253.
 - 7. Smoke: < 450 when tested in accordance with ASTM E662 NBS smoke chamber.
 - 8. Maximum Electrostatic Charge: 3.5 Kv. at 20 percent relative humidity.
 - 9. Recycled Content: 60% minimum. Carpet to be 100% recyclable including fiber and backing. Contact information for recycling shall be permanently affixed to tiles.
 - 10. Gage: 1/12 inch.
 - 11. Stitches: 9 per inch.
 - 12. Construction: Pattern loop
 - 13. Yarn: 100% Solution dyed
 - 14. Treatment: Tiles to be treated with soil protective treatment and antimicrobial treatment.
 - 15. Primary Backing Material: synthetic.
 - 16. Secondary Backing Material: thermoplastic polyolefin.
- C. Roll Carpet: Same manufacturer, type, color and pattern, and face fiber characteristics as carpet tile, 1.5 feet wide, manufactured in same color dye lot as tile.

3.03 ACCESSORIES

- A. Subfloor Filler: White premix latex; type recommended by flooring material manufacturer.
- B. Rubber Base: 6" High Rubber Base by Burke Mercer or equal. Color to be selected from the manufacturer's standard line.
- C. Edge Strips: Rubber, color as selected by Architect, u.n.o.
- D. Stair Nosing: Rubber type, square nose, ribbed top surface, one piece per stair tread width. By Burke Mercer or equal. Color to be selected from the manufacturer's standard line.
- E. Adhesives:
 - 1. Compatible with materials being adhered; maximum VOC content as specified in Section 01 6116.
- F. Carpet Tile Adhesive: Recommended by carpet tile manufacturer; releasable type.

PART 3 EXECUTION

4.01 EXAMINATION

- A. Verify that subfloor surfaces are dust-free and free of substances that could impair bonding of adhesive materials to subfloor surfaces.

4.02 PREPARATION

- A. Remove subfloor ridges and bumps. Fill minor or local low spots, cracks, joints, holes, and other defects with subfloor filler.
- B. Apply, trowel, and float filler to achieve smooth, flat, hard surface. Prohibit traffic until filler is cured.
- C. Vacuum clean substrate.

4.03 INSTALLATION

- A. Starting installation constitutes acceptance of subfloor conditions.
- B. Install carpet tile in accordance with manufacturer's instructions.
- C. Blend carpet from different cartons to ensure minimal variation in color match.
- D. Cut carpet tile clean. Fit carpet tight to intersection with vertical surfaces without gaps.
- E. Lay carpet tile in square pattern, with pile direction alternating to next unit, set parallel to building lines.
- F. Trim carpet tile neatly at walls and around interruptions.
- G. Complete installation of edge strips, concealing exposed edges.

4.04 INSTALLATION ON STAIRS

- A. Adhere carpet tight to stair treads and risers.

4.05 CLEANING

- A. Clean and vacuum carpet surfaces.

End of Section 09 6813

Section 09 7819

Plastic Laminate Faced Paneling

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Pre-manufactured panel system including mounting hardware and specified accessories.

1.02 RELATED SECTIONS

- A. 01 6116 - Volatile Organic Compound (VOC) Content Restrictions
- B. 09 2116 - Gypsum Board Assemblies
- C. 09 8414 - Acoustic Stretched-Fabric Wall Systems

1.03 REFERENCES

- A. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2015a.
- B. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards; 2014.
- C. CAL (CDPH SM) - Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions From Indoor Sources Using Environmental Chambers; California Department of Public Health; v1.1, 2010.
- D. NEMA LD 3 - High-Pressure Decorative Laminates; 2005.

1.04 SUBMITTALS

- A. See 01 3300 - Submittals - Submittals, for submittal procedures.
- B. Product Data including:
 - 1. Preparation instructions and recommendations.
 - 2. Storage and handling requirements and recommendations.
 - 3. Installation methods.
 - 4. Certification that that no composite wood products containing urea-formaldehyde binder are utilized in the work of this section
- C. Shop Drawings: Shop drawings in sufficient detail to show fabrication, installation, anchorage, and interface of the work of this Section with adjacent work.
- D. Verification Samples: For each finish specified, provide two 6 by 6 inch samples.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications:
 - 1. Firm experienced in successful production of wall systems similar to that indicated for the Project, with sufficient production capacity to produce required units without causing delay in the work.
 - 2. Provide certificate signed by panel manufacturer certifying that products comply with specified requirements.
- B. Installer Qualifications: Demonstrate successful experience in installing architectural woodwork similar in type and quality to those required for this project.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Do not deliver wall system until painting, wet work, grinding, and similar operations that could damage, soil, or deteriorate wall system have been completed in installation areas as specified by AWI/AWMAC/WI (AWS) 1700-G-3.

- B. If panels are stored prior to installation, store them flat in completely enclosed areas, out of the weather. If panels must be stored in other than installation areas, store only in areas where environmental conditions comply with manufacturers recommendations. Do not expose panels to continuous direct sunlight, nor to extremes in temperature and humidity. Store products in manufacturer's packaging until ready for installation.
- C. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

1.07 PROJECT CONDITIONS

- A. Do not install wall system until normal lighting conditions exist. Normal lighting conditions are described as those in place when the project is finished. This includes, but not limited to, design lighting (wall washers, spot lights and flood lights, and similar fixtures) and natural lighting.
- B. Wall, ceilings, floors, and openings must be level, plumb, straight, in-line and square as specified by AWI/AWMAC/WI (AWS) 1700-G-3.
- C. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits. Panels shall be conditioned in the environment in which they will be installed for a minimum of 72 hours prior to installation. The recommended environment is 75 degrees F (24 degrees C) and 45 percent relative humidity.
- D. Environmental Conditions: Comply with Woodwork Manufacturer's recommendations for optimum temperature and humidity conditions for woodwork during its storage and installation. Do not install woodwork until these conditions have been attained and stabilized so that woodwork is within plus or minus 1.0 percent of optimum moisture content from date of installation through remainder of construction period.

1.08 WARRANTY

- A. Manufacturer warrants any product it has manufactured and sold against defects in materials or workmanship for a period of five years from the date of original purchase and acceptance for use. This warranty extends to products assembled / installed and used in the manner intended and does not cover damage or failure caused by: misuse, abuse or accidents, exposure to extreme temperature, improper installation, improper maintenance and exposure to water or excessive humidity or excessive moisture.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Panel Specialists, Inc.; www.panelspec.com (Basis of Design)
- B. Marlite, Inc; www.marlite.com
- C. Substitutions will be considered in accordance with provisions of Section 01 2500 - Substitutions.

2.02 PANEL SYSTEMS

- A. Provide prefinished decorative panels where shown on the drawings, as specified herein, and as needed for a complete and proper installation.
- B. Comply with applicable requirements of "Architectural Woodwork Quality Standards" in the production and installation of the wall panel system as published by the Architectural Woodwork Institute (AWI) unless otherwise indicated.

- C. Panel System: #310EB/310 as manufactured by Panel Specialists, Inc.
 - 1. Panel Thickness: 7/16 inches (11.1 mm).
 - 2. Panel Finish: Refer to Room Finish Schedule and drawings.
 - 3. Main Laminated Panel Fire Rating: ASTM E84 Class C
 - 4. Tack Board Fire Rating: Resilient tack board as scheduled. ASTM E84 Class C
 - 5. Panel Dimensions: Refer to drawings.
 - 6. Molding: Provide manufacturer's accessories.
 - a. #603-90 End Cap for top and bottom of 90° outside corner molding
 - b. #603-135 End Cap for top and bottom of 135° outside corner molding
 - c. #304 Edge Trim Molding
 - d. #304A Edge Trim Molding (2-piece)
 - e. #412H Divider Molding
 - 7. Finishes:
 - a. Panel Face:
 - 1) As selected by Architect from standard colors, assume two colors
 - b. Panel Edge Banding:
 - 1) 1. .5mm PVC Black
 - c. Aluminum Molding Finish:
 - 1) 2. Black

2.03 MATERIALS

- A. High Pressure Decorative Laminates (VGS,VGP,VGF & HGS) and non-decorative backers (BKV) used to surface wall panels systems shall be manufactured to meet or exceed the National Electrical Manufacturing Association (NEMA LD 3) standards for thickness, performance properties and appearance.
- B. Medium Density Fiberboard (MDF): 45# density shall be used in Class III panel composition. Fire-rated MDF shall be used for Class I and Class II panel compositions (refer to AWI Section 200)
- C. Bulletin Board:
 - 1. Linoleum resilient homogeneous tackable surface material shall be of natural materials consisting linseed oil, granulated cork, resin binders and dry pigments, mixed and bonded to a natural jute backing.
 - 2. Linoleum as scheduled in the Room Finish Schedule or as indicated on the drawings.
 - 3. Resilient tackable panel from manufacturer's standard line.
 - 4. Material shall be certified compliant with CAL (CDPH SM) with standards.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Do not begin installation until substrates have been properly prepared according to AWI 1700-G-3.
- B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.02 FIELD DIMENSIONS

- A. Where wall system is indicated to be fitted to other construction, check actual dimensions of other constructions by accurate field measurements before manufacturing wall system; show recorded measurements on final shop drawings. Coordinate manufacturing schedule with construction progress to avoid delay of work.

- B. Where field measurements cannot be made without delaying the work, guarantee dimensions and proceed with manufacture of wall system without field measurements coordinate other construction to ensure that actual dimensions correspond to guaranteed dimensions.

3.03 PREPARATION

- A. Panels must be acclimated to ambient temperature and humidity conditions in accordance with manufacturer's specifications prior to installation.
- B. Clean surfaces thoroughly prior to installation.
- C. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.04 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Field cutting of all wall systems should be accomplished using carbide tools. All face penetrations and cutouts should have a minimal 1/8 inch (3 mm) radius in corners according to NEMA Standards Publication LD 3-2005.
- C. All wall systems should receive an "S" bead of panel mastic on the back of the panel during installation.
- D. For vertical applications, wall systems shall be mechanically fastened to horizontal metal furring strapping spaced 24 inches (610 mm) O.C. Furring straps shall be no less than 18-ga 3-1/2 inches (89 mm) wide, continuously. Metal strapping to be installed to the drywall studs prior to the application of the gypsum board by the framing contractor.

3.05 PROTECTION

- A. Protect installed products until completion of project.
- B. Touch-up, repair or replace damaged products before Substantial Completion.

End of Section 09 7819

Section 09 9113
Exterior Painting

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Surface preparation.
- B. Field application of paints.
- C. Scope: Finish exterior surfaces exposed to view, unless fully factory-finished and unless otherwise indicated, including the following:
 - 1. Both sides and edges of plywood backboards for electrical and telecom equipment before installing equipment.
 - 2. Exposed steel surfaces such as structural steel elements
 - 3. Exposed galvanized metal surfaces such as sheet metal flashing, vents, and trim.
 - 4. Stucco
- D. Do Not Paint or Finish the Following Items:
 - 1. Items factory-finished unless otherwise indicated; materials and products having factory-applied primers are not considered factory finished.
 - 2. Items indicated to receive other finishes.
 - 3. Items indicated to remain unfinished.
 - 4. Fire rating labels, equipment serial number and capacity labels, and operating parts of equipment.
 - 5. Stainless steel, anodized aluminum, bronze, terne-coated stainless steel, zinc, and lead.
 - 6. Floors, unless specifically indicated.
 - 7. Brick, glass unit masonry, architectural concrete, cast stone, integrally colored plaster and stucco.
 - 8. Glass.
 - 9. Concealed pipes, ducts, and conduits.

1.02 RELATED REQUIREMENTS

- A. Section 05 5000 - Metal Fabrications: Shop-primed items.

1.03 DEFINITIONS

- A. Comply with ASTM D16 for interpretation of terms used in this section.

1.04 REFERENCE STANDARDS

- A. 40 CFR 59, Subpart D - National Volatile Organic Compound Emission Standards for Architectural Coatings; U.S. Environmental Protection Agency; current edition.
- B. ASTM D16 - Standard Terminology for Paint, Related Coatings, Materials, and Applications; 2014.
- C. ASTM D4442 - Standard Test Methods for Direct Moisture Content Measurement of Wood and Wood-Base Materials; 2007.
- D. MPI (APSM) - Master Painters Institute Architectural Painting Specification Manual; Current Edition, www.paintinfo.com.
- E. South Coast Air Quality Management District (SCAQMD) Rule 1113.
- F. SSPC-SP 1 - Solvent Cleaning; 2015.
- G. SSPC-SP 2 - Hand Tool Cleaning; 1982 (Ed. 2004).

H. SSPC-SP 6 - Commercial Blast Cleaning; 2007.

1.05 SUBMITTALS

- A. See General Conditions - Article 9, for submittal procedures.
- B. Product Data: Provide complete list of products to be used, with the following information for each:
 - 1. Manufacturer's name, product name and/or catalog number, and general product category (e.g. "alkyd enamel").
 - 2. MPI product number (e.g. MPI #47).
 - 3. Cross-reference to specified paint system(s) product is to be used in; include description of each system.
 - 4. Manufacturer's installation instructions.
 - 5. If proposal of substitutions is allowed under submittal procedures, explanation of substitutions proposed.
- C. Samples: Submit three paper "draw down" samples, 8-1/2 by 11 inches in size, illustrating range of colors available for each finishing product specified.
 - 1. Where sheen is specified, submit samples in only that sheen.
 - 2. Where sheen is not specified, submit each color in each sheen available.
 - 3. Paint color submittals will not be considered until color submittals for major materials not to be painted, such as factory finished metals and roof tiles, have been approved.
- D. Certification: By manufacturer that paints and finishes comply with VOC limits specified.

1.06 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified, with minimum three years documented experience.
- B. Applicator Qualifications: Company specializing in performing the type of work specified with minimum three years experience and approved by manufacturer.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.
- B. Container Label: Include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.
- C. Paint Materials: Store at minimum ambient temperature of 45 degrees F and a maximum of 90 degrees F, in ventilated area, and as required by manufacturer's instructions.

1.08 FIELD CONDITIONS

- A. Do not apply materials when surface and ambient temperatures are outside the paint product manufacturer's temperature ranges.
- B. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.
- C. Do not apply exterior paint and finishes during rain or snow, or when relative humidity is outside the humidity ranges required by the paint product manufacturer.
- D. Provide lighting level of 80 ft candles measured mid-height at substrate surface.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Provide paints and finishes from the same manufacturer.
- B. Paints:
 - 1. Base Manufacturer: Dunn Edwards Paints, www.dunnedwards.com
 - 2. Behr Process Corporation; _____: www.behr.com/#sle.
 - 3. PPG Paints; _____: www.ppgpaints.com/#sle.
 - 4. Sherwin-Williams Company; _____: www.sherwin-williams.com/#sle.
- C. Substitutions: See requirements in Contract Documents.
- D. Substitutions: See Section 01 6000 - Product Requirements.

2.02 PAINTS AND FINISHES - GENERAL

- A. Paints and Finishes: Ready-mixed, unless required to be a field-catalyzed paint.
 - 1. Provide paints and finishes of a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating, with good flow and brushing properties, and capable of drying or curing free of streaks or sags.
 - 2. Supply each paint material in quantity required to complete entire project's work from a single production run.
 - 3. Do not reduce, thin, or dilute paint or finishes or add materials unless such procedure is described explicitly in manufacturer's product instructions.
- B. Volatile Organic Compound (VOC) Content:
 - 1. Provide paints and finishes that comply with the most stringent requirements specified in the following:
 - a. 40 CFR 59, Subpart D--National Volatile Organic Compound Emission Standards for Architectural Coatings.
 - b. Architectural coatings VOC limits of California.
 - 2. Determination of VOC Content: Testing and calculation in accordance with 40 CFR 59, Subpart D (EPA Method 24), exclusive of colorants added to a tint base and water added at project site; or other method acceptable to authorities having jurisdiction.
- C. Colors: To be selected from manufacturer's full range of available colors.
 - 1. Match existing exterior paint.
 - 2. Selection to be made by Architect after award of contract.
 - 3. Allow for minimum of three colors for each system, unless otherwise indicated, without additional cost to CRPD.

2.03 PAINT SYSTEMS - EXTERIOR

- A. Exterior Surfaces to be Painted, Unless Otherwise Indicated: Including primed metal and plaster.
 - 1. Two top coats and one coat primer.
 - 2. Top Coat(s): Exterior Latex.
 - a. Products:
 - 3. Primer: As recommended by top coat manufacturer for specific substrate.

2.04 PRIMERS

- A. Primers: Provide the following unless other primer is required or recommended by manufacturer of top coats.
 - 1. Anti-Corrosive Alkyd Primer for Metal; MPI #79.

2.05 ACCESSORY MATERIALS

- A. Accessory Materials: Provide primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials as required for final completion of painted surfaces.
- B. Patching Material: Latex filler.
- C. Fastener Head Cover Material: Latex filler.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that surfaces are ready to receive work as instructed by the product manufacturer.
- B. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially effect proper application.
- C. Test shop-applied primer for compatibility with subsequent cover materials.
- D. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces are below the following maximums:
 - 1. Exterior Plaster and Stucco: 12 percent.
 - 2. Exterior Wood: 15 percent, measured in accordance with ASTM D4442.

3.02 PREPARATION

- A. Clean surfaces thoroughly and correct defects prior to application.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
- C. Remove or mask surface appurtenances, including electrical plates, hardware, light fixture trim, escutcheons, and fittings, prior to preparing surfaces for finishing.
- D. Seal surfaces that might cause bleed through or staining of topcoat.
- E. Remove mildew from impervious surfaces by scrubbing with solution of tetra-sodium phosphate and bleach. Rinse with clean water and allow surface to dry.
- F. Exterior Plaster: Fill hairline cracks, small holes, and imperfections with exterior patching plaster. Make smooth and flush with adjacent surfaces. Wash and neutralize high alkali surfaces.
- G. Galvanized Surfaces:
 - 1. Remove surface contamination and oils and wash with solvent according to SSPC-SP 1.
- H. Ferrous Metal:
 - 1. Solvent clean according to SSPC-SP 1.
 - 2. Remove rust, loose mill scale, and other foreign substances using using methods recommended in writing by paint manufacturer and blast cleaning according to SSPC-SP 6 "Commercial Blast Cleaning". Protect from corrosion until coated.
- I. Exterior Wood Surfaces to Receive Opaque Finish: Remove dust, grit, and foreign matter. Seal knots, pitch streaks, and sappy sections. Fill nail holes with tinted exterior calking compound after prime coat has been applied. Back prime concealed surfaces before installation.

3.03 APPLICATION

- A. Exterior Wood to Receive Opaque Finish: If final painting must be delayed more than 2 weeks after installation of woodwork, apply primer within 2 weeks and final coating within 4 weeks.

- B. Apply products in accordance with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual".
- C. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.
- D. Apply each coat to uniform appearance.
- E. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.
- F. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

3.04 CLEANING

- A. Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.

3.05 PROTECTION

- A. Protect finishes until completion of project.
- B. Touch-up damaged finishes after Substantial Completion.

End of Section 09 9113

Section 09 9123
Interior Painting

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Surface preparation.
- B. Field application of paints.
- C. Scope: Finish interior surfaces exposed to view, unless fully factory-finished and unless otherwise indicated.
- D. Do Not Paint or Finish the Following Items:
 - 1. Items factory-finished unless otherwise indicated; materials and products having factory-applied primers are not considered factory finished.
 - 2. Items indicated to receive other finishes.
 - 3. Items indicated to remain unfinished.
 - 4. Fire rating labels, equipment serial number and capacity labels, bar code labels, and operating parts of equipment.
 - 5. Stainless steel, anodized aluminum, bronze, terne-coated stainless steel, and lead items.
 - 6. Marble, granite, slate, and other natural stones.
 - 7. Floors, unless specifically indicated.
 - 8. Ceramic and other tiles.
 - 9. Glass.
 - 10. Concealed pipes, ducts, and conduits.

1.02 RELATED REQUIREMENTS

- A. Section 01 8113 - Sustainable Design Requirements – LEED for Homes, including VOC restrictions
- B. Section 09 9113 - Exterior Painting.

1.03 DEFINITIONS

- A. Comply with ASTM D16 for interpretation of terms used in this section.

1.04 REFERENCE STANDARDS

- A. 40 CFR 59, Subpart D - National Volatile Organic Compound Emission Standards for Architectural Coatings; U.S. Environmental Protection Agency; current edition.
- B. ASTM D16 - Standard Terminology for Paint, Related Coatings, Materials, and Applications; 2014.
- C. ASTM D4442 - Standard Test Methods for Direct Moisture Content Measurement of Wood and Wood-Base Materials; 2007.
- D. MPI (APSM) - Master Painters Institute Architectural Painting Specification Manual; Current Edition, www.paintinfo.com.
- E. South Coast Air Quality Management District (SCAQMD) Rule 1113.
- F. SSPC-SP 1 - Solvent Cleaning; 2015.
- G. SSPC-SP 6 - Commercial Blast Cleaning; 2007.

1.05 SUBMITTALS

- A. Product Data: Provide complete list of products to be used, with the following information for each:

1. Manufacturer's name, product name and/or catalog number, and general product category (e.g., "alkyd enamel").
 2. MPI product number (e.g., MPI #47).
 3. Cross-reference to specified paint system(s) product is to be used in; include description of each system.
- B. Samples: Submit three paper "draw down" samples, 8-1/2 by 11 inches in size, illustrating range of colors available for each finishing product specified.
1. Where sheen is specified, submit samples in only that sheen.
 2. Where sheen is not specified, discuss sheen options with Architect before preparing samples, to eliminate sheens not required.
 3. Allow 30 days for approval process, after receipt of complete samples by Architect.
 4. Paint color submittals will not be considered until color submittals for major materials not to be painted, such as factory finished metals and wood cabinets, have been approved.
- C. Certification: By manufacturer that paints and finishes comply with VOC limits specified.

1.06 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified, with minimum three years documented experience.
- B. Applicator Qualifications: Company specializing in performing the type of work specified with minimum three years experience.

1.07 MOCK-UP

- A. Provide panel, 8 feet long by 8 feet wide, illustrating paint color, texture, and finish.
- B. Provide door and frame assembly illustrating paint color, texture, and finish.
- C. Mock-up may remain as part of the work.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.
- B. Container Label: Include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.
- C. Paint Materials: Store at minimum ambient temperature of 45 degrees F and a maximum of 90 degrees F, in ventilated area, and as required by manufacturer's instructions.

1.09 FIELD CONDITIONS

- A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the paint product manufacturer.
- B. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.
- C. Provide lighting level of 80 ft candles measured mid-height at substrate surface.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Provide paints and finishes from the same manufacturer.
- B. Paints:
 1. Base Manufacturer: Dunn Edwards Paints. www.dunnedwards.com
 2. Behr Process Corporation: www.behr.com/#sle.

3. Sherwin-Williams Company: www.sherwin-williams.com/#sle.
- C. Substitutions: See Section 01 6000 - Product Requirements.

2.02 PAINTS AND FINISHES - GENERAL

- A. Paints and Finishes: Ready-mixed, unless intended to be a field-catalyzed paint.
 1. Provide paints and finishes of a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating, with good flow and brushing properties, and capable of drying or curing free of streaks or sags.
 2. Supply each paint material in quantity required to complete entire project's work from a single production run.
 3. Do not reduce, thin, or dilute paint or finishes or add materials unless such procedure is specifically described in manufacturer's product instructions.
- B. Volatile Organic Compound (VOC) Content:
 1. Provide paints and finishes that comply with the most stringent requirements specified in the following:
 - a. 40 CFR 59, Subpart D--National Volatile Organic Compound Emission Standards for Architectural Coatings.
 - b. Architectural coatings VOC limits of California.
 2. Determination of VOC Content: Testing and calculation in accordance with 40 CFR 59, Subpart D (EPA Method 24), exclusive of colorants added to a tint base and water added at project site; or other method acceptable to authorities having jurisdiction.
- C. Sheens: Provide the sheens specified; where sheen is not specified, sheen will be selected later by Architect from the manufacturer's full line.
- D. Colors: To be selected from manufacturer's full range of available colors.
 1. Selection to be made by Architect after award of contract.
 2. Allow for minimum of two colors for each system, unless otherwise indicated, without additional cost to CRPD.
 3. Extend colors and sheens to surface edges; colors may change at any edge as directed by Architect.

2.03 PAINT SYSTEMS - INTERIOR

- A. Interior Surfaces to be Painted, Unless Otherwise Indicated: Including gypsum board, wood, shop primed steel, galvanized steel, and aluminum.
 1. Two top coats and one coat primer.
 2. Top Coat(s): Institutional Low Odor/VOC Interior Latex.
 - a. Products:
 - 1) Dunn Edwards, SPARTAZERO, Interior Flat Paint (SZRO10)
 - 2) Dunn Edwards, SPARTAZERO, Interior Velvet Sheen Paint (SZRO20)
 - 3) Dunn Edwards, SPARTAZERO, Interior Eggshell Sheen Paint (SZRO30)
 - 4) Dunn Edwards, SPARTAZERO, Interior Low Sheen Paint (SZRO40)
 - 5) Dunn Edwards, SPARTAZERO, Interior Semi-Gloss Paint (SZRO50)
 - 6) Dunn Edwards, SPARTASHIELD, Interior - Exterior Gloss Paint (SSHL60)
 - 7) PPG Paints Speedhide zero Latex, 6-4110XI Series, Flat. (MPI #143)
 - 8) PPG Paints Speedhide zero Latex, 6-4310XI Series, Eggshell. (MPI #144)
 - 9) PPG Paints Speedhide zero Latex, 6-4410XI Series, Satin. (MPI #145)
 - 10) PPG Paints Speedhide zero Latex, 6-4510XI Series, Semi-Gloss. (MPI #147)
 - 11) Sherwin-Williams ProMar 200 Zero VOC Interior Latex, Flat.

- 12) Sherwin-Williams ProMar 200 Zero VOC Interior Latex, Low Sheen. (MPI #144)
- 13) Sherwin-Williams ProMar 200 Zero VOC Interior Latex, Semi-Gloss.
3. Top Coat Sheen:
 - a. Velvet: MPI gloss level 2; use this sheen at typical interior walls and ceilings.
 - b. Semi-Gloss: MPI gloss level 5; use this sheen at bath and kitchen areas walls, door trim, doors, base boards.
4. Primer: As recommended by top coat manufacturer for specific substrate.

2.04 ACCESSORY MATERIALS

- A. Accessory Materials: Provide primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials as required for final completion of painted surfaces.
- B. Patching Material: Latex filler.
- C. Fastener Head Cover Material: Latex filler.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Do not begin application of paints and finishes until substrates have been adequately prepared.
- B. Verify that surfaces are ready to receive work as instructed by the product manufacturer.
- C. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially affect proper application.
- D. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.
- E. Test shop-applied primer for compatibility with subsequent cover materials.
- F. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces is below the following maximums:
 1. Gypsum Wallboard: 12 percent.
 2. Interior Wood: 15 percent, measured in accordance with ASTM D4442.

3.02 PREPARATION

- A. Clean surfaces thoroughly and correct defects prior to application.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
- C. Remove or mask surface appurtenances, including electrical plates, hardware, light fixture trim, escutcheons, and fittings, prior to preparing surfaces or finishing.
- D. Seal surfaces that might cause bleed through or staining of topcoat.
- E. Gypsum Board: Fill minor defects with filler compound. Spot prime defects after repair.
- F. Aluminum: Remove surface contamination and oils and wash with solvent according to SSPC-SP 1.
- G. Galvanized Surfaces:
 1. Remove surface contamination and oils and wash with solvent according to SSPC-SP 1.
- H. Ferrous Metal:
 1. Solvent clean according to SSPC-SP 1.

2. Shop-Primed Surfaces: Sand and scrape to remove loose primer and rust. Feather edges to make touch-up patches inconspicuous. Clean surfaces with solvent. Prime bare steel surfaces. Re-prime entire shop-primed item.
 3. Remove rust, loose mill scale, and other foreign substances using using methods recommended in writing by paint manufacturer and blast cleaning according to SSPC-SP 6 "Commercial Blast Cleaning". Protect from corrosion until coated.
- I. Wood Surfaces to Receive Opaque 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. Back prime concealed surfaces before installation.
 - J. Wood Doors to be Field-Finished: Seal wood door top and bottom edge surfaces with tinted primer if not otherwise factory sealed.

3.03 APPLICATION

- A. Apply products in accordance with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual".
- B. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.
- C. Apply each coat to uniform appearance in thicknesses specified by manufacturer.
- D. Dark Colors and Deep Clear Colors: Regardless of number of coats specified, apply as many coats as necessary for complete hide.
- E. Sand wood and metal surfaces lightly between coats to achieve required finish.
- F. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.
- G. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

3.04 CLEANING

- A. Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.

End of Section 09 9123

Section 09 9750
Anti-Graffiti Coating

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Provide all labor materials and equipment necessary for anti-graffiti coating on all exposed cast-in-place concrete.

1.02 RELATED REQUIREMENTS

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

1.03 SUBMITTALS

- A. See General Conditions - Article 9, for submittal procedures.
- B. Product Data:
 - 1. Materials list of items proposed to be provided under this Section;
 - 2. Manufacturer's specifications and other data needed to prove compliance with the specified requirements;
 - 3. Manufacturer's recommended application procedures which, when approved by the District, will become the basis for accepting or rejecting actual installation procedures used on the Work.

1.04 QUALITY ASSURANCE

- A. Test Panel:
 - 1. Construct test panel and test product to be used, before full-scale application.
 - 2. Apply product using manufacturer-approved application methods, determining actual requirements for surface preparation, coverage rate, number of coats, and application procedures.
 - 3. After manufacturer's recommended cure time, review effectiveness of protections, compatibility with substrates, and ability to achieve desired results.
 - 4. Test panel location: inside project fencing, in an area that will not impede construction activities.
 - 5. Test panel size: 4-feet by 4-feet minimum.
 - 6. Test panel shall remain intact as referee sample, until work of this section is completed to the satisfaction of the District, at which time it shall be removed.
 - 7. Test panel may not become part of the Work.

1.05 PRODUCT HANDLING

- A. Deliver materials to the job-site in satisfactory sealed containers with labels intact with manufacturer's name, brand name, type of material and batch number.
- B. Store materials in suitable location where directed by the Architect, in original unopened containers in compliance with manufacturer's printed instructions.
- C. Inspected for approval before containers are opened and any condemned materials to be removed from the job-site.
- D. Protect anti-graffiti coating materials from exposure to weather or damage caused by other construction operations.

1.06 GUARANTEE

- A. The Contractor shall furnish the Owner with a written guarantee that during a period of 2-years from date of completion and acceptance of the work, the coating will not turn white, peel, chip

or crack, and that the Contractor will without additional cost to the Owner, promptly make any repairs required as a result of ordinary wear and tear of the elements, and further guaranties that any defective material or work shall be properly repaired or replaced without additional cost to the Owner.

1.07 WARRANTY

- A. Manufacturer shall provide a written warranty for 10-years to include material only when said materials are applied in accordance with manufacturer's guidelines. Refer to manufacturer for warranty policy.

1.08 MAINTENANCE

- A. Extra Materials: Furnish CRPD with five (5) factory sealed 1-gallon containers of each of the following:
 - 1. Graffiti removal material recommended by the manufacturer for the substrate and the graffiti protection system specified.
 - 2. Restorer for the coating material specified, designed to restore graffiti resistance as required after five removals.

PART 2 - PRODUCTS

2.01 PRODUCTS

- A. Performance Criteria: Completed graffiti protection shall include the following performance criteria:
 - 1. Appropriate for use on concrete masonry materials.
 - 2. Flat nonglossy appearance.
 - 3. Non-yellowing and contain no waxes, urethanes or other yellowing resins.
 - 4. Shall cause little or no change in the appearance of the treated surface.
 - 5. Allow moisture vapor transmission.
 - 6. Dirt pickup shall not be increased by coating.
 - 7. Conform to all State and City waste disposal regulations including but not limited to those involving Proposition 65.
 - 8. Resistant to rain, weather, abrasion, peel, ultra-violet, and be clear and non-yellowing.
- B. Products:
 - 1. "World's Best Graffiti Coating", manufactured by Urban Restoration Group US, Inc. www.graffitiremovalinc.com.
 - 2. "VandlGuard Ten", manufactured by Weatherman Products, Inc. www.rainguard.com.
 - 3. Approved equal. See requirements in Contract Documents.
- C. After application of materials, a field demonstration or test will be performed to the satisfaction of the District, which will include:
 - 1. Spray paint applied to material to simulate graffiti.
 - 2. Allow to stand 14 days before removal.
 - 3. Removal by manufacturer's recommended process shall determine that at least 98% of the graffiti has been removed.

2.02 EQUIPMENT

- A. All clear materials shall be applied by airless spray equipment. Tip size .015-.021.

PART 3 - EXECUTION

3.01 Surface Conditions

- A. Examine the areas and conditions on which materials of this Section will be applied. Correct conditions detrimental to timely and proper completion of the work. Do not proceed with contracted work of this section until such detrimental conditions are corrected at no added cost to the Owner.

3.02 Environmental Conditions

- A. Do not proceed with application of anti-graffiti materials when the ambient temperature is less than 45 degrees F., when low temperature of 40 degrees F. or less is predicted within a period of 24 hours, or if rain is expected in the next 24 hours.
- B. Do not apply materials in rainy conditions or within 5 days after surfaces have become wet from rainfall or other moisture.

3.03 Inspection

- A. Applicator shall notify manufacturer's representative a minimum of 72 hours prior to scheduled application for field inspection.

3.04 Application

- A. Apply to all exposed cast-in-place concrete surfaces, except the following:
 - 1. Concrete flatwork/paving.
 - 2. Artificial rock in playground area.
- B. Prepare surfaces and apply 2 coats per manufacturer's instructions.
- C. Protection: Applicator shall be responsible for protection of this and all adjacent work from damage during application with dropcloths or other suitable materials.

3.05 Clean-up and Repairs

- A. Required Clean-Up: Conform to provisions of Section 01 74 20. The Contractor shall carefully remove all protection materials from adjacent surfaces and any residue resulting from this operation. Completely remove oversprays and spills as soon as possible before curing and excess materials from the job-site.
- B. Repairs: Any soiling of the work of this section shall be repaired by the installer of the anti-graffiti material at no added cost to the District.

End of Section 09 9750

Section 10 2113.17

Phenolic Toilet Compartments

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Phenolic toilet compartments.
- B. Urinal and vestibule screens.

1.02 RELATED REQUIREMENTS

- A. Section 06 1000 - Rough Carpentry: Blocking and supports.
- B. Section 10 2800 - Toilet, Bath, and Laundry Accessories.

1.03 REFERENCE STANDARDS

- A. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2015.
- B. NFPA 286 - Standard Methods of Fire Tests for Evaluating Contribution of Wall and Ceiling Interior Finish to Room Fire Growth; 2015.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination: Coordinate the work with placement of support framing and anchors in walls and ceilings.

1.05 SUBMITTALS

- A. See Section 01 3300 - Submittals, for submittal procedures.
- B. Product Data: Provide data on panel construction, hardware, and accessories.
- C. Shop Drawings: Indicate partition plan, elevation views, dimensions, details of wall supports, door swings.
- D. Samples: Submit two samples of partition panels, ___by___ inch in size illustrating panel finish, color, and sheen.
- E. Manufacturer's Installation Instructions: Indicate special procedures.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Phenolic Toilet Compartments:
 - 1. ASI Accurate Partitions; ____: www.asi-accuratepartitions.com/#sle.
 - 2. ASI Global Partitions; ____: www.asi-globalpartitions.com/#sle.
 - 3. or approved equal.

2.02 PHENOLIC TOILET COMPARTMENTS

- A. Toilet Compartments: Factory fabricated doors, pilasters, and divider panels made of solid phenolic core panels with integral melamine finish, floor-mounted unbraced.
 - 1. Color: as selected by owner, highest product line available.
- B. Doors:
 - 1. Thickness: 3/4 inch.
 - 2. Width: 24 inch.
 - 3. Width for Handicapped Use: 36 inch, out-swinging.
 - 4. Height: 58 inch.
- C. Panels:

1. Thickness: 1/2 inch.
 2. Height: 58 inch.
 3. Depth: As indicated on drawings.
- D. Pilasters:
1. Thickness: 3/4 inch.
 2. Width: As required to fit space; minimum 3 inch.
- E. Screens: Without doors; to match compartments; mounted to wall with two panel brackets with vertical support/bracing same as compartments.

2.03 ACCESSORIES

- A. Pilaster Shoes: Formed ASTM A666, Type 304 stainless steel with No. 4 finish, 3 inch high, concealing floor fastenings.
1. Provide adjustment for floor variations with screw jack through steel saddles integral with pilaster.
- B. Head Rails: Hollow anodized aluminum, 1 inch by 1-1/2 inch size, with anti-grip profile and cast socket wall brackets.
- C. Wall and Pilaster Brackets: Polished stainless steel; manufacturer's standard type for conditions indicated on drawings.
- D. Attachments, Screws, and Bolts: Stainless steel, tamper proof type.
- E. Hardware: Polished stainless steel:
1. Pivot hinges, gravity type, adjustable for door close positioning; two per door.
 2. Door Latch: Slide type with exterior emergency access feature.
 3. Door strike and keeper with rubber bumper; mounted on pilaster in alignment with door latch.
 4. Coat hook with rubber bumper; one per compartment, mounted on door.
 5. Provide door pull for outswinging doors.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install partitions secure, rigid, plumb, and level in accordance with manufacturer's instructions.
- B. Maintain 3/8 inch to 1/2 inch space between wall and panels and between wall and end pilasters.
- C. Attach panel brackets securely to walls using anchor devices.
- D. Attach panels and pilasters to brackets. Locate head rail joints at pilaster center lines.

3.02 TOLERANCES

- A. Maximum Variation From True Position: 1/4 inch.
- B. Maximum Variation From Plumb: 1/8 inch.

3.03 ADJUSTING

- A. Adjust and align hardware to uniform clearance at vertical edge of doors, not exceeding 3/16 inch.
- B. Adjust hinges to position doors in partial opening position when unlatched. Return out-swinging doors to closed position.

End of Section 10 2113.17

Section 10 2233

Accordion Folding Partitions

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Accordion folding partitions.
- B. Track and operating hardware.

1.02 REFERENCE STANDARDS

- A. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2015a.
- B. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2009.
- C. ASTM E413 - Classification for Rating Sound Insulation; 2010.
- D. ASTM E557 - Standard Guide for Architectural Design and Installation Practices for Sound Isolation between Spaces Separated by Operable Partitions; 2012.
- E. ASTM F793/F793M - Standard Classification of Wall Coverings by Use Characteristics; 2015.

1.03 SUBMITTALS

- A. Product Data: Provide data on partition operation, hardware and accessories, electric operating components, track switching components, colors and finishes available.
- B. Shop Drawings: Indicate opening sizes, track layout, details of track and required supports, static and dynamic loads, adjacent construction and finish trim, and stacking sizes.
- C. Samples: Submit two samples of full manufacturer's color range for selection of colors.
- D. Samples: Submit two samples of surface finish, 12 by 12 inches size, illustrating quality.
- E. Manufacturer's Installation Instructions: Indicate special procedures.
- F. Manufacturer's Certificate: Certify that partition system meets or exceeds specified acoustic requirements and _____.

1.04 QUALITY ASSURANCE

- A. Sound Transmission Class (STC): As indicated, calculated in accordance with ASTM E413, based on tests performed in accordance with ASTM E90, on panel size of 100 sq ft.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Basis of Design: Wondoor, Durasound.
- B. Other Acceptable Manufacturers:
 - 1. Approved Equal.

2.02 ACCORDION FOLDING PARTITIONS

- A. Partition Construction: Acoustical.
 - 1. Operation: Shall be top supported and manually operated.
 - 2. Construction: Shall consist of two parallel accordion-type walls of panels independently suspended with no pantographs or interconnections except at the lead-post.
 - 3. Panels shall be formed of cold rolled vinyl-clad 24-gauge V-grooved steel. Vinyl shall be permanently bonded by heat pressure lamination to the steel panel. Panels shall be connected by full height extruded vinyl hinges.

4. Insulation: Interior surfaces of both walls shall be completely covered with a continuous blanket of 2 lb. density foil-backed fiberglass fastened in place with steel spring-clips.
 5. Suspension systems: Shall consist of two extruded aluminum tracks spaced 6" or 8" on center attached to the overhead structural support. Each panel shall be suspended by a steel hanger pin and a pair of nylon-tired ball bearing rollers. Each lead-post shall be suspended by an 4-wheel ball bearing trolley.
 6. Lead-posts: Shall be of 16-gauge cold rolled steel and shall be connected to the partition by specially formed steel panels. Lead-post hardware shall include standard grip-type handles and sliding latch to affect closure.
 7. Perimeter Seals: Shall consist of continuous extruded vinyl sweep strips attached to the top and bottom of the partition. Leading edges of lead-posts and receiver posts shall be acoustically sealed by extruded vinyl interlocking seals.
 8. Hanging weight shall be 4.2 pounds per square foot.
 9. Acoustic seals at top, meeting mullions, jambs, and bottom.
- B. 2.03 ACOUSTICAL PERFORMANCE
1. Sound transmission class (STC) shall be STC 48 when tested in accordance with requirements of ASTM E-90.
- C. 2.04 COLORS
1. Vinyl finish color shall be selected by the architect from manufacturer's standard colors.

2.03 COMPONENTS

- A. Trim: Aluminum moldings, clear anodized.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify that field measurements are as indicated.
- C. Verify track supports are laterally braced and will permit track to be leveled within 1/4 inch of required position and parallel to the floor surface.

3.02 INSTALLATION

- A. Install partition in accordance with manufacturer's instructions and ASTM E557.
- B. Fit and align partition assembly level and plumb.
- C. Lubricate moving components.

3.03 ADJUSTING

- A. Adjust partition assembly to provide smooth operation from stacked to full open position.
- B. Visually inspect partition in full open position for light leaks to identify a potential acoustical leak. Adjust to achieve light tight seal.

3.04 CLOSEOUT ACTIVITIES

- A. Demonstrate operation of partition and identify potential operational problems.

End of Section 10 2233

Section 10 2239

Folding Panel Partitions

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Top-supported folding panel partitions, horizontal opening.

1.02 RELATED REQUIREMENTS

- A. Section 06 1000 - Rough Carpentry: Wood blocking and track support shimming.
- B. Section 06 2000 - Finish Carpentry: Product requirements for plastic laminate finish for installation by this section.

1.03 REFERENCE STANDARDS

- A. ANSI A208.1 - American National Standard for Particleboard; 2009.
- B. ASCE 7 - Minimum Design Loads for Buildings and Other Structures; 2010, with 2013 Supplements and Errata.
- C. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2014.
- D. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes [Metric]; 2013.
- E. ASTM C1396/C1396M - Standard Specification for Gypsum Board; 2014.
- F. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2012.
- G. ASTM E557 - Standard Guide for Architectural Design and Installation Practices for Sound Isolation between Spaces Separated by Operable Partitions; 2012.
- H. UL (FRD) - Fire Resistance Directory; current edition.

1.04 SUBMITTALS

- A. See Section 01 3300 - Submittals, for submittal procedures.
- B. Product Data: Provide data on partition materials, operation, hardware and accessories, electric operating components, track switching components, and colors and finishes available.
- C. Design Data: Design calculations, bearing seal and signature of structural engineer licensed to practice in California, showing loads at points of attachment to the building structure.
- D. Shop Drawings: Indicate opening sizes, track layout, details of track and required supports, static and dynamic loads, location and details of pass door and frame, adjacent construction and finish trim, and stacking depth.
- E. Samples for Selection: Submit two samples of full manufacturer's color range for selection of colors.
- F. Samples for Review: Submit two samples of surface finish, 12 by 12 inches size, illustrating quality, colors selected, texture, and weight.
- G. Certificates: Certify that partition system meets or exceeds specified acoustic requirements.
- H. Manufacturer's Instructions: Indicate special procedures.
- I. Maintenance Data: Include recommended cleaning methods, cleaning materials, and stain removal methods. Describe cleaning materials detrimental to finish surfaces and hardware finish.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified this section with minimum three years of documented experience.
- B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until installation.

1.07 WARRANTY

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
- B. Provide two year manufacturer warranty against defects in material and workmanship, excluding abuse.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Folding Panel Partitions - Horizontal Opening:
 - 1. Modernfold, a DORMA Group Company; Acousti-Seal Legacy Paired Panel: www.modernfold.com/#sle.
 - 2. Or Approved Equal _____.

2.02 FOLDING PANEL PARTITIONS - HORIZONTAL OPENING

- A. Folding Panel Partitions: Side opening; paired panels; side stacking; manually operated.
- B. Panel Construction:
 - 1. Nominal 3-inch (76mm) thick panels in manufacturer's standard 48-inch (1220mm) widths. All panel horizontal and vertical framing members fabricated from minimum 16-gage formed steel with overlapped and welded corners for rigidity. Top channel is reinforced to support suspension system components. Frame is designed so that full vertical edges of panels are of formed steel and provide concealed protection of the edges of the panel skin.
 - 2. Panel Skin Options:
 - a. Roll-formed 21-gage steel wrapping around panel edge. Panel skins shall be lock formed and welded directly to the frame for unitized construction. Acoustical ratings of panels with this construction (select one):
 - 1) 52 STC
 - b. Roll-formed 21-gage Micro-perforated steel wrapping around panel edge provided on 50% of panel faces manufactured with sound absorptive backing. Panel skins shall be lock formed and welded directly to the frame for unitized construction. Acoustical ratings of panels with this construction shall be no less than:
 - 1) 45 STC (net with NRC construction)
 - 2) 0.65 NRC with wall covering and upholstery fabric or non-woven needle punch carpet covering
 - c. Hinges for Closure Panels, Pass Doors, and Pocket Doors shall be:
 - 1) Full leaf butt hinges, attached directly to panel frame with welded hinge anchor plates within panel to further support hinge mounting to frame. Lifetime warranty on hinges. Hinges mounted into panel edge or vertical astragal are not acceptable.

- 2) SOSS® Invisible laminated hinge with antifriction segments mounted between each heat-treated link. Hinge to be attached directly to panel frame. Welded internal hinge bracket shall support the hinge and allow for adjustment of hinge plates. Concealed hinges mounted into edge or vertical astragal are not acceptable (available on steel skin panel only).
- d. Panel Trim: No vertical trim required or allowed on edges of panels; minimal groove appearance at panel joints.
3. E. Panel Weights shall conform to the following maximum loads allowable per existing structure and in compliance with product requirements. Notify architect of any operational discrepancies.
 - a. length/600 deflection limit = 0.44". Maximum dead load = 75 pounds per foot
 - b. length/480 deflection limit = 0.55". Maximum dead load = 100 pounds per foot
 - c. length/600 deflection limit = 0.73". Maximum dead load = 125 pounds per foot
 - d. length/600 deflection limit = 1.1". Maximum dead load = 175 pounds per foot
- C. Panel Finishes:
 1. A. Panel face finish shall be (select as required):
 - a. 4. Wall covering and upholstery fabric with surface treatment to resist stains.
 2. B. Panel trim: Exposed panel trim of one consistent color from manufacturer's standard offering.
- D. Panel Seals:
 1. Vertical Interlocking Sound Seals between panels: Roll-formed steel astragals, with reversible tongue and groove configuration in each panel edge for universal panel operation. Rigid plastic or aluminum astragals or astragals in only one panel edge are not acceptable.
 2. Horizontal Top Seals: Continuous contact extruded vinyl bulb shape with pairs of non-contacting vinyl fingers to prevent distortion without the need for mechanically operated parts.
 3. Horizontal Bottom Seals:
 4. SM4 - Manually activated bottom seals providing nominal 4-inch (102 mm) operating clearance with an operating range of +1/2-inch (13 mm) to -3-1/2-inch (89 mm). Seal shall be operable from panel edge or face. Extended seal shall exert nominal 120 pounds (265 kg) downward force to the floor throughout operating range
- E. Suspension System:
 1. A. #17 Suspension System
 - a. Suspension Tracks: Minimum 11-gage, 0.12-inch (3 mm) roll-formed steel track, suitable for either direct mounting to a wood header or supported by adjustable steel hanger brackets, supporting the load-bearing surface of the track, connected to structural support by pairs of 3/8-inch (9.5mm) diameter threaded rods. Aluminum track is not acceptable.
 - b. Exposed track soffit: Steel, integral to track, and pre-painted off-white.
 2. Carriers: One all-steel trolley with steel-tired ball bearing wheels per panel (except hinged panels). Non-steel tires are not acceptable.
 3. Warranty period: Five (5) years.
- F. Performance:
 1. Installed partition system track capable of supporting imposed loads, with maximum deflection of 1/360 of span.
- G. Accessories:

1. Ceiling Closure: White enameled ceiling closure; aluminum jamb and head molding, fittings and attachments, and intermediate meeting posts.

2.03 MATERIALS

- A. Aluminum Extrusions: ASTM B221 (ASTM B221M), 6063 alloy, T6 temper.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as indicated.

3.02 INSTALLATION

- A. Install partition in accordance with manufacturer's instructions and ASTM E557.
- B. Lubricate moving components.
- C. Install acoustic sealant to achieve required acoustic performance.
- D. Coordinate electrical connections.

3.03 ADJUSTING

- A. Adjust partition assembly to provide smooth operation from stacked to full open position. Do not over-compress acoustic seals.
- B. Visually inspect partition in full extended position for light leaks to identify a potential acoustical leak.
- C. Adjust partition assembly to achieve lightproof seal.

3.04 CLEANING

- A. Clean finish surfaces and partition accessories.
- B. Condition markerboard surfaces in accordance with manufacturer's instructions.

3.05 CLOSEOUT ACTIVITIES

- A. Demonstrate operation of partition and identify potential operational problems.

End of Section 10 2239

Section 10 2800

Toilet, Bath, and Laundry Accessories

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Utility room accessories.

1.02 RELATED REQUIREMENTS

- A. Section 01 3514 - LEED Credit Summary
- B. Section 01 3515 - LEED Certification Procedures
- C. Section 06 1000 Rough Carpentry: Concealed supports for accessories, including in wall framing and plates.
- D. Section 09 3000 - Tiling
- E. Section 10 2113.19 - Plastic Toilet Compartments.
- F. Section 22 0000 Plumbing: Toilet and lavatory fixtures

1.03 REFERENCE STANDARDS

- A. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2015.
- B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2015.
- C. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2015.
- D. ASTM C1036 - Standard Specification for Flat Glass; 2011.
- E. ASTM C1503 - Standard Specification for Silvered Flat Glass Mirror; 2008 (Reapproved 2013).

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate the work with the placement of internal wall reinforcement to receive anchor attachments.

1.05 SUBMITTALS

- A. See Section 01 3300 - Submittals, for submittal procedures.
- B. Product Data: Submit data on accessories describing size, finish, details of function, and attachment methods.
- C. Provide LEED submittal forms with the product submittal for each different product and manufacturer. Recycled content, regional distance and materials costs must be identified for each manufacturer and product. Submittals without the LEED forms will be rejected as incomplete. Refer to Specification Section 01 3516 – LEED Submittal Forms.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Basis of Design: Bobrick.
- B. Commercial Toilet, Shower, and Bath Accessories:
 - 1. ASI - American Specialties, Inc: www.americanspecialties.com.
 - 2. Bradley Corporation: www.bradleycorp.com.

- C. Electric Hand/Hair Dryers:
 - 1. American Dryer, Inc: www.americandryer.com.
 - 2. Excel Dryer: www.exceldryer.com.
 - 3. World Dryer Corporation; Basis of Design: www.worlddryer.com.
 - 4. Bobrick Washroom Equipment Inc.: www.bobrick.com
- D. Provide products of each category type by single manufacturer.

2.02 MATERIALS

- A. Accessories - General: Shop assembled, free of dents and scratches and packaged complete with anchors and fittings, steel anchor plates, adapters, and anchor components for installation.
- B. Stainless Steel Sheet: ASTM A666, Type 304.
- C. Galvanized Sheet Steel: Hot-dipped galvanized steel sheet, ASTM A653/A653M, with G90/Z275 coating.
- D. Mirror Glass: Annealed float glass, ASTM C1036 Type I, Class 1, Quality Q2, with silvering, protective and physical characteristics complying with ASTM C1503.

2.03 FINISHES

- A. Stainless Steel: Satin finish, unless otherwise noted.
- B. Galvanizing for Items Other than Sheet: Comply with ASTM A123/A123M; galvanize ferrous metal and fastening devices.

2.04 Utility Room Accessories

- A. Combination Utility Shelf/Mop and Broom Holder: 0.05 inch thick stainless steel, Type 304, with 1/2 inch returned edges, 0.06 inch steel wall brackets.
 - 1. Hooks: 4, 0.06 inch stainless steel rag hooks at shelf front.
 - 2. Mop/broom holders: Three spring-loaded rubber cam holders at shelf front.
 - 3. Length: 34 inches.
 - 4. Product: B-239 manufactured by Bobrick.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify exact location of accessories for installation.
- C. For electrically-operated accessories, verify that electrical power connections are ready and in the correct locations.

3.02 PREPARATION

- A. Deliver inserts and rough-in frames to site for timely installation.
- B. Provide templates and rough-in measurements as required.

3.03 INSTALLATION

- A. Install accessories in accordance with manufacturers' instructions in locations indicated on drawings.
- B. Install plumb and level, securely and rigidly anchored to substrate.
- C. Mounting Heights: As required by accessibility regulations, unless otherwise indicated.

End of Section 10 2800

Section 11 6833
Athletic Equipment

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Outdoor basketball equipment.
- B. Volleyball equipment.
- C. Exercise stations
- D. Table Tennis, paddles and balls
- E. Cornhole Boards and bags

1.02 RELATED REQUIREMENTS

- A. Section 03 3000 - Cast-in-Place Concrete: Footings for equipment.

1.03 REFERENCE STANDARDS

- A. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2015.
- B. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes; 2013.

1.04 SUBMITTALS

- A. See Article 9 of the General Conditions for submittal procedures.
- B. Product Data: Provide athletic field equipment manufacturer's product data indicating materials of construction, compliance with specified standards, installation procedures, and necessary safety limitations.
- C. Shop Drawings: Submit detailed scale drawings showing athletic field equipment and perimeter layout.
- D. Samples: Submit color chart for each item that color must be selected showing full range of colors and finishes.
- E. Maintenance Data: Submit manufacturer's recommended maintenance instructions and list of replaceable parts for each equipment item, along with supplier's address and phone number.
- F. Warranty: Submit manufacturer warranty and ensure that forms have been completed in CRPD's name and registered with manufacturer.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, handle, and store equipment on project site in accordance with manufacturer's recommendations.
- B. Store materials in a dry, covered area, and elevated above grade.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Athletic Equipment:
 - 1. Mega Slam Hoops; www.megaslamhoops.com
 - 2. Volleyball USA; www.volleyballusa.com
 - 3. Exercise Equipment: www.recwest.com
 - 4. Approved Equal.

2.02 PRODUCTS

- A. Basketball Hoop: "MEGASLAM XL", as manufactured by Mega Slam Hoops.
 - 1. Description:
 - a. 12" x 8" monster-sized, 5-gauge steel main pole
 - b. Regulation-sized 72"-wide backboard with ½"- thick tempered glass
 - c. 180 Pro Rim® with Directional Flex® Technology
 - d. 1 UV coated net
 - e. Upper and lower adjustable steel arms
 - f. 2 lift-assist cylinders
 - g. Height actuator and adjustable crank
 - h. 2" - thick padding for main pole and base
 - i. 1" - thick backboard padding
 - 2. Accessories
 - a. "MEGASLAM XL" anchor kit
 - b. Actuator Security Cover
 - 3. Approved Equal.
- B. Volleyball net and posts: "Monson Slider Quick Adjust Poles" and "Anodized Aluminum, Seamless Ground Sleeves", as manufactured by Volleyball USA.
 - 1. Description: Adjustable net under full tension with high strength galvanized steel tracks with eye bolts and stainless steel slider bars. Adjustable net from approximately 9' to 3 feet.
 - 2. Accessories: furnish Owner with one #19 or 3/4 size tool or crescent wrench to tighten winch
 - 3. Provide cap with sleeving system.
 - 4. Approved Equal.
- C. Exercise Equipment: Manufacturer Quote Number: 1139052-01-02
 - 1. Quote number represents multiple exercise equipment. Contact manufacturer for complete list of equipment, colors, and materials.
 - a. Do not order equipment until color selection has been approved by CRPD in writing.
 - 2. Concrete footings: Per manufacturer's instructions.
- D. Table Tennis: STIGA Premium Compact Table Tennis (Amazon.com)
 - 1. Description: Comes Preassembled, folds to minimal storage dimensions. 1" Tournament Top with Silk Screen Striping and 2-2/5" Steel Apron
 - 2. Dimensions: 70 x 62 x 22.5 inches; 300 Pounds
 - 3. Item model number: T8513
 - 4. Manufacturer: Escalade Sports - Dropship
 - 5. Accessories
 - a. The Stiga Performance 4-player set includes four performance rackets with inverted rubber and six 3-star balls (three white and three orange) (Amazon.com)
 - b. Quantity: 1
 - c. Item model number: T1364
- E. Cornhole: PureBond Unfinished Red Oak Cornhole Set (Home Depot)
 - 1. Description: Regulation-sized for official cornhole play (2 ft. x 4 ft. with a 6 in. hole that's 6 in. from the top)
 - 2. Model: #5046
 - 3. Accessories

- a. Regulation Cornhole Bag Set with Included Case in Red/Blue
- b. Quantity: 2 - 16 bags total
- c. Model #BG5039

PART 3 EXECUTION

3.01 VERIFICATION OF CONDITIONS

- A. Verify that athletic field equipment area has been graded to subgrade elevations required and that excess soil, rocks, and debris has been removed as necessary for installation of footings.
- B. Verify that athletic field equipment footings have been installed in proper locations and at proper elevations.
- C. Verify location of underground utilities and facilities in athletic field equipment area; damage to underground utilities and facilities will be repaired at Contractor's expense.

3.02 PREPARATION

- A. Stake location of athletic field equipment elements, including necessary athletic field perimeters, surfacing, access and egress points, hard surfaces, walls, fences, stairs, and/or structures.
- B. Stake layout of athletic field equipment perimeter in accordance with approved shop drawings before starting any work.
 1. Verify that athletic field perimeters do not overlap hard surfaces, whether currently installed or not.
 2. Verify that athletic fields are free of obstructions.
 3. If conflicts or obstructions are found, notify Architect.
 4. Do not proceed with this work until revised drawings have been provided, showing corrected layout, and that any obstructions have been removed or corrections to layout have been made.

3.03 INSTALLATION

- A. Install concrete footings with top surface a minimum of 1/2 inch below required subgrade elevation and slope top to drain, unless otherwise indicated.
- B. Install athletic equipment in accordance with manufacturer's instructions, and rules and regulations of specified athletic association indicated for this work.
- C. Coordinate work with preparation for and installation of protective surfacing specified in Section 32 1816.13. The resilient portion of the protective surfacing is to be installed after exercise equipment installation.
- D. Install in accordance with CPSC Pub. No. 325, ASTM F1487, manufacturer's instructions, and requirements of authorities having jurisdiction.
- E. Anchor equipment securely below the bottom elevation of the resilient surfacing layer.
- F. Do not modify exercise equipment on site without written approval of manufacturer.
- G. Install athletic equipment without sharp points, edges, or protrusions; entanglement hazards or pinch, crush, or shear points.
- H. Install required signage if not factory-installed.

3.04 FIELD QUALITY CONTROL

- A. Obtain the services of the equipment manufacturer's field representative to review the finished installation for compliance with specified requirements and with design criteria to the extent known to the Contractor; submit report of field review.

- B. CRPD or CRPD representative will inspect exercise equipment after installation to verify that exercise equipment meets specified design safety and accessibility requirements.
- C. Repair or replace rejected work until compliance is achieved.

3.05 CLEANING

- A. Clean athletic field equipment of construction materials, dirt, stains, filings, and blemishes due to shipment or installation; clean in accordance with manufacturer's instructions, using cleaning agents as recommended by manufacturer.
- B. Clean athletic field area of excess construction materials, debris, and waste.
- C. Remove excess and waste material and dispose of off-site in accordance with requirements of authorities having jurisdiction.

3.06 PROTECTION

- A. Protect installed products until Date of Substantial Completion.
- B. Replace damaged products before Date of Substantial Completion.

End of Section 11 6833

Section 12 3600

Countertops

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Countertops for architectural cabinet work.

1.02 DESCRIPTION OF WORK

- A. Replacement of existing kitchen and restroom countertops over existing or new casework including caulk where new countertops abut wall.

1.03 RELATED REQUIREMENTS

- A. Section 06 4100 - Architectural Wood Casework.
- B. Section 22 4000 - Plumbing Fixtures: Sinks.

1.04 REFERENCE STANDARDS

- A. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2015a.
- B. California Green Building Code 2013: Residential Mandatory Measures; Section 4.504 Pollution Control.
- C. ISFA 2-01 - Classification and Standards for Solid Surfacing Material; 2013.
- D. NEMA LD 3 - High-Pressure Decorative Laminates; 2005.
- E. SCAQMD 1168 - South Coast Air Quality Management District Rule No. 1168 Adhesive and Sealant Applications; current edition; www.aqmd.gov.
- F. PS 1 - Structural Plywood; 2009.

1.05 SUBMITTALS

- A. Product Data: Manufacturer's data sheets on each product to be used, including:
 - 1. Preparation instructions and recommendations.
 - 2. Storage and handling requirements and recommendations.
 - 3. Specimen warranty.
- B. Verification Samples: For each finish product specified, minimum size 3 inches square, representing actual product, color, and patterns.
- C. Materials must be compliant with the VOC restrictions of California Green Building Standards Code, Section 4.504
 - 1. Adhesive, adhesive bonding primers, adhesive primer, sealants, sealant primers, and caulks shall comply with local or regional air pollution control or air quality management district rule where applicable or SQAQMD Rule 1168 VOC limits, as shown in Table 4.504.1 or 4.504.2, as applicable. Such products also shall comply with the Rule 1168 prohibition on the use of certain toxic compounds (chloroform, ethylene dichloride, methylene chloride, perchloroethylene and trichloroethylene), except for aerosol products, as specified in subsection 2 below.
 - 2. Aerosol adhesives, and smaller unit sizes of adhesives, and sealant or caulking compounds (in units of product, less packaging, which do not weigh more than 1 pound and do not consist of more than 16 fluid ounces) shall comply with statewide VOC standards and other requirements, including prohibitions on use of certain toxic compounds, of *California Code of Regulations*, Title 17, commencing with Section 94507.

1.06 QUALITY ASSURANCE

- A. A. Fabricator and Installer Qualifications: Minimum [2] years experience in work of this Section.

1.07 FIELD CONDITIONS

- A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

PART 2 PRODUCTS

2.01 COUNTERTOPS

- A. Solid Surfacing Countertops: Solid surfacing sheet or plastic resin casting over continuous substrate.
 - 1. Flat Sheet Thickness: 1/2 inch, minimum.
 - 2. Solid Surfacing Sheet and Plastic Resin Castings: Complying with ISFA 2-01 and NEMA LD 3; acrylic or polyester resin, mineral filler, and pigments; homogenous, non-porous and capable of being worked and repaired using standard woodworking tools; no surface coating; color and pattern consistent throughout thickness.
 - a. Finish on Exposed Surfaces: Matte, gloss rating of 5 to 20.
 - b. Color and Pattern: Vanilla Sugar #GT913.
 - c. Manufacturers:
 - 1) LG Hi-Macs, Solid Surface: lghimacsusa.com
 - 3. Other Components Thickness: 1/2 inch, minimum.
 - 4. Counter Depth: 26 inch
 - 5. Exposed Edge Treatment: Built up to minimum 1 inch thick net; eased edge.
 - 6. Back and End Splashes: Same sheet material, square top; minimum 4 inches high.

2.02 ACCESSORY MATERIALS

- A. Plywood for Supporting Substrate: PS 1 Exterior Grade, A-C veneer grade, minimum 5-ply; minimum 3/4 inch thick; joint lengths using metal splines.
- B. Adhesives: Chemical resistant waterproof adhesive as recommended by manufacturer of materials being joined.
- C. Joint Sealant: Mildew-resistant silicone sealant, clear.

2.03 FABRICATION

- A. Fabricate tops and splashes in the largest sections practicable, with top surface of joints flush.
 - 1. Join lengths of tops using best method recommended by manufacturer.
 - 2. Fabricate to overhang fronts and ends of cabinets 1 inch except where top butts against cabinet or wall.
 - 3. Prepare all cutouts accurately to size; replace tops having improperly dimensioned or unnecessary cutouts or fixture holes.
- B. Provide back/end splash wherever counter edge abuts vertical surface unless otherwise indicated.
 - 1. Secure to countertop with concealed fasteners and with contact surfaces set in waterproof glue.
 - 2. Height: 4 inches, unless otherwise indicated.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Do not begin installation until substrates have been properly prepared.
- B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.
- C. Verify that wall surfaces have been finished and mechanical and electrical services and outlets are installed in proper locations.

3.02 PREPARATION

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
- C. Plumber to provide cut out templates and countertop fabricator to prepare cut out for sink, whether rim set or bottom mounted, as well as fixtures.

3.03 INSTALLATION

- A. Securely attach countertops to cabinets using concealed fasteners. Make flat surfaces level; shim where required.
- B. Seal joint between back/end splashes and vertical surfaces.

3.04 CLEANING

- A. Clean countertop surfaces thoroughly.

3.05 PROTECTION

- A. Protect installed products until completion of project.
- B. Touch-up, repair or replace damaged products before Date of Substantial Completion.

End of Section 12 3600

Section 13 3000
Shipping Container Sheds

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Pre-fabricated containers.

1.02 RELATED REQUIREMENTS

- A. Section 03,3000 - Cast-in-Place Concrete.
- B. Section 32 1123 Aggregate Base Courses

1.03 REFERENCE STANDARDS

- A. AISC 360 - Specification for Structural Steel Buildings; American Institute of Steel Construction, Inc.; 2010.
- B. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination; American Welding Society; 2012.
- C. AWS D1.1/D1.1M - Structural Welding Code - Steel; American Welding Society; 2010.
- D. ISO 668 - Series 1 Freight Containers - Classification external dimensions and ratings.
- E. ISO 830 - Terminology in relation to freight container.
- F. ISO 1161 - Series 1 freight containers - Corner fittings Specification
- G. ISO 1496-1 - Series 1 freight containers - Specification and testing.
- H. ISO 6346 - Freight containers - coding, identification and marking

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Convene one week before starting work of this section.

1.05 SUBMITTALS

- A. See General Conditions - Article 9, for submittal procedures.
- B. Samples: Submit two samples of precoated metal panels for each color selected, 2 x 2 inch minimum in size illustrating color and texture of finish.
- C. Manufacturer's Instructions: Indicate preparation requirements, anchor bolt placement.
- D. Erection Drawings: Indicate members by label, assembly sequence, and temporary erection bracing.

1.06 QUALITY ASSURANCE

- A. Design structural components, develop shop drawings, and perform shop and site work under direct supervision of a Professional Structural Engineer experienced in design of this Work.
 - 1. Design Engineer Qualifications: Licensed in California.
 - 2. Conform to applicable code for submission of design calculations as required for acquiring permits.
- B. Perform welding in accordance with AWS D1.1.
- C. Manufacturer Qualifications: Company specializing in the manufacture of products similar to those required for this project.
 - 1. Not less than 3 years of documented experience
- D. Erector Qualifications: Company specializing in performing the work of this section with minimum 5 years experience.

1.07 WARRANTY

- A. Provide 10 year manufacturer warranty for defects in materials and workmanship.

PART 2 PRODUCTS

2.01 PRE-FABRICATED CONTAINER

- A. Manufacturers:
1. Mid-State Containers; midstatecontainers.com; or approved equal.
 2. Estimate #32420
- B. Description: Pre-engineered and pre-manufactured 'One-Trip' containers.
- C. Dimensions: 20 foot x 9'-6" high cube.
- D. Container Type 1:
1. Doors:
 - a. 36" steel man door.
 - b. 7' rolling door
 2. Window:
 - a. 6' wide roll up
 - b. With stainless steel counter; 30" wide x length of window; mounted 36" from finished surface.
 3. Colors:
 - a. Exterior: Per Owner's decision.
 - b. Interior: Per Owner's decision.
 4. Electrical:
 - a. Electrical package to include light switch(s) and lights
 5. Floors:
 - a. Epoxy coating.
- E. Container Type 2:
1. Doors:
 - a. 7' rolling door
 2. Colors:
 - a. Exterior: Per Owner's decision.
 - b. Interior: Per Owner's decision.
 3. Electrical:
 - a. Electrical package to include light switch and lights
 4. Floors:
 - a. Epoxy coating.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that foundation, aggregate base, and electrical utilities are in correct position

3.02 TOLERANCES

- A. Framing Members: 1/4 inch from level; 1/8 inch from plumb.

End of Section 13 3000

Section 13 3123

Pre-Engineered Fabric Tension Structures

PART 1 – GENERAL

1.01 SUMMARY

- A. USA SHADE shall be responsible for the design, wet stamped engineering drawings, permitting, fabrication specified herein.

1.02 SUBMITTALS

- A. With Bid Submittals:
 - 1. Provide proof of installed reference sites with structures for similar scope of project and installation that are engineered to CBC specifications.
 - 2. Provide a minimum of 7 fabric samples to demonstrate color range, and a digital (PDF) or paper document showing a minimum of 9 powder coat color choices. Also provide letter of authorization from fabric manufacture for use of the specified fabric.
 - 3. Provide proof of all quality assurance items including;
 - a. A list of at least 3 reference projects in CA that have been installed a minimum of 12 years.
 - b. Proof of current CA contractor's license Class A or Class B.
 - c. Proof of IAS certification as per section 1.4 D
 - d. Proof of a Corporate Safety Program along with an Injury & Illness Prevention Program.
 - e. Proof of an Annual Maintenance Inspection Program

1.03 QUALITY ASSURANCE

- A. Fabrication and erection are limited to firms with proven experience in the design, fabrication, and erection of fabric shade structures, and such firms shall meet the following minimum requirements. No substitutions shall be allowed for the following:
 - 1. USA SHADE shall design, engineer, and manufacture the fabric shade structures.
 - 2. Manufacturer shall be accredited by the IAS (International Accreditation Service) for Structural Steel Fabrication under CBC specified requirements.
 - 3. The fabric shade structure contractor shall have a Corporate Quality Control program (manual), which describes their complete quality assurance program.

1.04 PROJECT CONDITIONS

- A. Field Measurements: Verify layout information for shade structures shown on the Drawings in relation to the property survey and existing structures, and verify locations by field measurements prior to construction.

1.05 WARRANTY

- A. Provide a 12 month warranty on all labor and materials.
- B. A supplemental warranty from the manufacturer shall be provided for a period of 10 years on fabric and 10 years on the structural integrity of the steel from date of substantial completion.
- C. The warranty shall not deprive the Owner of other rights the Owner may have under the provisions of the Contract Documents and will be in addition to and run concurrent with other warranties made by the Contractor under requirements of the Contract Documents.

PART 2 – PRODUCTS

2.01 GENERAL

- A. Items specified in this section are based on the products of:
1. USA SHADE & Fabric Structures
1085 N. Main St., Suite C, Orange, CA 92867
Phone:(805) 249-8153
Attn: Laura Frantzen
Lfrantzen@usa-shade.com
 2. CON-FEB-015-20-FITNESS AREA – 4 PT HYPAR SAIL -38'.6" X 29'.2" X 48' X 44'.8"
Elevations 12'/16', 16'/14', 14'/12', 16'/12'
 3. CON-FEB-015-20-TEEN PATIO - 3 PT SAIL - SIZE - 37'.6" X 34' X 48'11", Elevations
-17', 13'
 4. CON-FEB-015-20-TEEN STAGE 4 PT HYPAR SAILS - Size 30' X 53'.11" X 24'.6" X
24'.6" X 50'.6" Elevations – 14'/12', 17'/20', 12'/16'
- B. Structures shall be manufactured by Shade Structures, Inc., d/b/a USA SHADE & Fabric Structures, at time of bid that includes CBC approved engineering drawings, fabric roof, steel cables, and all fasteners.
- C. The fabric shade structure(s) shall conform to the current CBC requirements.
- D. Steel:
1. All steel members of the shade structure shall be designed in strict accordance with the requirements of the “American Institute of Steel Construction” (AISC) Specifications and the “American Iron and Steel Institute” (AISI) Specifications for Cold Formed Members and manufactured in a IAS (International Accreditation Service) accredited facility for Structural Steel Fabrication under CBC2013 based on IBC 2012 Section 1704.2.2
 2. All connections shall have a maximum internal sleeving tolerance of .0625 inches using high tensile strength steel sections with a minimum sleeve length of 6 inches.
 3. All non-hollow structural steel members shall comply to ASTM A-36. All hollow structural steel members shall be cold formed, high strength steel and comply with ASTM A-500, Grade C. All steel plates shall comply to ASTM A-572, Grade 50. All galvanized steel tubing shall be triple coated for rust protection using an in-line electro-plating coat process. All galvanized steel tubing shall be internally coated with zinc and organic coatings to prevent corrosion.
- E. Bolts:
1. All structural field connections of the shade structure shall be designed and made with high strength bolted connections using ASTM A-325, Grade B or SAE J249, Grade 8.
- F. Welding:
1. All shop welded connections of the shade structure shall be designed and performed in strict accordance with the requirements of the “American Welding Society” (AWS) Specifications. Structural welds shall be made in compliance with the requirements of the “Prequalified” welded joints where applicable and by certified welders. No onsite or field welding shall be permitted.
 2. All full penetration welds shall be continuously inspected by an independent inspection agency and shall be tested to the requirement of 2013 CBC.
- G. Powder coating:
1. Galvanized steel tubing preparation prior to powder coating shall be executed in accordance to solvent cleaning SSPC-SP1. Solvent such as water, mineral spirits, xylol,

- toluol, which are to be used to remove foreign matter from the surface. A mechanical method prior to solvent cleaning prior to surface preparation shall be executed according to Power Tool Cleaning SSPC-SP3 and utilizing wire brushes abrasive wheels and needle gun, etc.
2. Carbon structural steel tubing preparation prior to powder coating shall be executed in accordance to commercial blast cleaning SSPC-SP6 or NACE #3. A commercial blast cleaned surface, when viewed without magnification, shall be free of all visible oil, grease, dirt, mill scale, rust, coating, oxides, corrosion, products and other foreign material.
 3. Powder coating shall be sufficiently applied, with a minimum 3 mils thickness and cured at the recommended temperature to provide proper adhesion and stability to meet salt spray and adhesion tests as defined by the American Society of Testing Materials.
 4. Powder used in the powder coat process shall have the following characteristics:
 - a. Specific Gravity: 1.68 +/- 0.05.
 - b. Theoretical coverage: 114 +/- 4ft²/lb/mil
 - c. Mass loss during cure: <1%
 - d. Maximum storage temperature: 85F
 - e. Interpon® 800 is a high-durability TGIC powder coating designed for exterior exposure. Tested against the most severe specifications, Interpon® 800 gives significantly improved gloss retention and resistance to color change.
 5. Tension Cable: Steel cable is determined based on calculated engineering load.
 - a. For light and medium loads; ¼” (nominal) galvanized 7x19 strand cable to be used.
 - b. For heavy loads; 3/8” (nominal) galvanized 7 x 19 cable to be used.
- H. Fabric Roof Systems:
1. UV Shade Fabric:
 - a. Colourshade FR UV Shade fabric is made of a UV stabilized high-density polyethylene as manufactured by Multiknit. HDPE mesh shall be a heat-stentered, three bar Rachel-knitted, lockstitch fabric with one monofilament and two tape yarns to ensure that the material will not unravel if cut. Raw fabric rolls shall be 9.8425 feet wide.
 - b. Fabric properties:
 - 1) ~ Life Expectancy: minimum 8 years with continuous exposure to the sun
 - 2) ~ Fading: minimum fading after 5 years (3 years for Red)
 - 3) ~ Fabric Mass: 5.31 oz/yd² ~ 5.6 oz/yd² (180gsm ~ 190gsm)
 - 4) ~ Fabric Width: 9.8425 feet (3m)
 - 5) ~ Roll Length: 164.04 feet (50m)
 - 6) ~ Roll Dimensions: 62.99 inches x 16.5354 inches (160cm x 42cm)
 - 7) ~ Roll Weight +/- 66 lbs (+/- 30kg)
 - 8) ~ Minimum Temp: -13°F (-25°C)
 - 9) ~ Maximum Temp: +176°F (80°C)
 - 10) NFPA 701-97 (Weathered or unweathered)
 - 11) CA Fire Marshall Certification
 - c. Fabric shall meet the following flame spread and fire propagation tests:
 - 1) ASTM E-84
 - 2) NFPA 701 Test Method 2
 - 3) California's Office of the State Fire Marshal, Registered Flame Resistant Product
 2. Stitching & Thread:

- a. All sewing threads are to be double stitched.
- b. Thread shall be GORE Tenara Sewing Thread manufactured from 100% expanded PTFE (Teflon); mildew resistant exterior approved thread. Thread shall meet or exceed the following:
 - 1) Flexible temperature range
 - 2) Very low shrinkage factor
 - 3) Extremely high strength, durable in outdoor climates
 - 4) Resists flex and abrasion of fabric
 - 5) Unaffected by cleaning agents; acid rain, mildew, salt water and rot resistant, unaffected by most industrial pollutants.
 - 6) Treated for prolonged exposure to the sun.
 - 7) Rot resistant
3. Shade and UV Factors:
 - a. Shade protection and UV screen protection factors shall be as follows:

	UV Block %	Shade %
Pacific Blue	85%	86%
Rain Forest Green	85%	86%
Red	86%	83%
Silver	81%	85%
Desert Sand	92%	84%
Terracotta	82%	83%
Yellow	89%	82%

PART 3 – EXECUTION

3.01 INSTALLATION

- A. The installation of fabric shade structures shall be performed by a contractor, which shall be bonded and holding a current contractor’s license with the State of California’s Contractors State License Board. All installation personnel must have experience in the erection of tensioned fabric structures.
- B. Installations of shade structures shall be performed by a State of CA licensed and bonded contractor with certified Rope Access Technicians on staff with experience in tension fabric structures.
- C. The contractor installing the structure shall comply with manufactures instructions for assembly, installation, and erection per approved drawings.

End of Section 13 3123

6. The fabric shade structure contractor shall have a Corporate Quality Control program (manual), which describes their complete quality assurance program.
7. All bidders must be a current Member Contractor with ISNetwork, which confirms the bidder's strict adherence to Safety, Insurance, Quality, and Regulatory standards.

1.04 PROJECT CONDITIONS

- A. Field Measurements: Verify layout information for shade structures shown on the Drawings in relation to the property survey and existing structures, and verify locations by field measurements prior to construction.

1.05 WARRANTY

- A. Provide a 12 month warranty on all labor and materials.
- B. A supplemental warranty from the manufacturer shall be provided for a period of 10 years on fabric and 10 years on the structural integrity of the steel from date of substantial completion.
- C. The warranty shall not deprive the Owner of other rights the Owner may have under the provisions of the Contract Documents and will be in addition to and run concurrent with other warranties made by the Contractor under requirements of the Contract Documents.

PART 2 – PRODUCTS

2.01 GENERAL

- A. Items specified in this section are based on the products of:
 1. USA SHADE & Fabric Structures
1085 N. Main St., Suite C, Orange, CA 92867
Phone:(805) 249-8153
Attn: Laura Frantzen
Lfrantzen@usa-shade.com
 2. CON-FEB-015-20-FITNESS AREA – 4 PT HYPAR SAIL -38'.6" X 29'.2" X 48' X 44'.8"
Elevations 12'/16', 16'/14', 14'/12', 16'/12'
 3. CON-FEB-015-20-TEEN PATIO - 3 PT SAIL - SIZE - 37'.6" X 34' X 48'11", Elevations -17', 13'
 4. CON-FEB-015-20-TEEN STAGE 4 PT HYPAR SAILS - Size 30' X 53'.11" X 24'.6" X 24'.6" X 50'.6" Elevations – 14'/12', 17'/20', 12'/16'
- B. To qualify as an approved equal, please submit product documentation, fabric samples and all quality assurance criteria required herein at least 10 days prior to bid to be considered. No substitutions will be allowed after the deadline. Any approval of alternate manufacturers shall be by addendum prior to the bid date and shall not be allowed without written notification.
- C. Structures shall be manufactured by Shade Structures, Inc., d/b/a USA SHADE & Fabric Structures, or approved equal, at time of bid that includes CBC approved engineering drawings, fabric roof, steel cables, all fasteners, and erection of structure(s)
- D. The fabric shade structure(s) shall conform to the current CBC requirements.
- E. Steel:
 1. All steel members of the shade structure shall be designed in strict accordance with the requirements of the "American Institute of Steel Construction" (AISC) Specifications and the "American Iron and Steel Institute" (AISI) Specifications for Cold Formed Members and manufactured in a IAS (International Accreditation Service) accredited facility for Structural Steel Fabrication under CBC2013 based on IBC 2012 Section 1704.2.2
 2. All connections shall have a maximum internal sleeving tolerance of .0625 inches using high tensile strength steel sections with a minimum sleeve length of 6 inches.

3. All non-hollow structural steel members shall comply to ASTM A-36. All hollow structural steel members shall be cold formed, high strength steel and comply with ASTM A-500, Grade C. All steel plates shall comply to ASTM A-572, Grade 50. All galvanized steel tubing shall be triple coated for rust protection using an in-line electro-plating coat process. All galvanized steel tubing shall be internally coated with zinc and organic coatings to prevent corrosion.
- F. Bolts:
1. All structural field connections of the shade structure shall be designed and made with high strength bolted connections using ASTM A-325, Grade B or SAE J249, Grade 8.
- G. Welding:
1. All shop welded connections of the shade structure shall be designed and performed in strict accordance with the requirements of the “American Welding Society” (AWS) Specifications. Structural welds shall be made in compliance with the requirements of the “Prequalified” welded joints where applicable and by certified welders. No onsite or field welding shall be permitted.
 2. All full penetration welds shall be continuously inspected by an independent inspection agency and shall be tested to the requirement of 2013 CBC.
- H. Powder coating:
1. Galvanized steel tubing preparation prior to powder coating shall be executed in accordance to solvent cleaning SSPC-SP1. Solvent such as water, mineral spirits, xylol, toluol, which are to be used to remove foreign matter from the surface. A mechanical method prior to solvent cleaning prior to surface preparation shall be executed according to Power Tool Cleaning SSPC-SP3 and utilizing wire brushes abrasive wheels and needle gun, etc.
 2. Carbon structural steel tubing preparation prior to powder coating shall be executed in accordance to commercial blast cleaning SSPC-SP6 or NACE #3. A commercial blast cleaned surface, when viewed without magnification, shall be free of all visible oil, grease, dirt, mill scale, rust, coating, oxides, corrosion, products and other foreign material.
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 4. Powder used in the powder coat process shall have the following characteristics:
 - a. Specific Gravity: 1.68 +/- 0.05.
 - b. Theoretical coverage: 114 +/- 4ft²/lb/mil
 - c. Mass loss during cure: <1%
 - d. Maximum storage temperature: 85F
 - e. Interpon® 800 is a high-durability TGIC powder coating designed for exterior exposure. Tested against the most severe specifications, Interpon® 800 gives significantly improved gloss retention and resistance to color change.
 5. Tension Cable: Steel cable is determined based on calculated engineering load.
 - a. For light and medium loads; ¼” (nominal) galvanized 7x19 strand cable to be used.
 - b. For heavy loads; 3/8” (nominal) galvanized 7 x 19 cable to be used.
- I. Fabric Roof Systems:
1. UV Shade Fabric:
 - a. Colourshade FR UV Shade fabric is made of a UV stabilized high-density polyethylene as manufactured by Multiknit. HDPE mesh shall be a heat-stentered,

three bar Rachel-knitted, lockstitch fabric with one monofilament and two tape yarns to ensure that the material will not unravel if cut. Raw fabric rolls shall be 9.8425 feet wide.

- b. Fabric properties:
 - 1) ~ Life Expectancy: minimum 8 years with continuous exposure to the sun
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 - 3) ~ Fabric Mass: 5.31 oz/yd² ~ 5.6 oz/yd² (180gsm ~ 190gsm)
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 - 7) ~ Roll Weight +/- 66 lbs (+/- 30kg)
 - 8) ~ Minimum Temp: -13°F (-25°C)
 - 9) ~ Maximum Temp: +176°F (80°C)
 - 10) NFPA 701-97 (Weathered or unweathered)
 - 11) CA Fire Marshall Certification
- c. Fabric shall meet the following flame spread and fire propagation tests:
 - 1) ASTM E-84
 - 2) NFPA 701 Test Method 2
 - 3) California's Office of the State Fire Marshal, Registered Flame Resistant Product

2. **Stitching & Thread:**

- a. All sewing threads are to be double stitched.
- b. Thread shall be GORE Tenara Sewing Thread manufactured from 100% expanded PTFE (Teflon); mildew resistant exterior approved thread. Thread shall meet or exceed the following:
 - 1) Flexible temperature range
 - 2) Very low shrinkage factor
 - 3) Extremely high strength, durable in outdoor climates
 - 4) Resists flex and abrasion of fabric
 - 5) Unaffected by cleaning agents; acid rain, mildew, salt water and rot resistant, unaffected by most industrial pollutants.
 - 6) Treated for prolonged exposure to the sun.
 - 7) Rot resistant

3. **Shade and UV Factors:**

- a. Shade protection and UV screen protection factors shall be as follows:

	UV Block %	Shade %
Pacific Blue	85%	86%
Rain Forest Green	85%	86%
Red	86%	83%
Silver	81%	85%
Desert Sand	92%	84%
Terracotta	82%	83%
Yellow	89%	82%

PART 3 – EXECUTION

3.01 INSTALLATION

- A. The installation of fabric shade structures shall be performed by manufacturer or manufacturer-approved contractor, which shall be bonded and holding a current contractor's

license with the State of California's Contractors State License Board. All installation personnel must have experience in the erection of tensioned fabric structures.

- B. Installations of shade structures shall be performed by a State of CA licensed and bonded contractor with certified Rope Access Technicians on staff with experience in tension fabric structures.
- C. The contractor installing the structure shall comply with manufactures instructions for assembly, installation, and erection per approved drawings.

End of Section 13 3123

Section 21 1300
Fire Sprinkler System

PART 1-GENERAL

1.01 SUMMARY

- A. This includes the following fire-suppression piping inside the building.
 - 1. Wet-pipe automatic fire sprinkler system .
- B. This section includes the following fire-suppression piping inside the building:
- C. Fire-suppression system design shall be done by a qualified C-16 licensed design-build firm.

1.02 SYSTEM DESCRIPTIONS

- A. The building shall be protected per applicable portions NFPA 13R
 - 1. The system shall be monitored for water flow, low air pressure, and control valve(s) tamper.
 - 2. System to be equipped with a fire department connection.
- B. Sprinkler heads in service areas may be exposed. All other areas to utilize pop down heads.

1.03 RELATED WORK

- A. Section 28 3100 - Fire Sprinkler Monitoring and Alarm System

1.04 REFERENCE STANDARDS

- A. ASME B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings; 2013.
- B. ASTM A135/A135M - Standard Specification for Electric-Resistance-Welded Steel Pipe; 2009 (Reapproved 2014).
- C. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2012.
- D. ASTM A795/A795M - Standard Specification for Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Fire Protection Use; 2013.
- E. ASTM B32 - Standard Specification for Solder Metal; 2008 (Reapproved 2014).
- F. ASTM B813 - Standard Specification for Liquid and Paste Fluxes for Soldering of Copper and Copper Alloy Tube; 2010.
- G. ASTM B88 - Standard Specification for Seamless Copper Water Tube; 2014.
- H. ASTM F437 - Standard Specification for Threaded Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80; 2015.
- I. ASTM F439 - Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80; 2013.
- J. ASTM F442/F442M - Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe (SDR-PR); 2013.
- K. NFPA 13 - Standard for the Installation of Sprinkler Systems; 2016.
- L. NFPA 13R - Standard for the Installation of Sprinkler Systems in Low-Rise Residential Occupancies; 2016.
- M. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- N. NFPA 72 - National Fire Alarm and Signaling Code; 2016.
- O. UL 199 - Standard for Automatic Sprinklers for Fire-Protection Service; 2005.

1.05 PERFORMANCE REQUIREMENTS

- A. Standard piping system component working pressure: Listed for at least 175 PSIG.
- B. All materials in accordance with NFPA 13R

1.06 SUBMITTALS

- A. Product data: For each product indicated.
 - 1. Sprinkler piping drawings: Working plans, prepared to applicable portions of NFPA-13 including hydraulic calculations.
 - 2. Field test reports and certificates.
 - 3. Field quality-control test reports.
 - 4. Operation and maintenance data sheets

1.07 QUALITY ASSURANCE

- A. Installer Qualifications: Installer's responsibilities include designing, fabricating, and installing fire-suppression systems and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire hydrant flow test. The Contractor shall be responsible for performing all fire hydrant flow tests.
 - 1. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a qualified professional contractor.
- B. NFPA Standards: Fire-suppression-system equipment, specialties, accessories, installation, and testing shall comply with applicable portions of the following:
 - 1. NFPA 13R "Sprinkler Systems in Residential Occupancies Up to and Including Four Stories in Height".

PART 2- PRODUCTS

2.01 PIPE AND FITTINGS

- A. Threaded-End, Scheduled Steel Pipe: ASTM A53/A53M, ASTM A135/A135M, or ASTM A795/A795M.
- B. Wet system- black pipe with factory- or field-cut threaded ends.
- C. Dry system- hot dip galvanized pipe with factory- or field-cut threaded ends.
- D. Grooved-End, Schedule 10 Steel Pipe: ASTM A53/A53M, ASTM A135/A135M, or ASTM A795/A795M
 - 1. Wet system- black pipe with factory- or field-formed, square cut or roll-grooved ends.
 - 2. Dry system- hot-dip galvanized pipe with factory- or field-formed, square cut or roll-grooved ends.
- E. Copper Pipe: ASTM B88, copper tubing, hard drawn, type M.
- F. Fittings: ASME B16.22, wrought copper solder joint.
 - 1. Joints: ASTM B32, solder metal, 95-5 tin-antimony, allow grade Sb5. Flux shall be ASTM ASTM B813, liquid or paste type.
- G. Plastic Pipe: ASTM F442/F442M, chlorinated polyvinyl chloride (CPVC) UL listed for a working pressure of 175 PSI (1200 kPa). Pipe shall be specifically listed for use in fire sprinkler systems.
 - 1. Plastic Pipe Fittings: CPVC fittings, UL listed for fire sprinkler systems. ASTM F437 B-96, threaded fittings, schedule 80. ASTM F439, socket type fittings, schedule 80.
 - 2. Solvent Cement: Primer and solvent cement manufactured by pipe and fitting manufacturer for joining sprinkler piping.

2.02 CHECK VALVE:

- A. Check Valve: 250 pound non-shock WOG, bronze body, stainless steel spring and disc holder, rubber disc, inline lift type. Model KT-480 by Nibco, Inc., Elkhart, IN 46515 or approved equal.

2.03 RISER MANIFOLD:

- A. Integral assembly specifically manufactured for NFPA 13R and 13D systems that consists of water flow indicator, pressure gauge, and drain valve. Model 13 and 13D Riser manifold.

2.04 SPRINKLERS

- A. UL 199, residential automatic sprinklers for “ordinary” temperature classification, except where higher temperature heads are required and indicated. Provide higher temperature heads in mechanical rooms.
- B. Mechanical rooms, storage rooms, and garages shall have guards and a brass finish, all other areas shall be chrome plated.
- C. PIPE SLEEVES: Sleeves in Partitions, Walls, and Floors: Zinc-coated steel sheet having nominal weight of not less than 0.90 pound per square foot.
- D. ESCUTCHEON PLATES: Two-piece or split hinge metal plates for piping passing through floors, walls, and ceilings in exposed areas. Provide chromium-plated finish on plates in finished areas and paint finish on plates in unfinished areas.
- E. PRESSURE GAUGES: 2-1/2 inch dial type with maximum limit not less than twice the normal working pressure.
- F. INSPECTOR’S TEST CONNECTION: Accessible test connection connected to the most remote part of the sprinkler system with the discharge routed to the outside.
- G. ELECTRICAL WORK: Provide control wiring, including connections to fire alarm system in accordance with NFPA 70 and NFPA 72.

PART 3 -EXECUTION

3.01 SURFACE CONDITIONS

- A. Coordination- Coordinate with all other trades as required to ensure proper and adequate installation of cabinets and brackets in the locations shown.
- B. Inspection:
 - 1. Prior to installation, inspect all areas to verify that all necessary provisions have been made and installed.
- C. In the event of discrepancy immediately notify the architect.
 - 1. Do not proceed with installation in areas of discrepancy until all such discrepancies have been resolved.

End of Section 21 1300

Section 22 0500

Common Work Results for Plumbing

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:

1. This Section provides the basic plumbing requirements that apply to the Work of Division 22.

B. Related Requirements:

1. Division 01: General Requirements.
2. Division 22: Plumbing
3. Division 23: HVAC
4. Division 26: Electrical.

1.02 REGULATORY REQUIREMENTS

A. Current federal Safe Drinking Water Act (SDWA) regulations require the furnishing of lead-free pipe, solder, and flux in the installation or repair of plumbing in non-residential facilities connected to public drinking water systems. Under this regulation, solders and flux are considered lead-free when they contain 0.2 percent lead or less. Under California regulations pipes and pipe fittings are considered lead-free when they contain 0.25 percent lead or less as defined in California Assembly Bill 1953 (AB 1953). No pipe, pipe fittings, or any other fitting or fixture intended to convey or dispense water for human consumption by drinking or cooking is allowed in the domestic plumbing system, if they do not meet the low lead definition of AB 1953. Weighted average lead content of the wetted surface area of pipes, fittings and fixtures may not exceed 0.25 percent.

1. Provide lead-free water pipe, solder, and flux materials that meet the standards as outlined by the federal SDWA regulations and California AB 1953 if installed in drinking water system.
2. Collect pipe, solder, and flux material samples as required by the Project Inspector. Test samples shall be delivered to an Owner designated testing laboratory for testing of lead content.
 - a. Test samples for lead content by the atomic absorption spectrophotometry method.
3. Materials found not conforming to SDWA and California AB 1953 regulations shall be deemed defective Work and shall be replaced with lead-free materials.
4. Comprehensive testing of the remaining materials for their lead content shall be performed as required by the Project INSPECTOR.

A. Materials, fabrication, equipment, and installation shall comply with industry standards and code requirements. Where manufacturer's recommendations exceed industry standards, the manufacturer's recommendation shall establish the minimum standard. As a minimum, standards from the following organizations shall apply:

1. ANSI - American National Standards Institute.
2. ASME - American Society of Mechanical Engineers.
 - a. ASME Boiler and Pressure Vessel Code.
 - b. ASME B31 - Standards for Pressure Piping.

3. ASHRAE - American Society of Heating, Refrigerating and Air-Conditioning Engineers.
 4. ASTM - American Society for Testing and Materials.
 - a. ASTM A53 Specification for Welded and Seamless Pipe.
 5. AWWA - American Water Works Association.
 6. CSA - Canadian Standards Association.
 7. FM Global - Factory Mutual Global
 8. IAPMO - International Association of Plumbing and Mechanical Officials.
 9. NFPA - National Fire Protection Association.
 10. OSHA - Occupational Safety and Health Administration.
 11. SMACNA - Sheet Metal and Air Conditioning Contractors' National Association.
 12. UL - Underwriters Laboratories Inc.
 13. Intertek (ETL Certification).
- B. Materials, fabrication, equipment, and installation shall comply with federal, state, and local codes including, but not limited to, the following:
1. CBC, California Building Code, and CMC, California Plumbing Code.
 - a. Latest edition as adopted by the City of Thousand Oaks, the County of Ventura, and the State of California including amendments effective on the Effective Date of the Contract.
 2. California Code of Regulations, Title 8, Industrial Relations, Division 1, Chapter 4, Division of Industrial Safety.
 3. OSHA - Occupational Safety and Health Administration.
 4. CDPH - California Department of Public Health.
 5. SCAQMD - South Coast Air Quality Management District.
- C. Specifications or Drawings shall not be construed to permit deviation from the requirements of governing codes unless approval has been obtained from legally constituted authorities having jurisdiction, and the Architect. The Contract Documents may contain more stringent requirements than those legally required.
- D. Permits and Fees: Refer to the General and Supplementary Conditions.

1.03

SUBMITTALS

- A. Provide submittals in accordance with Section 01 3300: Submittal Procedures and with specific requirements of Division 22 sections, as applicable.
- B. The above information shall become the basis for inspecting and testing materials and actual installation procedures performed in the Work.
- C. Shop Drawings: Submit one additional copy when control diagrams having line voltage connections are indicated. Shop Drawings shall be specifically prepared for the Work of this Project. Drawings prepared in accordance with requirements of Section 01 3113: Project Coordination and Section 01 3300 may be provided by the Architect to serve as a background for the Shop Drawings. Shop Drawings shall comply with the requirements of Section 01 3113 and Section 01 3300 and shall indicate at a minimum:
 1. Complete system layout of equipment, components, plumbing fixtures, piping, indicating service clearances, and pipe sizes, fitting types and sizes and pipe

elevations, distances of pipes and equipment from building reference points and hanger support locations. The above items shall be coordinated on the shop drawings according to the requirements of Section 01 3113.

2. Schedule and description of equipment, piping and fittings.

1.04

PROJECT RECORD DOCUMENTS

- A. Comply with provisions of Section 01 7700: Contract Closeout.
- B. Project Record Drawings:
 1. Provide a complete set of plumbing and fire protection drawings in AutoCAD and, if available, BIM, complete with external reference drawings, fonts, blocks and plotter pen color/line thickness settings on CD-ROM. Also submit one set of full size reproducible plots on vellum and 3 sets of prints.
 2. Before Contract Completion, deliver corrected and completed prints to the OAR. Delivery of project record documents to the OAR does not relinquish responsibility of furnishing required information omitted from project record documents.
- C. Operation and Maintenance Manuals:
 1. Submit two copies of operation and maintenance manuals in required form and content. If no revisions are required, furnish one additional copy. If revisions are required, one copy shall be returned with instructions for changes; perform such changes and return three copies of manuals. Manuals shall be bound in accordance to Section 01 7700. Deliver manuals to the OAR. Submit an electronic copy of the entire manual in PDF file format.
 2. Contents of Manual:
 - a. Title sheet with Project name, including names, addresses and telephone number of Contractor, installer, and related equipment suppliers.
 - b. Manufacturer's operating instructions including, but not limited to, the following:
 - 1) Identification of components and controls.
 - 2) Trouble shooting checklist and guidelines.
 - 3) Recommendations for optimum performance.
 - 4) Warnings and safety precautions on improper or hazardous operational procedures or conditions
 - c. Manufacturer's product data and parts and maintenance booklet for each item of equipment furnished under Division 22 that includes the following as a minimum:
 - 1) Manufacturer's model, identification and serial numbers.
 - 2) Exploded view of assembly drawings identifying each component or part with the relevant part number.
 - 3) Directory of manufacturer's representatives, service contractors and part distributors.
 - 4) Maintenance and trouble-shooting instructions, including schedule for preventive maintenance, periodic inspection and cleaning criteria.
 - d. Project Record Drawings: Complete set of plumbing, fire protection and control system drawings in 50 percent reduced print format shall be furnished

with the manual. Submit the above record drawings on CD-ROM in AutoCAD and, if available, BIM, complete with external reference drawings, fonts, blocks, and plotter pen color/line thickness settings.

- e. Testing, Adjusting, and Balancing reports: Submit as specified in Section 23 0593.
- f. South Coast Air Quality Management District (SCAQMD) permits to install and operate boilers, water heaters and other fuel burning equipment and third-party source test reports as required by SCAQMD to allow start-up and operation of equipment.
- g. Ventura County industrial waste permits.
- h. Valve directory complete with location, function, size, and model of each valve with reference to the project record drawings.
- i. Equipment and component identification chart complete with location, function, size, and model of each equipment or component with reference to the project record drawings.

1.05 COORDINATION

- A. Contract Documents indicate extent and general arrangement of Work under Division 22. Contractor shall coordinate work in accordance with Section 01 3113 requirements and make adjustments as required to provide maximum headroom, a neat arrangement to keep passageways and openings clear to provide accessibility and provisions for maintenance, and to meet code requirements.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Delivery and Storage: Deliver materials to Project site in their original unopened containers with labels intact and legible at time of delivery. Store in strict accordance with manufacturer's recommendations.
- B. Do not store plastic pipe or materials in direct sunlight.

1.07 PRELIMINARY OPERATION

- A. OAR may require any portion of plumbing Work to be operated before Substantial Completion. Such operation shall be in addition to regular tests, demonstrations and instructions required under the Contract Documents, and shall be performed as required.
- B. Notify the INSPECTOR at least 24 hours in advance of lighting or re-lighting pilots.

1.08 TRAINING OF OWNER PERSONNEL

- A. Training of Owner's personnel shall include:
 - 1. A minimum of 4 hours of on-site overview of the overall Plumbing System.
 - 2. Refer to Division 22 sections for specific training on each of the components of the Plumbing System.
- B. Contract shall include the cost of training Owner operation and maintenance personnel in operating, adjusting, maintenance, trouble-shooting, and Project site repair of each component, equipment, or system provided under this Contract.
- C. Operational and maintenance training shall be conducted on the Project site, unless indicated otherwise.
- D. Upon completion of Owner training, a completion certificate indicating the nature of the training and a description of the systems, complete with equipment and component lists shall

be issued to each trainee. The certificate should be issued in duplicate with one copy retained by OAR.

- E. An attendance sheet with the names and signatures of all participants attending the training shall be submitted to the OAR and kept as part of the project documents.

1.09 GUARANTEES AND DAMAGE RESPONSIBILITY

- A. Sound of water flowing in piping shall not be transmitted to building structure. Operation of mechanical system shall not produce operational sounds that can be heard outside of rooms enclosing apparatus or equipment.

PART 2 – PRODUCTS

2.01 MATERIALS AND EQUIPMENT

- A. Unless otherwise specified, materials and equipment shall be new, in good and clean condition. Equipment, materials, and components shall be of the make; type and model number noted on Drawings or specified. Pieces of equipment of the same type shall be by the same manufacturer.
- B. Whenever an item is listed by a single proprietary name, with or without model number and type, it shall be for purpose of design only, to indicate characteristics and quality desired. Proprietary designation listed on Drawings, or listed first in Specifications, is used as a basis for design to establish a standard for quality and performance and space requirements.
- C. Equipment and materials indicated or required to be installed outdoors shall be of the type that is designed, manufactured, listed or approved by authorities having jurisdiction for outdoor installation by being resistant to the adverse effects of weather. The additional protective measures against outdoor weather required by the manufacturers' installation instructions and prevalent practice shall be provided.
- D. For substitution of materials or products, refer to the General Conditions.

PART 3 – EXECUTION

3.01 SERVICE INTERRUPTIONS, OFF-SITE, GAS AND WATER

- A. Schedule Work so there shall be no service interruptions of existing systems or systems during normal hours of operation of affected systems and facilities.
- B. When service interruptions are mandatory, arrange in advance with the OAR as to time and date of such interruptions.
- C. Systems, which are interrupted, shall be returned back into operation in such manner that they will function as originally intended.

3.02 CUTTING, NOTCHING, AND BACKING

- A. Conform to California Building Code, Title 24, Part 2, for notches and bored holes in wood and for pipes and sleeves embedded in concrete and for cuts in steel, as detailed on structural Drawings.
- B. Where pipes pass through, or are located within one inch of any construction element, install a resilient pad, ½ inch thick minimum, to prevent contact.
- C. Furnish provisions for recesses, chases, and accesses and provide blocking and backing for proper reception and installation of plumbing Work.

3.03 LOCATION OF PIPING AND EQUIPMENT

- A. Location of piping, apparatus and equipment indicated on the Drawings is approximate and shall be altered to avoid obstructions, preserve headroom, and provide free and clear openings and passageways.

- B. Trenches parallel to footings shall not be closer than 18 inches to the face of footings and shall not be below a plane having a downward slope of 2 horizontal to one vertical, from a line 9 inches above bottom of footing.
- C. Pipe in tunnels shall be installed close to one side of tunnel to provide maximum space for passage. Pipe shall not be installed through crawl hole unless otherwise specified or detailed on Drawings.
- D. Place equipment in locations and spaces indicated, disassemble and/or reassemble equipment as required by Project conditions.

3.04 TESTS AND TESTING

- A. Tests shall be as required under the applicable sections of Division 22, including this Section.
- B. Additional tests may be required in the case of products, materials, and equipment if:
 - 1. Submitted items are altered, changed, or cannot be determined as exactly conforming to the Contract Documents.
 - 2. Performance testing and results may also be required on certain items which are as specified, including fan, and pump performance.
- C. Piping Tests:
 - 1. Perform tests required to demonstrate that operation of plumbing systems and their parts are in accordance with Specifications covering each item or system, and furnish materials, instruments and equipment necessary to conduct such tests. Tests shall be performed in presence of the Inspector, and representatives of any governmental agency having jurisdiction. Work shall not be concealed or covered until required results are provided.
 - 2. If required tests are not performed, Owner may provide in accordance with the Contract Documents.
 - 3. Pressure gauges furnished in testing shall comply with CPC. Air shall be bled from lines requiring hydrostatic or water tests.
 - 4. Systems shall be pressure-tested in accordance with pipe testing schedule below. Pipe test shall indicate no loss in pressure after a minimum duration of 4 hours at test pressures indicated. Where local codes require higher test pressures than specified herein for fire sprinkler systems, local codes shall govern.
 - 5. Fuel gas lines shall be first tested with piping exposed, before backfilling trenches or lathing; second with piping in finished arrangement, backfilled and paved where required, and walls finished.
 - 6. Piping systems may be tested as a unit or in sections, but entire system shall successfully meet requirements specified herein, before final testing by the Inspector.
 - 7. Repair of damage to pipes and their appurtenances or to any other structures resulting from or caused by these tests, shall be provided.

D. Pipe Testing Schedule:

System Tested	Test Pressure (psig)	Test With:
Durham system, glass or plastic acid waste, vent and roof drain (except pipes running under a slab or underground)	Fill with water to top of highest vent; allow to stand two hours, or longer, as required by Inspector. Minimum head required for any joint shall be 10 feet in building.	Water

Cast-iron soil, waste and interior downspout, condensate drain from air conditioning equipment	10 feet of water, vertically	
Storm water disposal lines	Running water test	Water
Vacuum pump or condensate pump discharge and condensate return piping	150	Water
Domestic water piping	200	Water
Standpipes, wet or dry	300	Water
Fire sprinkler piping	200	Water
Gas piping(steel threaded or plastic)	60 (both tests)	Air
Gas piping (steel welded)	100 (both tests)	Air
Gas welding station	1-1/2 Working pressure 100 min.	Dry nitrogen
Compressed air piping	175	Air

E. Equipment Performance Assurance Tests:

1. Before operating any equipment or systems, a thorough check shall be performed to determine that systems have been flushed and cleaned as required and that equipment has been properly installed, aligned, lubricated, and serviced. Factory instructions shall be checked to verify installations have been completed and recommended lubricants have been installed in bearings, gearboxes, crankcases, and similar equipment. Particular care shall be furnished in lubricating bearings to avoid damage by over-lubrication and blowing out seals. Equipment shall also be checked for damage that may have occurred during shipment, after delivery, or during installation. Damaged equipment, products, and materials shall be replaced or repaired as required.
2. Upon completion of the above, adjust the system settings to within normal operating conditions to prevent the system from being damaged upon start-up.
3. Run-test the equipment after start-up for five consecutive days. Tests shall include operation of all equipment and systems for a period of not less than two 8 hour periods at 90 percent of the full specified capacities.
4. Equipment Start-up Reports: For each equipment or system on which start-up is performed, submit 8 copies of start-up report for review by the Architect.
 - a. The start-up report shall include the manufacturer's standard start-up form completed and signed by the start-up technician.
5. Provide, maintain, and pay costs for equipment, instruments, and operating personnel as required for specified tests.
6. Provide electric energy and fuel required for tests.
7. Final adjustment to equipment or systems shall meet specified performance requirements.
8. Equipment, systems, or Work deemed defective during testing shall be replaced or corrected as required. Test until satisfactory results are provided.

F. Specific Coordinated Plan for Test and Balance:

1. Provide a narrative of the operational intent that clearly describes the function and sequence of operation of each component, equipment, or system installed. Instruct designated Owner personnel in the operation of the installed systems.
2. Prior to final test and balance, plumbing equipment and systems shall be operated and tested as indicated in Article 3.04.F above to demonstrate satisfactory overall operation of the installed systems.
3. Welding performed as part of this Division may be subject to radiographic inspections at random in accordance with requirements specified in Section 22 0513: Basic Plumbing Materials and Methods.

3.05 NOISE AND VIBRATION REDUCTION

- A. Correct noise or vibration caused by plumbing systems. Provide all necessary adjustments to specified and installed equipment and accessories to reduce noise to the lowest possible level
- B. Correct noise or vibration problems caused by failure to install work in accordance with Contract Documents. Include all labor and materials required as a result of such failure. Pay for re-testing of corrected noise or vibration problems by the project acoustical consultant including travel, lodging, test equipment expenses, etc.

3.06 PROTECTION, CARE AND CLEANING

- A. In addition to storage criteria of the General Conditions, and provisions under Section 01 5000: Construction Facilities and Temporary Controls, the following shall be provided:
 1. Provide for the safety and good condition of materials and equipment until Substantial Completion. Protect materials and equipment from damage.
 2. Protect installed Work.
 3. Replacements: In case of damage, immediately provide repairs and/or replacements as required.
 4. Protect covering for bearings, open connections to tanks, pumps, compressors and similar equipment.
 5. Interior of piping shall be maintained free of dirt, grit, dust, and other foreign materials.
 6. Fixtures, piping, finished brass or bronze, and equipment shall have grease, adhesive, labels, and foreign materials removed. Chromium, nickel plate, polished bronze or brass Work shall be polished. Glass shall be cleaned inside and out.
 7. Before initial start-up and again before Substantial Completion, piping shall be drained and flushed to completely remove grease and foreign matter. Pressure regulating assemblies, traps, strainers, boilers, flush valves, and similar items shall be thoroughly cleaned. Tag system with an information tag listing responsible party and date of element, before initial start-up and again before Substantial Completion. Compressed air, oil, and gas piping shall be blown out with oil-free compressed air or inert gas.

End of Section

Section 22 0513

Basic Plumbing Materials and Methods

PART 1 – GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. This Section prescribes basic materials and methods generally common to the Work of Division 22.
- B. Related Requirements:
 - 1. Division 01: General Requirements.
 - 2. Division 22: Plumbing.
 - 3. Division 23: HVAC.
 - 4. Division 26: Electrical.
 - 5. Section 32 8413: Potable Water Irrigation.
 - 6. Section 32 8426: Reclaimed Water Irrigation.
 - 7. Division 33: Site Improvements.

1.02 SUBMITTALS

- A. Provide in accordance with Division 01, Section 22 0500 and specific requirements of each section of Division 22.
- B. Types of welding rods to be used.

1.03 QUALITY ASSURANCE

- A. Standards: Comply with applicable national, state, and local codes and standards: ASTM, ASME, and ANSI. Federal Specifications, AWWA, SISPI, NFPA, FM, UL, CPC (California Plumbing Code), CMC (California Plumbing Code), CSA.
- B. Conform to provisions of Section 22 0500: Common Work Results for Plumbing.
- C. Manufacturer of plumbing products must be third-party certified to ANSI/NSF Standard 61, Section 9 certification, and ANSI/NSF 372 to demonstrate compliance with the federal requirements for lead contribution to drinking water, the Safe Drinking Water Act SDWA, and the California Health and Safety Code Section 116875.
- D. Qualifications of Manufacturer: Products used in the Work of this Section shall be produced by manufacturers regularly engaged in manufacture of similar items and with a history of successful production as reviewed by the ARCHITECT.

1.04 COORDINATION

- A. Coordinate related Work in accordance with provisions of Section 01 3113: Project Coordination.

PART 2 – PRODUCTS

2.01 GENERAL

- A. Provide the following products if they are indicated in the Contract Documents or if they are required for the proper installation, function or operation of equipment, systems or components indicated in the Contract Document.

- B. Provide the following products as a complete assembly with required accessories for a complete and functioning entity in compliance with governing codes and applicable standards as specified in Section 22 0500, manufacturer's instructions or as required.
1. Omission of minor details in the Contract Documents does not waive and/or otherwise relinquish compliance with the above requirements.

2.02 MANUFACTURERS AND MATERIALS

- A. Ball Valves: 2-inch and smaller:

BV-1: Class 150, 600 psi, Bronze, CWP two piece construction with reinforced TFE seats, full port, adjustable packing gland, (no threaded stem designs allowed), threaded or solder ends.

Manufacturer: NIBCO T-685-66-LF/S-685-66-LF, Hammond UP8303A/UP8513, Milwaukee UPBA400S/ UPBA450S, or equal.

BV-2: Class 150, 600 psi, Stainless Steel, CWP two piece construction with reinforced TFE seats, full port, adjustable packing gland, (no threaded stem designs allowed), threaded or solder ends.

Manufacturer: NIBCO T-585-S6-R-66-LL, Milwaukee BA260, or equal.

Ball Valves in Insulated Piping: Use extended operating handle of non-thermal conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation and memory stops that are fully adjustable after insulation is applied. NIBCO Nib-Seal Handle.

- B. Butterfly Valves:

BFV-1 Centerline Series A, 200 psi CWP tight shut-off.

1. Body: Lug type ductile iron. Suitable for bi-directional dead-end service at rated pressure without use of downstream flange.
2. Disc: Bronze, or aluminum bronze.
3. Stem: One or two-piece, 400 series stainless steel.
4. Seat and O-Rings: EPDM.
5. Upper and Lower Stem Bearings: Copper alloy or non-metallic material.
6. Operators: Valves 6 inches and smaller, with lever handle. Valves 8 inches and larger, with manual gear operator and disc position indicator.
7. Manufacturers:
 - a) Valves 2.5 to 6-inch: Milwaukee ML 233E, Hammond 6411-03, or equal.
 - b) Valves 8-inch and larger: Milwaukee ML 333E, Hammond 6411-03, NIBCO LD 2000, or equal.

- C. Check Valves:

1. Bronze, 2-inch and smaller:

CHV-1: 200 psi, CWP horizontal swing, Y pattern, renewable seat and disc, threaded ends.

Manufacturer: NIBCO T-413-Y-LF, Milwaukee UP-509, Hammond UP-904, or equal.

CHV-2: 200 psi, CWP, bronze body, horizontal swing, Y pattern, renewable seat and disc, solder ends.

Manufacturer: Nibco S-413-Y-LF, Hammond Up-943, or equal.

CHV-3: Class 125, 200 psi, swing check, bronze body, Teflon disc, soldered ends.

Manufacturer: Stockham B-310TY, Crane 1340, NIBCO S-413-Y, Milwaukee 1509-T, Hammond IB-912, or equal.

2. Cast Iron 2 1/2-inch and larger:

CHV-4: Class 125, 200 psi, CWP, IBBM, renewable seat and disc, bolted cap, threaded ends:

Manufacturer: Crane 372, Stockham G-927, NIBCO T-918-B, or equal.

CHV-5: Special low-pressure check valve for installation in gas lines.

Manufacturer: Circle Seal Products Co., 119B-xPP; 0-15 psi; #1:1/8 inch IPS; #2:1/4 inch IPS #3:3/8 inch IPS.

D. Earthquake Valve:

EQV-1: Mechanically triggered by seismic movement, complying with state of California seismic response specifications, UL listed and certified by D.S.A. Size and pressure as required or indicated on Drawings. (Minimum 1/4 psi, maximum 10 psi. Earthquake valve shall shut off gas automatically during an earthquake to prevent an explosion or fire. Valve shall be Koso California seismic valve, or equal.

1. Not sensitive to vibrations caused by passing trucks or accidental bumping.
2. Sensitive to wide amplitude G's only. Preset at factory for the correct G-rating.
3. Positive sealing from minus 10 degrees F. to 150 degrees F.
4. Visual open-close indicator.
5. Manual reset.
6. Plumb line for mounting.
7. Tripping mechanism has non-creeping rolling latch.
8. Install valve per manufacturer's recommendations only.

E. Expansion Tank:

ET-1: Pressurized, vertical, steel expansion tank for potable water systems with FDA approved, replaceable, heavy duty, butyl rubber blend diaphragm, polypropylene lined dome, 1/2 inch, 3/4 inch, 1 inch or 1 1/2-inch NPT system connection, 1/2 inch or 3/4 inch drain, 0.302 inch-32 standard automobile tire valve type charging connection, lifting rings and a floor mounting skirt for vertical installation. The tank must be constructed in accordance with Section VII of the ASME Boiler and Pressure Vessel Code and stamped for 125 psi working pressure. The tank must be also rated for a continuous working temperature of 240 degrees F. Provide weather and rust resistant coating.

Manufacturer: Bell and Gossett, Wheatley, Taco, Amtrol, or equal.

F. Flow Control Valve – Manual:

FC-1: Flow control valves: Bell and Gossett Series CB circuit setter balancing valve, line size, with integral pointer (to register degree of valve opening), differential pressure meter connections with built-in check valves and lockable memory stops. Manufacturer: Armstrong ARMFLO circuit-balancing valves, series CBV, or equal.

G. Gate Valves:

1. Bronze, 2-inch and smaller:

GV-1: Class 125, 200 psi, CWP, bronze body and bonnet, non-rising stem, inside screw, screw-in bonnet, solid disc, threaded ends:

Manufacturer: NIBCO T-113-LF, Milwaukee UP105-P2, Hammond UP645, or equal.

GV-2: Same as GV-1, except solder ends:

Manufacturer: NIBCO S-113-LF, Milwaukee UP115, Hammond UP647, or equal.

2. Bronze, 2-1/2-inch and larger:

GV-3: Class 125 250 psi CWP iron body, flanged ends, bolted bonnet with wheel handle, resilient wedge, non-rising stem.

Manufacturer: NIBCO F-619-RW, or equal.

GV-4: Class 125, 250 psi CWP iron body, flanged ends, bolted bonnet with 2-inch operating nut, resilient wedge, non-rising stem, fusion bonded epoxy coated.

Manufacturer: NIBCO F-619-RW-SON, or equal.

GV-5: Class 250, 250 psi, CWP, O S and Y, IBBM, resilient seat gate valve, flanged ends.

Manufacturer: Watts 408-OSYRW, or equal.

GV-6: Class 125, 200 psi CWP, bronze body and bonnet non-rising stem, inside screw, screw-in bonnet, solid disc, threaded ends.

Manufacturer: Hammond IB645, Crane 1701, Milwaukee 105, American 3F, NIBCO T-113, or equal.

H. Globe Valves:

1. Bronze, 2-inch and smaller:

GLV-1: Class 125, 200 psi, CWP, screw-in bonnet, Teflon disc, threaded ends:

Manufacturer: Milwaukee UP502-P2, Hammond UP440-P2, or equal.

GLV-2: Class 125, 200 psi, CWP, screw in bonnet, Teflon disc, soldered ends.

Manufacturer: Hammond UP418, Milwaukee UP1502, or equal.

I. Heater Vent Pipe:

1. Schedule Number:

HVP-1 Shall be UL approved for service specified. Concealed heater vent pipe, including pipe in or through attic spaces, shall be City of Thousand Oaks approved double wall metal vent pipe. For recessed wall heaters, furnish B.W. type. All others may be Type B, or B.W. Clearances must comply with City of Thousand Oaks code and conditions of UL listing.

Manufacturer: American Metal Products Co., Inc., Simpson Dura-Vent, AmeriVent, Hart & Cooley Mfg. Co., Metalbestos, or equal.

J. Liquid Level Gage:

LLG-1 Refrigerant type, carbon steel with stainless steel trim or all forged steel construction, back-seating standard design. Upper and lower valve furnished with ball check valves; 1/2 inch diameter glass on center. Four 3/16 inch diameter gage glass guard rods or slotted steel guard.

Manufacturer: Peneberthy, Henry, Conbraco, or equal.

K. Piping and fittings:

1. Piping shall be continuously and permanently marked with manufacturer's name, type of material, size, pressure rating, and the applicable ASTM, ANSI, UL, or NSF listing. On plastic pipe, date of extrusion must also be marked.

2. Underground non-ferrous pressure pipes shall be installed with proper color tracer wires. Refer to color code provisions in Section 22 0553: Plumbing Identification.
- P-1: Cast iron: Hubless, service weight, ASTM A888, CISPI 301, conforming to CISPI 310 and installed in accordance to IAPMO IS 6.
Manufacturer: American Foundry, Tyler, AB & I, or equal.
PF-1a: Cast iron, soil or waste no-hub coupling with neoprene gaskets, stainless steel corrugated shields and stainless steel clamps. 2 bands for size 1 ½-inch thru 4-inch, IAPMO, ASTM C 564 and CISPI 310.
Manufacturer: American Foundry, Tyler, AB & I, or equal.
PF-1b: Cast iron, soil or waste, Heavy-duty no-hub coupling with neoprene gaskets, stainless steel corrugated shields and stainless steel clamps. 4 bands for size 5-inch thru 10-inch. IAPMO, ASTM C564 and CISPI 310.
Manufacturer: American Foundry, Tyler, AB & I, or equal.
PF-1c: Same as PF-1a with Heavy Duty Husky SD 4000 Coupling and stainless steel clamps. IAPMO, ASTM C564 and CISPI 310.
- P-2: Galvanized steel, Schedule 40, ASTM A53.
Manufacturer: US Steel or equal.
PF-2: Malleable iron, Class 150, threaded, galvanized, beaded, ANSI B 16.3.
Manufacturer: Stockham, Stanley Flagg, Grinnell, or equal.
- P-3: Copper drainage tube, inside structure and above grade. Type DWV hard temper, ASTM B 306.
Manufacturer: Mueller, Anaconda, Cerro Brass, Cambridge-Lee, Halstead, or equal.
PF-3: Cast brass drainage fittings ASA B 16.23, ASTM B 42.
Manufacturer: Mueller Brass, Nibco, Stanley Flagg, Lee Brass, or equal.
- P-4: Copper water tube, Type L hard, ASTM B88. (For above ground use only.)
Manufacturer: Mueller, Cambridge-Lee, Halstead, or equal.
PF-4a: Copper Press-Connect pressure fittings, comply with ASME B16.51 “Copper Alloy Press-Connect Pressure Fittings”, with Ethylene Propylene Diene Monomer, EPDM O-Ring Seal in each end. Fittings with the sizes of 2-1/2” and larger shall have cross-section Grab Rings and separation rings.
Manufacturer: Viega, Mueller Industries, Apollo, or equal.
PF-4b: Wrought copper - solder type ANSI B 16.22.
Manufacturer: Mueller Brass, Nibco, Lee Brass, or equal.
PF-4c: Grooved end type– ASTM B75 or B152 and ANSI B16.22 wrought copper, bronze sand casting per ASTM B584-87 copper alloy CDA 836 per ANSIB16.18. Couplings shall be CTS style 606 supplied with angle pattern bolt pads for rigidity, coated with copper coated alkyd enamel. Gaskets shall be pre-lubricated Flush seal type.
Manufacturer: Victaulic, or equal.
- P-5: Copper water tube, Type K hard, ASTM B88.
Manufacturer: Mueller, Cerro Brass, Cambridge-Lee, Halstead, or equal.

- P-6: Type 316L Stainless steel chemical waste pipe, marked with manufacturer's identification and fittings. Manufacturer's representative shall instruct installers and certify them for joint installation. Piping system shall be provided with a five-year manufacturer's material warranty.
Manufacturer: Blucher-Josam, Viega, or equal.
- PF-6a: Type 316L Stainless Steel Mechanical joints. Stainless steel joint for chemical waste piping systems including drain or bottle traps.
Manufacturer: Blucher-Josam, or equal.
- PF-6b: Type 316L Stainless Steel Press Fittings. For chemical waste piping systems including drain, vent or bottle traps, provide with EPDM seals. For compressed air piping systems, provide with HNBR seals. Manufacturer's representative shall instruct installers and certify them for joint installation.
Manufacturer: Viega, or equal.
- P-7: Black steel pipe, Schedule 40, ASTM A53, Type E, ERW.
Manufacturer: US Steel, or equal.
- PF-7a: Malleable iron, Class 125, ANSI B 16.3, threaded or welded Schedule 40 black steel for 2-inches and below and welded for 2 ½-inch and above.
Manufacturer: Stockham, or equal.
- PF-7b: Grooved end type– ASTM A395 and A536 ductile iron; ASTM A234 WPB forged steel; fabricated from ASTM A53 carbon steel. Couplings shall be supplied with angle-pattern bolt pads for rigidity, except in locations where flexibility is desired. Gaskets shall be pre-lubricated.
Manufacturer: Victaulic, Galvanized or painted, or equal.
- PF-7c: MegaPressG, ASME B31, Carbon Steel, – For aboveground piping 2-inches and below. Provide fittings with Hydrogenated Nitrile Butadiene Rubber, HNBR Sealing Element.
Manufacturer: Viega, or equal.
- PF-7d: Malleable Iron, class 125, ANSI B 16.3, threaded schedule 80 black steel.
Manufacturer: Stockham, or equal.
- P-8: Red seamless brass 85-5-5-5, iron pipe size (IPS), threaded pipe, ASTM B43.
Manufacturer: Mueller, Cerro Brass, Cambridge-Lee, Halstead, or equal.
- PF-8: Bronze and brass, 250 psi, threaded, ASA B16.17 and F S WW-P-460.
Manufacturer: Mueller Brass, Lee Brass, or equal.
- P-9: PVC, thick wall, cast-iron OD sized, UL, and NSF listed, comply with AWWA C900, and ASTM D1784 Cell Class 12454B, with tracer wire.
Manufacturer: Blue Brute, or equal.
- PF-9: Ductile Iron conforming to AWWA C110, and AWWA C153, with bell and spigot gasket joints conforming to AWWA C111/A21.11.
Manufacturer: EBAA Iron Sales Inc. Megalug 2000PV, or equal.
- P-10: CPVC (Chlorinated polyvinyl Chloride) schedule 40 pipe, conforming to ASTM D1784, and UL723 (ASTM E84).
Manufacturer: Spears, Corzan, Charlotte, or equal.

- PF-10: CPVC (Chlorinated Polyvinyl Chloride) schedule 40 fittings, conforming to ASTM D1784, and UL723 (ASTM E84). The joints shall be of solvent cement type conforming to ASTM F493. Installer shall be certified by the manufacturer for this type of joint installation. Drains, bottle traps and similar devices shall be the same material and gauge as the pipe with mechanical joints.
Manufacturer: Spears, Corzan, Charlotte, or equal.
- P-11: PVDF (Polyvinylidene Fluoride) schedule 40 chemical waste pipe, conforming to ASTM F1673, ASTM D3222 and complying with UL723 (ASTM E84). The joints shall be no-hub mechanical Joints or Socket Fusion. Installer shall be certified by manufacturer for joint installation.
Manufacturer: Orion, or equal.
- PF-11a: PVDF (Polyvinylidene Fluoride), schedule 40, No-hub coupling. Each coupling shall have 300 series stainless steel outer band and 5/16 inch bolts, nuts and washers plated to meet a 100-hour salt spray test per ASTM B117. Drains, bottle traps and similar devices shall be the same material and gauge as the pipe with mechanical joints. Installer shall be certified by the manufacturer for this type of joint installation.
Manufacturer: Orion, or equal.
- PF-11b: PVDF (Polyvinylidene Fluoride), schedule 40 coupling. Joined using the socket fusion system conforming to ASTM 2657. Drains, bottle traps and similar devices shall be the same material and gauge as the pipe with mechanical joints. Installer shall be certified by the manufacturer for this kind of joint installation.
Manufacturer: Orion, or equal.
- P-12: FRPP (Flame Retardant Polypropylene) schedule 40 chemical waste pipe, conforming to ASTM F1412 and ASTM D4101. The joints shall be no-hub mechanical joints or Socket Fusion type. Installer shall be certified by the manufacturer for joint installation.
Manufacturer: Orion, or equal.
- PF-12a: FRPP (Flame Retardant Polypropylene), schedule 40, No-hub coupling. Each coupling shall have 300 series stainless steel outer band and 5/16 inch bolts, nuts and washers plated to meet a 100-hour salt spray test per ASTM B117. Drains, bottle traps and similar devices shall be the same material and gauge as the pipe with mechanical joints. Installer shall be certified by the manufacturer for this type of joint installation.
Manufacturer: Orion, or equal.
- PF-12b: FRPP (Flame Retardant Polypropylene), schedule 40 coupling. Joined using the socket fusion system conforming to ASTM 2657. Drains, bottle traps and similar devices shall be the same material and gauge as the pipe with mechanical joints. Installer shall be certified by the manufacturer for this kind of joint installation.
Manufacturer: Orion, or equal.
- P-13: Polyethylene plastic pipe, ASTM D 2513, Standard Dimension Ratio 11 rated at 80 psi working pressure and 73° Fahrenheit for 3 inches and smaller, SDR 11.5 rated at 76 psi and 73° Fahrenheit for 4 inches and above, butt or socket type fittings, joined

by heat fusion, orange or yellow color. Installer shall be certified by the manufacturer for this kind of joint installation.

Manufacturer: CPCHEM (Chevron Phillips Chemical Company LP) PE 2406, or equal.

PF-13a: Polyethylene plastic fittings, ASTM D 3261 and D 2683, Standard Dimension Ratio 11 rated at 80 psi working pressure and 73° Fahrenheit for 3 inches and smaller, SDR 11.5 rated at 76 psi at 73° Fahrenheit for 4 inches and above, butt or socket type fittings, joined by heat fusion, Installer shall be certified by manufacturer for joint installation. Color orange or yellow.

Manufacturer: CPCHEM, (Chevron Phillips Chemical Company LP), or equal.

PF-13b: Polyethylene transition risers, for PF-13a above, Transition fitting must have a minimum vertical height of 36 inches from the horizontal connection which will allow for a 6-inch steel riser above ground. Polyethylene transition risers shall be anodeless.

Manufacturer: Central Plastics Company, or equal.

P-14: PVC, schedule 40, extruded from 100 percent virgin Polyvinyl Chloride (PVC) compound, meeting requirements of class 1254-13 of ASTM D1784. (Use for irrigation systems after the control valves only.)

Manufacturer: Spears, Charlotte, or equal.

PF-14 Plastic fittings, schedule 40 molded from PVC type I compound, conforming to the requirements of specification ASTM D2466.

Manufacturer: Spears, Charlotte, Harvel Plastics Inc., or equal.

P-15: Purple pipe, PVC, schedule 40 for reclaimed or recycled water (below ground only for non-potable irrigation systems), type 1, grade 1, PVC-1120, Cell Class 12454 B.

Manufacturer: Charlotte, or equal.

PF-15: Purple Plastic fittings, schedule 40 molded from PVC type I compound, conforming to the requirements of specification ASTM D2466. Refer to section 32 8426 “Reclaimed Water Irrigation”.

Manufacturer: Charlotte, or equal.

L. Pipe and Fitting Requirements Schedule: Unless otherwise specified or indicated on Drawings, pipe and fittings shall be installed in accordance with the following table:

TABLE I
 PIPE AND FITTING SCHEDULE

Use	Limits	Pipe	Fittings
Compressed air	All sizes	P-6	PF-6
Condensate drains and drains From HVAC Equipment	All sizes	P-4, or P-6 *Roof penetration & above, and exterior exposed piping shall be P-6 only	PF-4b, or PF-6b *Roof penetration & above, and exterior exposed piping shall be P-6 only
Domestic Cold Water,	Within 5’ from	P-5	PF-4a, or PF-4b

Use	Limits	Pipe	Fittings
underground	building, All sizes		
Domestic Cold Water, underground	Site distribution only, 4" and over	P-9; Refer to 33 1100	PF-9; Refer to 33 1100
Domestic Hot and Cold water, aboveground	Interior only	P-4	PF-4a, or PF-4b
Downspouts, Interior Storm Drainage	Within 5' from building, All sizes	P-1	PF-1a, or PF-1b
Exposed Downspouts, Interior Storm Drainage	Existing Buildings and aboveground only	P-2	PF-2
Fire Mains (Fire Hydrants), Underground	Site distribution only, 4" and over	P-9; Refer to 33 1100	PF-9; Refer to 33 1100
Fire Suppression System, Interior	All sizes	P7; Refer to 21 1313	PF-7d; Refer to 21 1313
Irrigation, After Backflow Preventer	All sizes	P14; Refer to 32 8413	PF-14; Refer to 32 8413
Irrigation, Meter to Backflow Preventer	Up to 4"	P-5; Refer to 33 1100	PF-4a, or PF-4b; Refer to 33 1100
Irrigation, Meter to Backflow Preventer	4" and over	P-9; Refer to 33 1100	PF-9; Refer to 33 1100
Irrigation, Reclaimed Water or Recycled Water	All sizes	P15; Refer to 32 8426	PF-15; Refer to 32 8426
Natural Gas, Exterior	Underground, site only	P-13	PF-13a, and PF-13b
Natural Gas, Interior, aboveground	All sizes	P-7	PF-7a, PF-7b, or PF-7c
Vents-ACID,	All sizes	P-6, P-10, P-11, or P-12 *Roof penetration & above shall be P-6 only	PF-6a, PF-10, PF-11a, PF-11b, PF-12a, or PF-12b *Roof penetration & above: PF-6a only
Waste - ACID - Aboveground - Passing through Air Plenum	All sizes	P-11	PF-11a, or 11b
Waste - ACID - Aboveground - Fire-	All sizes	P-12	PF-12a, or 12b

Use	Limits	Pipe	Fittings
Rated			
Waste - ACID - Aboveground	All sizes	P-10	PF-10
Waste - ACID - Underground	All sizes	P-6	PF-6a, or 6b
Waste - FORCED	All sizes	P-1	PF-1c
Waste and Vent - Indirect	All sizes	P-3	PF-3
Waste and Vent – Sanitary/ Grease	All sizes	P-1	PF-1a, or 1b
Waste and Vent – Sanitary/ Grease	Underground, site only	P-1; Refer to 33 3000	PF-1a, or 1b; Refer to 33 3000

M. Pipe Isolators:

PLA-1 Absorption pad shall be not less than ½ inch thick, unloaded. Pad shall completely encompass pipe.

Manufacturer: Holdrite, LSP, Stoneman, Potter-Roemer, Trisolator, PR-Isolator, or equal.

Manufacturer: Hydra-Zorb Cushion Clamps, Acousto-Clamp, or equal.

N. Pressure Gage: Aluminum or steel case, minimum 4 ¼-inch dial; pressure type or combination vacuum-pressure type, with provisions for field calibration. Dial indicator to indicate pressure in psi with accuracy to within plus or minus 0.5 percent of maximum dial reading. Furnish gages with restriction screw, size 60, to eliminate vibration impulses. Black case and ring, bourdon tube of seamless copper alloy with brass tip and socket. Three way gage cock, constructed of brass with stuffing box, 1/2 inch couplings, with fixed or movable cap nut to shut off pressure gage.

PG-1 Pressure type, black drawn steel case, 4-1/2-inch glass dial, range approximately twice line pressure.

Manufacturer: Marsh Keckley, Trerice, Weksler, Weiss, or equal.

O. Plug Valves:

PV-1 2 inches and smaller: Rockwell No.114, lubricated plug type, 200-pound., water operating gauge pressure iron body and plug, regular pattern, threaded, with indicating arc.

Manufacturer: Walworth, Homestead, WKM, or equal.

PV-2. 2 ½-inch and larger: Rockwell No.115 and No.165 lubricated plug type, 200 pound water operating gauge. Iron body and plug, regular pattern, flanged, with indicating arc.

Manufacturer: Walworth, Homestead, WKM, or equal.

P. Safety Relief Valves:

SRV-1: Combination temperature and pressure relief type. CSA approved. Set to open at 125 psi pressure.

Manufacturer: Watts: 40L, Cash-Acme: NCLX-1, or equal.

SRV-2: Same as SRV-1, except provide on storage type water heater with anode in dip tube.

Manufacturer: Watts: 100XL, Cash-Acme: NCLX-1, or equal.

SRV-3 Spring type, ASME and NB stamped and certified with manual lifting device for air or gas.

Manufacturer: Bailey, Cash-Acme, Watts, Keckley, or equal.

Q. Strainers:

STR-1 Description: Wye type with monel or stainless steel strainer cylinder (manufacturer's standard mesh), and gasketed machine strainer cap. Where indicated on Drawings, provide with valved (globe valve) blowout piping, same size as blowout plug.

1. 2-inch and smaller:

C.M. Bailey No.100-A, 250 lb., cast iron body, threaded, Keckley: Style B, Spirax Sarco Y-type, or equal.

2. 2 ½-inch and larger:

C.M. Bailey No.100-A, 125 lb., cast iron body, flanged, or Victaulic style 732, 300 psi, ductile iron body, grooved, fusion bonded epoxy coated.

Manufacturer: C.M.Bailey, Armstrong, Muessco, Keckley 'A', or equal.

STR-2 Y pattern cast iron bodies, 125 psi, monel screen. Open area at least twice the cross-sectional area of IPS pipe in which strainer is installed and may be woven wire or perforated type. Screwed ends for sizes up to 2 inches, flanged ends fusion bonded epoxy coated for 2 ½-inch and larger perforations, in accordance with the following:

1. Steam service - 40 square mesh.

2. Other services - 16 square mesh.

Bailey No.100, Armstrong, RP&C, Keckley or equal.

STR-3 Flanged, bucket type, semi-steel body, 125 psi, stainless steel screen with 1/8 inch diameter perforations, all sizes.

Manufacturer: Bailey No.1, Zurn 150 Series, RP&C, Keckley GFV, or equal.

STR-4 Grooved, T-pattern, ductile iron body, 300 psi, stainless steel frame and mesh basket, grooved ends.

R. Vent Caps:

VC-1 Vandal-proof hood type, for plumbing vent lines.

Manufacturer: Stoneman Engineering and Mfg., Semco 1550, or equal.

S. Vacuum Valves:

VV-1 Vacuum valves; for vacuum serve, 125 psig working pressure, cast iron body, spring loaded lubricated plug type.

Manufacturer: General Controls, Honeywell, Valmatic, or equal.

T. Protective Coating for Underground Steel Piping Applied to Underground Automotive:

1. Black steel or galvanized steel piping indicated for below grade installation, shall be protected as specified prior to delivery to the Project site:

a. Sandblast black steel pipe to a gray finish. Sandblast galvanized steel pipe lightly only.

b. Install one coat of cut back asphalt to galvanized pipe immediately after sandblasting. Pre-heat black pipe to 180 degrees F. immediately before coating.

- c. Install one coat of high-temperature (melting point of 240 degrees F. minimum) Grade B asphalt enamel.
 - d. Install one wrapping of 20 mils thick glass, fiber mat, Owens-Corning Coromat or L.O.F. Blueflag with 1/4 inch overwrap. Glass fiber shall be dry at time of installation.
 - e. Install a second coat of asphalt enamel as specified above. Glass fiber mat shall be centered in the asphalt enamel.
 - f. Install an overwrap of Kraft ripple paper.
2. Total thickness of pipe wrapping shall be not less than 1/8 inch. Entire coating operation shall be accomplished by mechanical means in a continuous operation. Hand installation of protective coating is not permitted.
 3. Each piece of wrapped pipe shall be legibly identified at no greater than 5 feet intervals by fabrication company. Each material submittal shall include the name of the fabrication company. Maintain one reviewed Sample on the Project Site.
 4. Acceptable manufacturers of wrapping are: Hunt, Mobile, Conway or equal.
 5. Fittings (including couplings), unprotected pipe adjacent to fittings, and damaged pipe protection shall be wrapped at Project site as follows:
 - a. Fittings and pipe to be wrapped shall be thoroughly cleaned of material foreign to pipe manufacturer.
 - b. Install one coat of Plicoflex No. 105 or Protecto Wrap No. 1170 adhesive primer to metal.
 - c. Wrap pipe and fittings with a minimum thickness of 3/32 inch of Plicoflex No. 310 pipe line butyl molding tape, or Protecto Wrap No. 200 molding tape. Install 3 layers, each layer overlapping next approximately 2/3 width of tape, without stretching. Tape and primer shall be of the same manufacturer.
 - d. Wrap vinyl tape, 10 mil thickness, over molding tape with 1 inch minimum overlap.
Manufacturer: J.M. Trantex, 3M Scotchwrap or equal.
 5. Pipe and fittings specified to be wrapped shall be tested with a holiday detector, after pipe has been installed in trench and before backfilling, in presence of the Project Inspector. Furnish a Tinkler and Raser model E-P holiday detector, or similar equipment for this test. Work, which is deemed defective, shall be repaired or replaced. The Project Inspector may test for damaged pipe wrapping after backfilling.
 6. Instead of wrapping underground steel pipe as specified above, pipe may be machine-wrapped before delivery to the Project site as follows:
 - a. Pipe shall be cleaned of moisture, oil, grease, scale, and other foreign material by cleaning with non-oily solvent and wire brushing. Remove metal burrs and projections.
 - b. Install one coat of Plicoflex No.105 adhesive primer to cleaned pipe. If thinning is required, furnish only non-oily thinners as recommended by tape manufacturer.
 - c. Wrap coated pipe with Plicoflex No.340-25 tape (15 mil butyl and 10 mil vinyl laminate) Tape shall be installed by machine wrapping at approved

plant only. Maintain tension (minimum of 5 pounds per inch of width) on tape over entire diameter of pipe. Tape shall be permanently identified and visible on vinyl side.

- d. Fittings, unprotected pipe, and damaged pipe protection shall be wrapped as indicated above.

- U. Flanges: Flanges shall be furnished and installed at each flanged connection of each type of equipment, tanks, and valves. Faces of flanges being connected shall be furnished alike. Connection of a raised face flange to a flat-faced flange is not permitted. Flanges shall conform to following schedules:

TYPE OF PIPE	FLANGE
Screwed black or galvanized grooved steel pipelines.	125-pound black cast iron screwed flange, flat faced or grooved flange adapters, Victaulic Style 741, Tyco-Grinnell Fig. 71, Gruvlok Fig. 7401, or equal.
Welded or grooved steel pipe, except high pressure steam lines.	150-pound black forged steel welding flanges, 1/16 inch raised face ASTM A 105, Grade II or grooved flange adapters, Victaulic Style 741, Tyco-Grinnell Fig. 71, Gruvlok Fig. 7401, or equal.
Copper and brass pipe or tubing.	150 pound cast bronze, flat-faced flange with solder end or grooved flange adapters, Victaulic Style 641, Tyco-Grinnell Fig. 61, Gruvlok Fig. 6084, or equal.

- 1. Gasket material for flanged connections shall be full faced or ring type to suit facing on flanges and shall be furnished in accordance with following schedule:

SERVICE	TYPE
Cold water	1/16-inch-thick neoprene

Grooved end flange adapters supplied with pressure responsive elastomeric Gaskets supplied with grooved flange adapters shall be pre-lubricated by the manufacturer. Grade of gasket to suit intended service.

- V. Unions:

- 1. Unions shall be furnished and installed in accordance with the following requirements (unless flanges are furnished):
 - a. At each threaded or soldered connection to equipment and tanks, except in Freon or fuel gas, piping systems, whether indicated or not.
 - b. Immediately downstream of any threaded connection to each manually operated threaded valve or cock, and each threaded check valve, yard box or access box except those in Freon piping systems, whether indicated or not.
 - c. At each threaded connection to threaded automatic valves (except those in Freon piping systems) such as reducing valves and temperature control valves, whether indicated or not.
 - d. If grooved piping is used, couplings shall serve as unions. Additional unions are not required

2. Unions shall be located so that piping can be easily disconnected for removal of equipment, tank, or valve.

PART 3 – EXECUTION

3.01 EXAMINATION

- A. Examine areas and conditions under which Work of this Section shall be performed. Correct conditions detrimental to proper and timely completion of Work. Do not proceed until unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Provide all materials and equipment for the Work. Furnish and install necessary apparatus, parts, materials, and accessories.
- B. Pipe Installation:
 1. Install piping parallel to wall and provide an orderly grouping of proper materials and execution.
 2. Piping shall clear obstructions, preserve headroom, provide openings and passageways clear, whether indicated or not. Verify the Work of other Divisions to avoid interference.
 3. If obstructions or the Work of other Divisions prevent installation of piping or equipment as indicated by the Drawings, perform minor deviations as required by the ARCHITECT.
 4. Install piping after excavation or cutting has been performed. Piping shall not be permanently enclosed, furred in, or covered before required inspection and testing is performed.
 5. Exposed polished or enameled connections from fixtures or equipment shall be installed with no resulting tool marks or threads at fittings. Residue or exposed pipe compound shall be removed from exterior of pipe.
 6. Piping shall be concealed in chases, partitions, walls, and between floors, unless otherwise directed or specifically noted on Drawings. When penetrating wood studs, joists, and other wood members, provide such members with reinforcement steel straps of Continental Steel & Tube Co., ULINE, Independent Metal Strap, or equal.
 7. Reduce fitting where any change in pipe size occurs. Bushings shall not be furnished unless specifically reviewed by the ARCHITECT, or indicated on Drawings.
 8. Piping subject to expansion or contraction shall be anchored in a manner, which permits strains to be evenly distributed. Swing joints or expansion loops shall be installed. Seismic restraints shall be installed so as not to interfere with expansion and contraction of piping. Seismic loops required at all building separations.
 9. Immediately after lines have been installed, openings shall be capped or plugged to prevent entrance of foreign materials. Caps shall be left in place until removal is necessary for completion of installation.
 10. Couplings shall not be installed except where required pipe runs between other fittings are longer than standard length of type of pipe being installed and except where their installation is specifically reviewed by the ARCHITECT.
 11. Water piping shall be installed generally level, free of traps, unnecessary offset, arranged to conform to building requirements, clear of ducts, flues, conduits, and other Work. Piping shall be arranged with valves installed to provide for complete drainage and control of system. Piping shall not be installed which causes an

objectionable noise from flow of water therein under normal conditions. Refer to Section 23 0500: Common Work Results for Plumbing.

12. Water lines may be installed in same trench with sewer lines, provided bottom of water line is 12 inches minimum above top and to the side of sewer line.
13. Changes in pipe sizes shall be furnished with eccentric reducers, flat on top. Offsets to clear obstruction shall not be installed so as to produce air pockets.

C. Pipe Sleeves and Plates:

1. Provide pipe sleeves of Schedule 40 black steel pipe or Schedule 40 PVC plastic pipe in concrete or masonry walls, footings, and concrete floors below grade. Provide adjustable submerged deck type sleeves at locations where pipes pass through concrete floors, except concrete slab floors on grade, and at locations where soil pipe for floor type water closets passes through concrete floors.
2. Sleeves shall provide ½ inch clearance around pipes, except plastic pipe shall have 1 inch clearance. Caps of deck type sleeves shall be removed just prior to installation of pipe. Area around sleeves shall be smooth and without high or low spots. Sleeves in walls shall not extend beyond exposed surface of wall. Sleeves in concrete floors and walls shall be securely fastened to forms to prevent movement while concrete is being placed.
3. Piping installed on a roof shall clear the roof surface by 10 inches minimum, with or without insulation. Bottom of individual fittings may infringe on 10 inches clear space but not groups of fittings or fittings located within 27 inches of each other.
4. Stiles shall be provided to facilitate crossing of piping when parallel piping runs are laterally greater than 12 inches out-to-out, or any pipe is higher than 18 inches, and more than 40 feet long or runs between two or more major pieces of equipment or housings greater than 20 feet apart. Stiles shall be not less than 20 inches wide with a minimum tread depth of 10 inches. Where stiles are required, they shall be located so greatest obstructed distance is 30 feet.
5. Where pipes pass through waterproofed walls, floors, or floors on grade, sealant with Link-Seal Modular Seals, or equal, between pipe and sleeve to provide a waterproof joint. Where earth is in contact with pipe on both sides of a wall or foundation, the waterproof joint is not required. Commercial rubber compression units may be furnished instead of sealed sleeves if reviewed by the ARCHITECT.
6. A swing joint, or other required device, shall be furnished and installed in hot water lines with 10 feet of sealant or compression joint to allow for expansion.
7. Provide polished, chrome-plated flanges when plumbing pipes pass through walls at plumbing fixtures, etcetera as specified in Section 22 4000 Plumbing. Provide polished steel, chromium-plated split floor and ceiling plates at locations where pipes pass through walls, floors, ceilings, and partitions in finished portion that neatly conceals pipe insert.
8. Pipe sleeves shall be provided where pipes intersect footings or foundation walls and sleeve clearances shall provide for footing settlement, but not less than one inch all around pipe.

D. Welding of Pipe and Qualifications of Welder:

1. Joints above grade or accessible conduit or tunnels in steel piping may be either welded or screwed unless specifically indicated otherwise on Drawings or specified.

- Joints in below grade steel piping, whether in insulation or not, shall not be welded, unless otherwise indicated.
2. Welded joints in pipe shall be continuous around pipe and shall comply with ASME B31: Code for Pressure Piping, unless otherwise specified.
 3. Each pipe weld shall be stamped with welder's identification mark. Welding shall be performed by welders possessing a valid certificate of qualification for welding carbon steel welding pipe in horizontal position (2G) and horizontal fixed position (5G) in accordance with the requirements of Section IX of the ASME Boiler and Pressure Vessel Code, by an OWNER-recognized, DSA approved testing laboratory.
 4. Before any welder performs welding on the Work, furnish the INSPECTOR with a copy of welder's valid qualification papers and obtain verification. Welder qualification is not valid unless it has been issued while welder was performing work for current employer, and has performed type of work described by qualification in the preceding 3 months.
 5. Welding performed under these Specifications is subject to special tests and inspections including rigid Ultra Sonic Testing (UT) and radiographic inspection at random, in accordance with Technique for Radiographic Examination of Welded Joints by an OWNER recognized, DSA approved testing laboratory.
- E. Unacceptable Welds and Repairs to Welding:
1. Welds containing any of the following types of imperfections shall be deemed defective Work:
 - a. Cracks of any type.
 - b. Zones of incomplete (in excess of 1/32 inch) fusion or penetration.
 - c. Elongated slab inclusions longer than 1/4 inch.
 - d. Groups of slag inclusions in welds having an aggregate length greater than thickness of parent metal in a length 12 times the thickness of the parent metal.
 - e. Undercuts greater than 1/32 inch.
 - f. Overlaps, abrupt ridges or valleys.
 3. When a defective weld is detected by examination as outlined above, two additional welds shall be radiographed at locations selected by the Project Inspector. If the two selected welds demonstrate compliant welding, then the two tested welds shall be deemed to be in compliance. Welding revealed by radiographs to be defective Work shall be removed, repaired, and tested by radiograph.
 4. If either of the two selected welds demonstrates welding deemed to be defective Work, all welding in that portion of the Work shall be deemed defective Work and either: all welds shall be cutout, prepare new ends for welding and weld to comply with this Specification, or radiograph all welds, removing and repairing only such welding deemed to be defective Work.
 5. Repair welding shall be performed in a manner in full compliance with ASME B31. The welded joints or repairs shall be spot examined with UT or radiographic tests in accordance with foregoing requirements.
 6. OWNER shall cause to be performed additional random UT and radiographic examinations of welds. OWNER shall be responsible for the costs of any UT and radiographic examinations found to be in compliance with specified requirements.

7. Installer shall be responsible for the costs of UT and radiographic re-examinations of welds deemed defective Work and not in compliance with this Specification, and shall repair or replace said welds in accordance with specified requirements.
- F. Welding Rods: Submit a written list of materials and proposed type of welding rods.
- G. Backing Rings: Backing rings may be submitted for installation provided the Product Data is submitted with the material list.
- H. Qualification Tests for Low-pressure Welding:
1. Tests shall be performed on 3-inch standard weight pipe ASTM A53, Grade A, and shall be welded by acetylene and electric arc. Each sample shall consist of 2 pieces, each 10 inches long, with 30-degree bevel at point weld.
 2. Two 20-inch samples shall be performed in the 2G and two 20-inch samples in the 5G positions, with positions defined in Section IX, ASME Boiler and Pressure Vessel Code. Welds shall have the reinforcement ground or machined flush to the surface of the pipe before testing. Samples shall be tested as full section tensile.
 3. Weld shall develop a load of 90 percent of 50,000 psi, i.e., 45,000 psi or shall develop a fracture in parent metal.
 4. Each qualified welder shall carry an identification card listing welder's name, date of test, and type of welding tests passed; signed by the welder and the laboratory.
 5. A valid certificate of qualification issued in compliance with requirements of the ASME Boiler Pressure Vessel Code Section IX shall qualify a welder for issuance of a certificate for low-pressure pipe welding.
- I. Certificates of Qualification for Welding of Unfired Pressure Vessels:
1. Certificates of qualification shall be issued by a laboratory recognized by the OWNER in compliance with the requirements of the ASME Boiler Pressure Vessel Code Section IX. Qualifications shall be for both acetylene and arc welding of Schedule 40 ASTM A53, Type B, steel welded or seamless pipe in the Horizontal Position (2G) and the Horizontal Fixed Position (5G) as defined by said code.
 2. Certificate described above is not valid unless it has been issued while welder was working for his current employer, and unless welder has performed type of work described by certificate in the preceding three months. Requirements for possession of a valid certificate shall not be waived for welders fabricating unfired pressure vessels when the Specifications require compliance with ASME code or when welding pipe carries working pressures greater than 75 psi and temperatures greater than 250 degrees F.
- J. Pipe Joints and Connections:
1. Pipe and tubing shall be cut per IAPMO Installation Standards. Pipe shall have rough edges or burrs removed so that a smooth and unobstructed flow shall be provided.
 2. Hot tapping of gas lines is strictly prohibited.
 3. Threaded Pipe: Joints in piping shall be installed according to the following service schedule:
 - a. Soap Piping: Litharge and glycerine, or Expando, Gasoila, or equal.
 - b. Plastic Piping: Teflon pipe joint compound tape.

- c. Oxygen Piping: Wash threads with S.P., rinse, blow-dry and apply litharge and glycerine.
 - d. Cleanout Plugs: No compound shall be used. After inspection and test, plugs shall be removed, cleaned, greased, and replaced.
 - e. Other services furnish sealant, suitable and as reviewed by the ARCHITECT.
4. Threads on pipe shall be cut with sharp, clean, unblemished dies and shall conform to ANSI/ASME B2.1 for tapered pipe threads.
 5. Joint compounds shall be smoothly placed on male thread and not in fittings. Threaded joints shall be installed tight with tongs or wrenches and sealant of any kind is not permitted. Failed joints shall be replaced with new materials. Installation of thread cement or sealant to repair a leaking joint is not permitted.
 6. Sharp-toothed Stillson, or similar wrenches, is not permitted for the installation of brass pipe or other piping with similar finished surfaces.
- K. Copper Tubing and Brass Pipe with Threadless Fittings:
1. Silver brazed joints shall be used for attaching fittings to non-ferrous metallic refrigerant piping.
 2. Non-pressure gravity fed condensate lines may be soldered with 95/5 solder.
 3. Silver brazing alloy, Class BCUP-5. Surfaces to be joined shall be free of oil, grease, and oxides. Socket of fitting and end of pipe shall be thoroughly cleaned with emery cloth and wiped to remove oxides. After cleaning and before assembly or heating, flux shall be installed to each joint surface and spread evenly. Heat shall be applied in accordance with instructions in the Copper Tube Handbook issued by Copper Development Associates. Joints constructed of rough bronze fittings shall be provided as recommended by manufacturer.
 4. Do not overheat piping and fittings when installing silver brazing.
 5. Joints in non-ferrous piping for services not covered above shall be installed with solder composed of 95/5 tin/antimony, ASTM B32, Grade 5A. Surfaces to be jointed shall be free of oil, grease, and oxides. Sockets of fitting and end of pipe shall be cleaned with emery cloth to remove oxides. Solder flux shall be sparingly installed and solder added until joint is completely filled. Do not overheat. Excess solder, while plastic, shall be removed with a small brush in order to provide an uninterrupted fillet completely around joint. Random inspection of joints shall be conducted by Project Inspector to ensure joints are lead-free.
 6. Grooved end joints for copper piping shall be assembled in accordance with the latest manufacturer recommendations. Pipe ends shall be clean and free from indentations, projections, and roll marks in the area from pipe end to groove for proper gasket sealing. Grooving tools shall be as manufactured by Victaulic, RIDGID, MAG Tool, or equal.
 7. Pressed fittings for copper or copper alloy pipe or tubing shall have an elastomeric O-ring that forms the joint. The pipe or tubing shall be fully inserted into the fitting, and the pipe or tubing marked at the shoulder of the fitting. Pipe or tubing shall be cut square, mechanically cleaned and reamed prior to joining to remove all burrs (interior and exterior) and restore full inside diameter and a smooth, chamfered exterior surface. The fitting alignment shall be checked against the mark on the pipe

- or tubing to ensure the pipe or tubing is inserted into the fitting. The joint shall be pressed using the tool recommended by the manufacturer.
- L. Ring-Type Pipe: Joints shall be installed in accordance with manufacturer's instructions with grooved couplings, fittings and rubber rings. Couplings and pipe shall be compatible and of the same manufacturer. Rings shall be accurately located and installed by grooves in coupling. Pipe shall be installed with zero deflection unless otherwise specified. Pressure pipe shall be furnished with thrust blocks at each offset point.
- M. Welded Pipe Joints:
1. Joints in welded steel pipelines shall be installed by oxyacetylene or electric arc process. Welding shall be continuous around pipe and provided as specified.
 2. Butt welds shall be of the single V-type, with ends of pipe and fittings beveled approximately 37 ½ degrees. Piping shall be aligned before welding is started with the alignment maintained during welding.
 3. Welds for flanges and socket fittings shall be of the fillet type with a throat dimension not less than pipe wall thickness.
- N. Grooved End Pipe Joints: Grooved end joints for carbon steel piping shall be assembled in accordance with the latest manufacturer recommendations. Pipe ends shall be clean and free from indentations, projections, and roll marks in the area from pipe end to grove for proper gasket sealing. Grooving tools shall be as manufactured by Victaulic, RIDGID, MAG Tool, or equal.
- O. Joints shall be Vic-Press 304TM, or equal, made with Victaulic Series 'PFT' tools and the appropriate sized jaw. Pipe shall be certified for use with Vic-Press 304TM system, and shall be square cut, properly deburred and cleaned, and marked at the required location to insure full insertion into the fittings and/or couplings.
- P. Polyethylene (Plastic) Pipe:
1. Joints shall be installed by the heat fusion method, in accordance with manufacturer's recommendations and IAPMO installation standard IS 12, for natural gas.
 2. Pipe Riser at Meter, Regulator and Building Wall: Prefabricated, anodeless type, utilizing a grade level transition between underground polyethylene pipe and gas supply steel pipe of riser outlet, R. W. Lyall Co., or equal. Below grade to above grade transition shall be installed in a welded, epoxy coated, steel casing.
 3. Connections to Existing Pipe Line or Branch:
 - a. Steel-to-plastic (PE): Provide manufacturer's prefabricated standard transition fitting, transition from epoxy-coated steel pipe to plastic, R. W. Lyall Co., or equal.
 - b. Plastic-to-plastic, PVC to PE: Provide manufacturer's prefabricated standard transition fitting, transition from PVC to epoxy-coated steel pipe to PE; R.W. Lyall Co., or equal.
 - c. Plastic-to-plastic, PE to PE: Provide manufacturer's standard fused tapping tee assembly with shut-off feature.
 4. Provide PE reinforcing sleeves where PE pipe is fused to multi-saddles, service punch tee, reducing tees, transition fittings and anodeless risers.
- Q. Valves: Valves shall conform to the following:

1. Piping systems shall be furnished with valves at points indicated on Drawings and specified, arranged to provide complete regulating control of piping system throughout building and the Project site.
2. Valves shall be installed in a neat grouping, so that parts are easily accessible and maintained.
3. Valves shall be full size of line in which they are installed, unless otherwise indicated on Drawings or otherwise specified, and shall be one of types specified.
4. Provide chain operators on valves 2-inch and larger located 7 feet or more above the servicing floor level.
5. Valves for similar service shall be of one manufacturer.
6. Except where otherwise specified, valves shall be Belimo, Victaulic, Stockham, Crane, Jenkins, Milwaukee, Hammond, American, NIBCO, Hoffman, or equal.
7. Ball valves below grade in yard boxes shall have stainless steel handles.
8. Hose bibs in dense garden areas shall be $\frac{3}{4}$ inch in size with one hose bib in the lunch pavilion 1 inch in size. Other hose bibs shall be $\frac{3}{4}$ inch lock shield type. Bibs shall be furnished with vacuum breaker protection.
9. Safety valves and pressure relief valves shall have stamp of approval as required by ASME and shall be provided with annual test lever. Where a hot water storage tank is heated by means of a coil, pressure relief valve shall have a steam BTU discharge rating of the coil. Discharge pipe from safety or pressure relief valves shall be not less than one pipe size larger than inlet pipe size of valve. Discharge pipe shall terminate as indicated and shall be free of traps. In addition to locations specified, pressure relief valves shall be installed in the following locations:
 - a. On discharge side of each pressure-reducing valve.
 - b. On each water heater connected to a hot water storage tank and other pressure vessels.
 - c. On cold water line to each water heater or hot water storage tank when there is a check valve, backflow prevention valve or similar device between water heater or hot water storage tank and meter or relief valve at the pressure reducing valve assembly.
 - d. On discharge side of each air compressor.
 - e. On each air receiver connected to an air compressor.
10. Temperature relief valves and combination temperature and pressure relief valves shall be as specified and furnished as set forth in this Section. Discharge pipe from relief valves shall be not less than discharge area of valve or valves it connects, based on discharge area of valves, and shall terminate as indicated and free of any traps. Valves shall be installed at following locations:
11. A combination temperature and pressure relief valve or combination of valves on each heating hot water storage tank. Temperature sending element shall extend into water inside tank.
12. Manual air vent valve assemblies shall be installed at each high point of hot water space heating and chilled water piping systems. Valves shall discharge through 1/4 inch diameter copper tubing and drain to nearest floor sink. Automatic type air vent valve shall only be installed where specifically indicated. Radiator, convectors, and finned pipe convectors shall be fitted with packless radiator valves, angle or straight

pattern. Each convector or radiator installed as part of a space hot water heating system shall be furnished with a manual-type air vent valve.

- R. Strainers: Strainers shall be installed on each water main (except for fire line) downstream of the meter, above grade, when a pressure regulator assembly is not installed. Main strainer shall be of Y-flange or groove type. On closed loop chilled and heating hot water systems pump systems, a strainer shall be installed at each pump inlet and upstream of each flow control valve assembly. The control valve assembly may include a modulating temperature control valve and a flow-limiting valve, manufactured by Griswold, AutoFlow, Flow Control Industries, Inc., or equal.
- S. Hangers and Supports:
1. Piping shall be securely fastened to building structure by approved iron hangers, supports, guides, anchors, and sway braces to maintain pipe alignment to prevent sagging and to prevent noise or excessive strain on piping due to uncontrolled or seismic movement under operating conditions. Hangers and supports shall conform to Manufacturer's Standardization Society Specification SP-69. Hangers shall be relocated as required to correct unsatisfactory conditions that may become evident when system is placed into operation. Appliances, heat exchangers, storage tanks, and similar equipment shall be securely fastened to structure in accordance with seismic requirements. Outdoor metal hangers and supports shall be hot-dipped galvanized steel, unless otherwise specified.
 2. Hose faucets, compressed air outlets, and similar items at ends of pipe branches shall be rigidly fastened to building construction near point of connection.
 3. Piping shall not be supported by wire, rope, wood, plumbers' tape, or other non-recognized devices.
 4. Hangers and supports shall be designed to support weight of pipe, fittings, weight of fluid and weight of pipe insulation, and shall have a minimum factor of safety of five, based on ultimate tensile strength of material installed.
 5. Burning or welding of any structural member under load is not permitted. Field welding not specified on Drawings or reviewed Shop Drawings is not permitted without review by ARCHITECT and DSA.
 6. Burning holes in beam flanges or other structural members is not permitted without review by the ARCHITECT and DSA.
 7. Pipe hangers on piping covered with low temperature insulation shall be installed on outside of insulation and not in contact with pipe unless otherwise detailed on Drawings. Insulation shall be protected by 18 gage galvanized steel shield, with a minimum length of 10 inches, installed completely around pipe covering between covering and hanger. Installing hangers directly on pipe and butting adjoining sections of insulation against hanger is permitted provided void and hanger rod are properly insulated and sealed so that no sweating occurs at hangers.
 8. Hanger rods shall be fastened to structural steel members with suitable beam clamps. Clamps shall be Tolco, Carpenter & Patterson, Fee and Mason, or equal, as follows:
 - a. Tolco I beam, Fig.62 for maximum 1000 pounds.
 - b. Tolco I or WF beam, Fig. 329, for maximum of 1290 pounds.
 9. Hanger rods shall be fastened to concrete inserts in concrete slabs or beams. Inserts shall be Tolco, Carpenter & Patterson, Fee and Mason, or equal, as follows:
 - a. Tolco Fig.310 for maximum of 600 pounds.

- b. Tolco Fig. 309 for maximum of 1140 pounds.
10. For fastening to wood ceilings, beams, or joists, furnish Grinnell Fig. 128R, Grinnell Fig. 153, Tolco 78, or equal pipe hanger flange fastened with drive screws. Under wood floors, 3/8 inch hanger rods shall be hung from 2-inch by 2-inch by 1/4 inch angle clips 3 inches long, with 2, staggered 10d nails, clinched over joist.
11. Hanger rod sizes for copper, iron, or steel pipe: 3/8 inch for pipe sizes 1/2 inch through 2-inch, 1/2 inch for pipe sizes 3-inch, 4-inch and 5-inch, 5/8 inch for pipe size 6-inch, and 3/4 inch for 8-inch and 10-inch pipe.
12. Turnbuckles, if furnished, shall provide a load carrying capacity equal to that of the pipe hanger with which they are being installed.
13. Pipe hangers shall be of same size, or nearest larger manufactured size available, as pipe or tubing on which they are being installed.
14. Hangers, clamps, and guides furnished for support of non-metallic pipe shall be padded with 1/8 inch thick rubber, neoprene, or soft resilient cloth.
15. Where special pipe-supporting requirements in the Specifications conflict with any standard requirements specified herein, the Specification requirements shall govern.
16. Vertical Piping:
 - a. Vertical pipe risers shall be securely supported with riser clamps of recognized type. Risers in reinforced concrete buildings shall be furnished with extension clamps fastened to pipe above each concrete floor slab with extended arms of clamp to rest on slab. Clamps shall be provided with lead or Teflon liners when installed on copper tubing. Clamps shall be plastic-coated when installed on non-ferrous pipe or tubing.
 - b. Copper tubing in sizes 1 1/2-inches and larger and steel pipelines passing up through building shall be supported at each floor of building or every 15 feet whichever is less.
 - c. Copper tubing sizes 1 1/4-inches and smaller shall be supported at not intervals not more than 6 feet on center. Special provisions shall be installed for vertical lines subject to expansion and contraction caused by operating temperature differences.
 - d. Vertical cast iron pipelines shall be supported from each floor and at its base. Malleable iron or steel pipe clamps with minimum thickness of 1/4 inch shall be furnished and fastened around pipe for support.
17. Horizontal Piping:
 - a. Roof Mounted Piping: Pressure and non-pressure piping shall be supported from channels, stands, clamps, trapezes, rollers, or structures mounted on 100% rubber, UV resistant rooftop supports with reflective strips, Dura-Block, or equal. Roller type supports shall be provided below and above pipe to prevent its dislodgement. Bottom of pipes shall clear the roof surface by 10 inches.
 - b. Insulated steam and space heating hot water insulated condensate lines, insulated domestic hot water supply and return piping shall be supported with Tolco Figure 4, B-Line Figure B3140, Grinnell Figure 212, or equal, steel hangers with welded eye rods to permit hinge movement at point of attachment of hangers. Hinge movement at point of support shall be

- provided by welded eye linked rods Tolco Figure 101L, B-Line Figure B3211X, Grinnell Figure 278, or equal.
- c. Domestic cold water piping, water supply and return piping, condenser water piping, insulated refrigerant piping gas piping, compressed air piping, cast iron soil piping, galvanized steel vents, waste and downspout piping and glass to be supported with Tolco Figure 1, B-Line Figure B3100, Grinnell Figure 260, or equal, hangers with rods, turnbuckles and inserts suitable for above hangers.
 - d. Maximum hanger and support spacing shall conform to CPC schedule for horizontal piping installed above grade.
18. A hanger or support shall be installed close to the point of change in direction of a pipe run, in either a horizontal or vertical plane.
 19. When practicable, supports and hangers for cast iron soil pipe shall be installed as close as possible to joints and when hangers or supports are not located within one foot of a branch line fitting, an additional hanger or support shall be installed at fitting.
 20. In systems where grooved piping is used, couplings shall be provided with angle pattern bolt pads to comply with support and hanging requirements of ANSI/ASME B31.1, ANSI/ASME B31.9, and NFPA Pamphlet 13.
- T. Flashings:
1. Each pipe, duct, or gas-fired equipment vent passing through roof shall be installed with waterproof flashing.
 2. Flashing or flanges on pipes, vents, and ducts passing through a tile or slate roof shall be constructed of sheet lead. Flashing for pipes and heater vents passing through a roof shall be 4 pound soft sheet lead. Flashing and flanges for ducts and heater vents passing through exterior walls shall be 22 gage sheet metal. Install caps on top of heater pipes. Flanges and flashing shall be installed waterproof at point of connection with pipe or duct. No soldered joints on roof flashings will be allowed. No Stoneman lead roof flashings will be allowed.3. Lead flashing and flanges shall be constructed of 4 pound sheet lead with burned joints. Flange of lead flashing or lead flange on a duct shall extend out onto roof a minimum of 12 inches from pipe or duct. Lead flashing shall extend up the pipe or duct not less than 8 inches.
 3. Sheet metal flashing shall be constructed of 24 gage galvanized sheet steel. Flanges on these flashings shall extend out onto roof a minimum of 10 inches from pipe or duct. Flanges on ducts through exterior walls shall extend out from duct a minimum of 2 ½ inches. Flanges on gas-fired equipment single-wall vents shall be of ventilated type. Type B gas vents through a roof shall be furnished with non-ventilated flashing as per NFPA Pamphlet 211.
 4. Cast iron, steel, brass, and copper pipe, which terminates less than 18 inches above roof, shall be furnished with a combination counter-flashing and vandal-proof hood for protection against water, birds and foreign matter. Cast iron, steel, brass and copper pipe, which does not terminate within 18 inches of roof, shall be furnished with a counter-flashing sleeve. Pipe, which terminates more than 18 inches above roof, shall be furnished with protection against entrance of water, birds, and foreign matter.
 5. Counter-flashing and combination counter-flashing sleeves and vandal-proof hoods shall be cast iron, vandal-proof, threaded, sealed or approved gas-heated sleeve type.

- Counter-flashing sleeves on each of these items shall extend down over flashing a minimum of $\frac{3}{4}$ inch.
6. Flashing and flanges on ducts shall be installed waterproof at point of connection to the duct by riveting and soldering. Storm collars shall be securely screwed and installed waterproof around appliance vent pipe immediately above flashing.
 7. Vent piping above roof shall be furnished with a combination counter-flashing sleeve and vandal-proof hood.
- U. Equipment Installation: Install roof or floor mounted equipment on level platforms, housekeeping pads or curbs and provide sound, vibration and seismic control measures per Section 23 0548 even if not indicated on Drawings.

End of Section

Section 22 0553
Plumbing Identification

PART 1 – GENERAL

1.01 SUMMARY

- A. Section Includes: Marking and identification on mechanical piping systems, ducts, controls, valves, and apparatus.
- B. Related Requirements:
 - 1. Division 01: General Requirements
 - 2. Section 21 1313: Fire-Suppression Sprinkler Systems.
 - 3. Section 22 0513: Basic Plumbing Materials and Methods.
 - 4. Section 22 1000: Plumbing.
 - 5. Section 22 2013: Plumbing Piping.

1.02 SUBMITTALS

- A. Submit in accordance with Division 01 and Section 22 0500: Common Work Results for Plumbing.
- B. Submit product data and installation instructions for each item specified.
- C. Submit Samples of materials.

1.03 QUALITY ASSURANCE

- A. Comply with provisions of:
 - 1. Section 22 0500: Common Work Results for Plumbing.
 - 2. ANSI/ASME A13.1: Scheme for the Identification of Piping Systems.
 - 3. APWA: Uniform Color Code.
 - 4. IAPMO: Uniform Plumbing Code (UPC)

PART 2 – PRODUCTS

2.01 MATERIALS

- A. General: Piping systems, controls, valves, apparatus, etc., except those that are installed in inaccessible locations in partitions, walls, and floors, shall be permanently identified.

2.02 VALVES

- A. Furnish prepared chart or diagram for each piping system, indicating by identifying letter or model number of each valve in the system, its location, and function.
- B. Install charts in aluminum frame with clear glass front and secure on wall where designated by the Project Inspector.
- C. Bind copies of each chart in operating instructions manual.
- D. Provide each valve with a brass, aluminum, or plastic disc, not less than 1-1/4 inches diameter bearing engraved numbers corresponding to those indicated on chart. Fasten discs to valve with No. 14 brass wire.
- E. Provide an additional tag for safety valves and other valves that could be hazardous to safety and health of occupants. Distinguish these tags from regular valve tags by color (such as yellow with black letters, and marked "Danger"); submit Sample tag to the Architect for review.

2.03 INSTRUMENTS AND CONTROLS

- A. Identify panel-mounted instruments and controls with engraved bakelite nameplates permanently affixed to panel boards.
- B. Identify alarm indicating devices and alarm reset devices by nameplates.
- C. Identify automatic valves, flow switches, and pressure switches, with embossed aluminum or plastic tape affixed to controller, indicating service and setting.

2.04 EQUIPMENT

- A. Identify each major piece of equipment with engraved bakelite nameplates permanently affixed to the equipment, indicating the room numbers it services, Equipment identification designation shall be the same to its designation indicated on the “As-Built Drawings”. Room numbers in the nameplates shall correspond to the final room numbers.

2.05 ABOVE GRADE PIPE IDENTIFICATION

- A. Identify pipes by means of colored labels with directional flow arrows and identification of the pipe content, in conformance to ANSI/ASME A13.1 or the UPC.
- B. Materials: Precoiled acrylic plastic with clear polyester coating, all-temperature, self-adhering, as manufactured by Brady, Brimar Industries, Seton, Stranco, Inc., or equal.
- C. Size:

Outside Diameter of Pipe or Insulation (in inches)	Length of Color Field (in inches)	Size of Letter (in inches)
¾ to 1 ¼	8	½
1 ½ to 2	8	¾
2 ½ to 6	12	1 ¼
8 to 10	24	2 ½
over 10	32	3 ½

- D. Locations:
 - 1. On accessible piping, whether insulated or not (including mechanical rooms, attic and ceiling spaces); except that labels shall be omitted from piping where contained material is obvious due to its connection to fixtures (such as faucets, water closets, etcetera.).
 - 2. Near each valve and branch connection in such accessible piping.
 - 3. At each pipe passage through wall or floor.
 - 4. At not more than 20 feet spacing on straight pipe run between bands required in 2 and 3 above.
 - 5. At each change in direction.
- E. Application: Install on clean surfaces free of dust, grease, oil, or any material that will prevent proper adhesion. Replace non-adhering or curling labels with new labels.

F. Color Schedule:

Content of Pipe	Legend	Background Color	Lettering Color
Domestic cold water	Domestic. C.W.	Green	White

Non-potable cold water	Caution: Non-potable Water Do Not Drink (1)(2)	Purple	Black
Domestic hot-water 140°F	Domestic H.W. 140°F	Blue	Black
Sanitary waste	San waste	Green	White
Sanitary vent	San vent	Green	White
Storm drain or downspout	Storm drain	Green	White
Indirect drain	Ind drain	Green	White
Sump pump discharge	Pump discharge	Green	White
Fire sprinkler supply	Fire Sprinkler supply	Red	White
Fire sprinkler drain	Sprinkler drain	Red	White
Fuel oil	Diesel oil	Yellow	Black
Gas	Gas	Yellow	White
Reclaimed Water	Caution: Reclaimed Water Do Not Drink (1)(3)	Purple	Black

H. Notes on Schedule:

1. Note (1) indicates 2 ¼ inch by 1 inch yellow label with ½ inch letters reading UNSAFE WATER at one end of primary label.
 Note (2) words should read “CAUTION: NONPOTABLE WATER DO NOT DRINK.” with international *do not drink* symbol.
 Note (3) words should read “CAUTION: RECLAIMED WATER DO NOT DRINK.” with international *do not drink* symbol.

2.06 UNDERGROUND PIPE

A. Detectable Marking Tape:

1. Provide and install detectable marking tape along buried piping. Tape shall be specifically manufactured for marking and locating underground utilities with electronic equipment. Tape shall be acid and alkali resistant, and manufactured with integral wires or foil backing, encased with protective cladding. Tape shall be a minimum of two inches in width.
2. Manufacturer: Reef Industries, Inc., Advantage Brands, Inc., Northtown Company, Mutual Industries, Inc., or equal.
3. Detectable marking tape shall be color-coded per APWA Color Code:
 - a. Yellow: Oil and gas.
 - b. Blue: Water, irrigation and slurry lines.
 - c. Green: Sewer and drain lines.

B. Tracer Wire:

1. Solid copper wire type THWN, 12 AWG gauge, with heat and moisture resistant insulation.

PART 3 – EXECUTION

3.01 INSTALLATION

- A. Correct detrimental conditions prior to commencing the Work of this Section. Install markers and identification tags as specified with materials and installation procedures recommended by manufacturer.
- B. Place tracer wire on top of non-metal utility lines allowing some slack. Do not wrap tracer wire around pipe. Fasten tracer wire in place at approximately 10 feet on centers with non-metal ties.
- C. Install underground detectable pipe marking tape continuously buried 8 to 10 inches above the buried utility pipe. Wrap tape on pipe risers up to a height of 12 inches above grade.

3.02 CLEANUP

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

End of Section

Section 22 0700
Plumbing Insulation

PART 1 – GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Insulation for plumbing piping.
- B. Related Requirements:
 - 1. Division 01: General Requirements.
 - 2. Section 22 0500: Common Work Results for Plumbing.
 - 3. Section 22 0513: Basic Plumbing Materials and Methods.
 - 4. Section 22 0553: Plumbing Identification.
 - 5. Section 22 1000: Plumbing.

1.02 REFERENCES

- A. American Society for Testing and Materials International (ASTM):
 - 1. ASTM C302 - Standard Test Method for Density and Dimensions of Preformed Pipe-Covering-Type Thermal Insulation.
 - 2. ASTM C411 - Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.
 - 3. ASTM C423 - Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.
 - 4. ASTM C533 - Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation.
 - 5. ASTM C547 - Standard Specification for Mineral Fiber Pipe Insulation.
 - 6. ASTM C1104 - Standard Test Method for Determining the Water Vapor Sorption of Unfaced Mineral Fiber Insulation.
 - 7. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
 - 8. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.
- B. Underwriters Laboratories, Inc.
 - 1. UL 723 - Test for Surface Burning Characteristics of Building Materials.
- C. National Fire Protection Association:
 - 1. NFPA 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials.
- D. California Code of Regulation Title 24.
 - 1. California Green Building Standards Code.

1.03 SUBMITTALS

- A. Submit in accordance with Division 01 and Section 22 0500: Common Work Results for Plumbing.
 - 1. Complete material list of items to be furnished and installed under this Section.

2. Manufacturer's specifications and other data required demonstrating compliance with the specified requirements.
3. Shop Drawings, catalog cuts and manufacturer's data indicating insulation, jacketing, adhesives, and coating. Insulating materials shall be certified by manufacturer to comply with the California quality standards for insulating materials.
4. Display sample cutaway sections.
5. Manufacturer's recommended method of installation procedures, which will become part of this Section.

1.04 QUALITY ASSURANCE

- A. Qualifications of Manufacturer and Installer, Materials, Fabrication, Execution, and Standard of Quality: Comply with provisions stated under Section 22 0500: Common Work Results for Plumbing and Section 22 0513: Basic Plumbing Materials and Methods.
- B. Insulation Work shall be in accordance with the California Building Energy Efficiency Standards, CBC, and Uniform Mechanical Code and the California Green Building Standards Code.
- C. Test Ratings:
 1. Comply with provisions stated under Section 22 0500 and 22 0513 with emphasis on ASTM E84, NFPA 255, or UL 723. ASTM C167, ASTM C302, UL label or listing of satisfactory test results from the National Institute of Standards and Technology, or a satisfactory certified test report from an acceptable testing laboratory. Approval by the State Fire Marshal is required.
 2. Furnish labels, legibly printed with the name of the manufacturer or listings indicate that fire hazard ratings do not exceed those specified for materials proposed for installation. Flame spread index of not more than 25 and smoke developed rating not exceeding 50.
 3. Tests shall be performed on each item individually when insulation, vapor barrier covering, wrapping materials, or adhesives are installed separately at the Project site.
 4. Test insulation, vapor barrier covering, wrapping materials and adhesives as an assembly when they are factory composite systems.
- D. Regulatory Requirements: Insulation furnished and installed under this Section shall meet minimum legal requirements of the Building Energy Efficiency Standards adopted and incorporated in the California Energy Commission, Title 24, Part 2, Chapters 2 through 53 and the California Green Building Standards Code unless otherwise noted, for the piping,
- E. Chemically based products such as sealers, primers, fillers, adhesives, etcetera must meet the California air quality regulations.

1.05 PRODUCT HANDLING

- A. Protection, Replacement, Delivery and Storage: Comply with provisions stated under Sections 22 0500: Common Work Results for Plumbing and 22 0513: Basic Plumbing Materials and Methods.

PART 2 – PRODUCTS

2.01 MATERIALS

- A. General:
 1. Insulating material shall be fire resistant, non-corrosive, shall not break, settle, sag, pack or disintegrate under vibration, nor absorb more than 1 percent moisture by weight.
 2. Insulating material shall be furnished with thickness indicated in Table 1, and shall furnish thermal resistance in the range of R-4.0 to 4.6 in accordance with inch at 75 degrees F. For

any other value of R, insulation thickness shall be calculated accordingly and submitted for review.

3. Asbestos in any quantity in insulating material is not permitted.
4. Provide insulation materials, adhesives, coatings, sealants, fitting covers, and other accessories with a fire hazard rating not to exceed 25 for flame spread, 25 for fuel contributed and 50 for smoke developed, except for materials listed as follows:
 - a. Nylon anchors for installing insulation to equipment.
 - b. Treated wood blocks.
5. Flame-proofing treatments subject to moisture damage are not permitted.

TABLE 1 - MINIMUM PIPING INSULATION THICKNESS ⁽¹⁾

Insulation Thickness Required (in inches)

Piping System Type	Temp. Range (degrees F)	Runouts up to 2 ⁽²⁾	1 and less	1.25 to 2	2.5 to 4	5 to 6	8 and larger
Service Water Heating Systems (recirculating, piping supply and return)							
Hot Water	Up to 180	0.5	1.0	1.0	1.5	1.5	1.5
Condensate Drain	½ inch minimum insulation thickness.	0.5	0.5	0.5	0.5	0.5	0.5
From A/C Equipment:	Insulate condensate drain lines within building, in room, inside walls and above ceilings.	0.5	0.5	0.5	0.5	0.5	0.5

NOTES: (1) For piping exposed to ambient temperatures, increase thickness by 0.5 inch.

(2) Runouts to individual terminal units, not exceeding 12 feet in length.

- B. Lagging Adhesives: Shall be nonflammable and fire-resistant and shall have a maximum flame spread index of 25 and a maximum smoke developed index of 50 when tested in accordance with ASTM E84. Insulation finished with canvas shall be provided with laps adhered in accordance to manufacturer's recommendation. A finish coat of same material shall be applied to entire outer surface of lagging cloth at coverage specified by manufacturer.
- C. Canvas Jackets: Provide 6 ounce, in accordance with square foot minimum, 48 by 48 thread count canvas jacketing.
- D. Insulation Jackets:
 1. Exterior insulation exposed to weather shall be weatherproofed with Childers aluminum jacketing as basis of design, or Pabco, RPR, or equal. Jacketing shall be manufactured from 1100, 3105 or 5010 aluminum alloy with 3/16 inch corrugations. Smooth or embossed jackets may be permitted in special situations to match an existing installation. Jacketing shall be furnished with an integrally bonded moisture barrier over entire surface in contact with insulation. A minimum thickness of 0.016 aluminum jacketing is to be provided on ducts and piping. A minimum thickness of 0.020 shall be provided on tanks, equipment, and heat exchangers.

- 2. Insulated elbows, of 90 degrees and 45 degrees, with a nominal iron pipe size of ½ inch to 8-inch shall be provided with Childers aluminum Ell-Jacs insulation covers as basis of design, or Pabco, RPR, or equal, manufactured from 1100 aluminum alloy of 0.024 inch thickness. Insulated elbows with a nominal pipe size of 10-inch to 18-inch shall be provided with Childers 4-piece aluminum Ell-Jacs as basis of design, or Pabco, RPR, or equal.
- 3. Tees, Flanges, and Valve Insulation in Conjunction with Aluminum Jacketing: Furnish Childers Aluminum Special Fabrications Insulation Covers as manufactured by Childers Products Company, Pabco, RPR, or equal.
- E. Adhesives: Adhesives shall be water based, UL Classified, meet the requirements of NFPA 90A and NFPA 90B, have been tested according to relevant ASTM requirements, and be acceptable to the State Fire Marshal. Name, type and method of installation shall be submitted for review.
- F. Valve and Fitting Cover: When installed in conjunction with PVC jacketing, furnish Zeston 25/50 rated polyvinyl chloride fitting covers as manufactured by Johns Manville, Knauf Insulation, Speedline, or equal.

2.02 DOMESTIC HOT WATER PIPING SYSTEM INSULATION

- A. General: Insulate domestic hot water supply and return piping, including valves, strainers and fittings with insulation thickness as indicated on Table 1.

B. Materials:

1. Classes of Insulation:

- a. Class A: Glass fiber molded pipe insulation suitable for service temperatures up to 850 degrees F. Pipe insulation shall be one piece, preformed, and provide a minimum R factor of 4.0 at 75 degrees F mean temperature. Insulation shall be faced with all-purpose fire retardant vapor barrier jacket. Pipe insulation shall be Johns Manville Micro-Lok, Knauf Redi-Klad 1000, Owens Corning FIBERGLAS Pipe Insulation SSL II-ASJ, or equal.
- b. Class B: Flexible open-cell melamine (foam insulation) suitable for service temperature -150 degrees F to 400 degrees F. Thermal conductivity at 75 degrees F, K= 0.26. Pipe insulation, one-piece pre-formed, laminated to heavy non-reinforced PVC jacket, with locking track, factory installed to jacket, to snap insulation and jacket onto pipe. Similar to TechLite 079 Series as manufactured by Accessible Products Co., or equal. Installation shall comply with manufacturers recommendations.
- c. Class C: Mineral fiber pipe insulation suitable for service temperatures up to 1200 degrees F. Pipe insulation shall be one-piece, preformed up to 3 inches thick, and provide a minimum R factor of 4.0 at 75 degrees F mean temperature. Insulation shall be faced with all-purpose fire-retardant vapor barrier jacket. Pipe insulation shall be 8 pounds in accordance with cubic foot density by Roxul Tehton 1200, Fibrex COREPLUS 1200, Industrial Insulation Group, LLC (IIG) MinWool-1200, or equal.

2. Locations and Class of Insulation Required:

TABLE 2 – LOCATIONS AND CLASS OF INSULATION REQUIRED

<u>LOCATION</u>	<u>CLASS OF INSULATION</u>
Equipment Room	A, B or C

Other Locations	A, B or C
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3. Fittings on indoor piping shall be covered with flush, hand-wrapped Class A, B, or C insulation, to match the adjoining pipe insulation and covered with polyvinyl chloride fitting covers: Zeston 2000 25/50 by Johns Manville, Knauf Insulation Proto PVC Fitting Cover, Speedline Polyco Smoke Safe, or equal.
4. Adhesive: Fibrous Adhesive to bond calcium silicate to itself and non-porous surfaces.

PART 3 – EXECUTION

3.01 INSTALLATION

- A. Except as specified herein, install material in accordance with recommendations of manufacturer. Do not install insulation materials until tests specified in other sections are completed. Remove foreign material such as rust, scale, or dirt. Surfaces shall be clean and dry. Maintain insulation clean and dry at all times.
- B. On cold surfaces where a vapor barrier must be provided and maintained, insulation shall be installed with a continuous, unbroken moisture and vapor seal. Hangers, supports, anchors, or other projections that are fastened to cold surfaces shall be insulated and vapor sealed to prevent condensation.
- C. Surface finishes shall be extended in such a manner as to protect raw edges, ends, and surfaces of insulation.
- D. Pipe or duct insulation shall be continuous through walls, ceiling or floor openings, or sleeves; except where firestop or firesafing materials are required.
- E. Metal shields shall be installed between hangers or supports and the piping insulation. Rigid insulation inserts shall be installed between the pipe and the insulation shields. Inserts shall be of equal thickness to adjacent insulation and shall be vapor sealed accordingly.
- F. Insulation shall not be installed in the following locations unless otherwise noted:
 1. On unions, flanged connections or valve handles.
 2. Over edges of any manhole, clean-out hole, clean-out plug, and to restrict opening or identification of access.
 3. Over any label or stamp indicating make, approval, rating, inspection, or similar data, unless provision is made for identification and access to label or stamp.

3.02 INSTALLATION OF DOMESTIC HOT WATER PIPING SYSTEM INSULATION

- A. General: Domestic hot water, tempered water supply and return piping and condensate return piping, after having been tested, shall be cleaned and insulated.
- B. Application: Insulate condensate return piping, domestic hot water supply and return, including tempered supply and return piping in accordance with manufacturer's instructions and as specified herein.
 1. Install insulation on valve bodies up to valve bonnet. Fill void in saddles, in accordance with Section 22 0513: Basic Plumbing Materials and Methods, with insulation and seal joints.
 2. Install insulating material to fittings, valves, and strainers and smooth to thickness of adjacent covering. Leave strainer clean-out plugs accessible. Covers fabricated from polyvinyl chloride shall be furnished.
- C. Insulation Jackets in Exposed Indoor Locations:

1. Cover completed insulation with canvas jacket tightly pasted to covering with lagging adhesive. Lap jacket seams 1 1/2-inch minimum. Finish entire jacket with coating of undiluted adhesive.
 2. Equivalent factory applied pre-sized, glass fiber reinforced, or glass fiber jackets may be furnished. Seal jacket seams with adhesive in accordance with manufacturer's instructions.
 3. Johns Manville Zeston 2000, Knauf Insulation Proto PVC Fitting Cover, Speedline Polyco Smoke Safe, or equal, fitting covers may be furnished, with molded or segmented insulation equal to specified insulation applied to fittings. Secure covers in accordance with manufacturer's instructions.
 4. In addition to above requirements, cover exposed insulated piping within a distance of 8 feet above floors with 26 gage galvanized steel jacket. Omit jacket in areas accessible only to maintenance personnel, such as mechanical equipment rooms, utility corridors, accessible pipe tunnels and manholes.
- D. Concealed Indoor Locations: Cover insulation over fittings, valves, and strainers with canvas. Provide pipe insulation with factory or field applied standard jacket of 4 ounce minimum canvas, fiberglass cloth, or glass fiber reinforced jacket. Seal jacket laps with adhesive in accordance with manufacturer's instructions.
- E. Exposed Outdoors: In addition to canvas or fiberglass cloth cover, pipe insulation exposed to weather shall be provided with an additional 0.016 inches thick aluminum jacket with 2-inch lap connected with one inch hem overlap joint located on side of pipe and turned down to shed water. Jacket shall be strapped 12 inches on center with 1/2-inch wide stainless steel strapping and wing seals. Aluminum jacket shall be mitered to fit fittings.

3.03 CLEANUP

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

3.04 PROTECTION

- A. Protect the Work of this Section until Substantial Completion.

End of Section

Section 22 1000

Plumbing

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes: Labor, materials, tools, and equipment to install plumbing systems as indicated.
- B. Related Sections:
 - 1. Division 01 - General Requirements.
 - 2. Section 07 9200: Joint Sealants.
 - 3. Section 11 4013: Food Service Equipment.
 - 4. Section 22 0500: Common Work Results for Plumbing.
 - 5. Section 22 0513: Basic Plumbing Materials and Methods.
 - 6. Section 22 0548: Vibration and Seismic Control for Plumbing Piping and Equipment.
 - 7. Section 22 0553: Identification for Plumbing piping and Equipment.
 - 8. Section 22 0700: Plumbing Insulation.
 - 9. Section 23 8000: Heating, Ventilating and Air Conditioning Equipment.
 - 10. Section 31 2323: Excavation, Backfill for Utilities.
 - 11. Section 33 3000: Site Sanitary Sewer Utilities.

1.02 SUBMITTALS

- A. Provide in accordance with Division 01 and Section 22 0500: Common Work Results for Plumbing.
- B. Provide necessary documentation to Owner for processing rebates for water efficient fixtures.

1.03 QUALITY ASSURANCE

- A. Unless otherwise noted, the California Plumbing Code is hereby made part of this section.
- B. Conform to provisions of Section 22 0500: Common Work Results for Plumbing.
- C. Manufacturer of plumbing products must be third-party certified to ANSI/NSF Standard 61, Section 9 certification, and ANSI/NSF 372 to demonstrate compliance with the federal requirements for lead contribution to drinking water, the Safe Drinking Water Act SDWA, and the California Health and Safety Code Section 116875.

1.04 PRODUCT HANDLING

- A. Conform to provisions of Section 22 0513: Basic Plumbing Materials and Methods.

PART 2 - PRODUCTS

2.01 PIPING SYSTEMS

- A. Materials: Refer to Section 22 0513: Basic Plumbing Materials and Methods.
- B. Insulation for Piping: Refer to Section 23 0700: Plumbing Insulation.

2.02 FIXTURES AND DRAINS

- A. General: Fixtures specified shall be furnished complete with trim and fittings. Cast iron plumbing fixtures shall be acid resistant enamel, and identified by casting letters "AR" or

words "acid-resistant" into metal. Fixtures shall be white unless otherwise specified. Cast iron fixtures shall be white enamel inside and on back, rim and apron, with exposed unfinished surfaces painted white. Fixtures of same general classifications shall be of same make.

B. Finished Brass:

1. Unless otherwise specified, finished brass of a similar type shall be of same manufacturer and model throughout buildings.
2. Finished and exposed brass equipment, except floor, shower and urinal drains shall be chromium-plated and polished. Floor, shower and urinal drains, unless otherwise specified, shall be nickel-bronze metal.

C. Traps, Trap Arms and Tailpieces:

1. Fixture traps shall be all cast brass, chromium-plated and polished. (No tubular traps). Exceptions as follows:
 - a. Traps that are an integral part of a fixture.
 - b. Traps concealed in floors, walls and furring.
 - c. Traps standard for service sinks and Industrial Shop equipment.
 - d. Laboratory traps and tailpieces shall be as specified in section 22-0513 "Basic Plumbing Materials and Methods".
2. Concealed traps and 17 gage tailpieces may be rough brass finish, except as otherwise specified. Laboratory traps and tailpieces shall be as specified in Section 22-0513: Basic Plumbing Materials and Methods. Furnish chromium-plated and polished cast brass wall flanges with setscrews and chromium-plated and polished brass casing on discharge side of each trap.
3. Tailpieces shall be not lighter than 17 gage, brass, chromium-plated, and polished. Furnish and install chromium brass plated wall flanges with set screws and chromium-plated 20 gage brass casing on discharge side of each chrome-plated all cast trap.

D. Faucet and Shower Valve Handles: Faucet and shower valve handles shall be solid brass, chromium-plated and polished, and fastened to their stems by Allen type hollow head stainless steel set screws through the side of the handle extending into the stem. Handles with sharp edges or projections shall not be furnished. At accessible fixtures: handles shall be operable with one hand and shall not require tight grasping, pinching, or twisting of the wrist. The force required to activate handles shall be 5 pounds maximum.

E. Fixture Supplies:

1. Supplies for water heaters shall be unplated rigid copper water tube with threaded adaptors for connections to valves and other threaded connections. All other supplies shall be chromium-plated brass with hospital threads or shall be furnished with fittings and valves, which completely cover threads.
2. Exposed supplies for showers shall be chromium-plated brass pipe up to header with hospital threads or shall be furnished with fittings and valves, which completely cover threads.
3. Supplies to water closet tanks, lavatories, and drinking fountains shall be furnished with a NSF 372/61 threaded brass nipple. Exposed unfinished piping shall be sleeved with chrome plated brass or copper cover casing and have an appropriate escutcheon for a clean finished appearance. Angle/straight valve stops shall be

female 1/2 IPS (inlet) by 3/8 compression (outlet). Fixture supplies shall be polished chrome-plated, solid supply bulbed end risers with size compatible supply nut connection to fixture and 3/8 O.D. compression nut and ferrule connection to angle stop outlet. Stainless steel flexible braided connectors with re-enforced PVC inner hose are not allowed.

4. Hot and cold water fitting supply outlet piping serving water closets, urinals, lavatories, drinking fountains, sinks, faucets, hose bibs, and sillcocks shall be iron pipe size (IPS) brass nipple, and piped in such a manner that through wall water supply outlet piping be removable, size appropriate, and lead free. The use of copper, copper MIP sweat adapters or similar fittings, in lieu of brass nipples is not allowed. The IPS brass nipple shall be directly connected to the fixture as follows:
 - a. Control stops for water closet and urinal flush valves.
 - b. Angle stop for lavatories, sinks and drinking fountains.
 - c. Shank/arm adapters for wall mounted sink faucets.
 - d. Iron pipe size (IPS) brass nipple connection for hose bibs, sillcocks, and other plumbing related fixture and/or plumbing fitting water supply outlets.
5. Water supply pipe that penetrates a finished surface, wall, countertop or part of a cabinet shall be appropriately sized polished chromium-plated cover casing and wall flange/escutcheon fitting tight to the brass through wall nipple and securely affixed to the finished wall surface.
6. Water supplies of plumbing fixtures shall be protected against back-siphonage in event of a vacuum in piping system. Toilet and urinal flush valves shall be furnished with recognized atmospheric vacuum breakers, installed a minimum of 6 inches above fixture.
7. Discharge outlets of supply faucets for lavatories and sinks shall clear top of overflow rim by at least one inch.

2.03 ACCESS PLATES (To cleanouts, valves, water hammer arrestors and hose faucets)

A. Schedule Numbers:

AP-1: Square, unless otherwise noted, steel, prime coated; frame, 18 gage minimum. Door shall be 16 gage minimum with concealed hinge or be removable, with vandal-proof lock operated by Allen wrench. **(Specify for painted and stucco walls.)**

SMITH	ZURN	ELMDOR	MILKOR	WATTS	MIFAB	JOSAM
Fig 4760 AK	Z-1462- VP	DW-AKL	MOR DW AK1	CO-300- S-6	UA-A	58650-VP OR EQUAL

AP-2: Round type, stainless steel, vandal-proof, 5/16 inch No. 18 or 1/4 inch No. 20 flat-head machine screw into cleanout plug. Plate shall be prime coated minimum 18 gage steel or polished chrome-plated brass, 18-8 No. 302 stainless steel, or polished nickel bronze.

(To be specified for painted walls, screwed into cleanout plug.)

SMITH	ZURN	JOSAM	WADE	WATTS	MIFAB	OR EQUAL
4710U	Z-1469- VP	58600	8480R	CO-480- RD-6	C1400-RD-6	

AP-3: Square, polished face chrome-plated bronze, aluminum alloy or brass chrome-plated brass frame with 14 gage polished 18-8 No. 302 stainless steel or brass chrome-plated secured

cover with vandal-proof screws.
 (To be specified for tile walls.)

SMITH	ZURN	WADE	WATTS	MIFAB	JOSAM	OR EQUAL
4735U	Z-1460-VP	58630	CO-300-S-6	C1400-S-3-6	58640-VP	

AP-4: Square, floor type, cast nickel-bronze aluminum alloy or brass, with Carborundum or Scoriated, secured top.

(To be specified for floor access to solid interceptor in Science Room, Ceramic Room, and Agriculture Room.)

SMITH	ZURN	JOSAM	WATTS	MIFAB	OR EQUAL
4910U	Z-1461-VP	58630	CO-300-S-6	C1300-S-6	

2.04 BACKFLOW PREVENTION ASSEMBLIES: NOT USED

2.05 BACKWATER SEWER VALVE ASSEMBLY: NOT USED

2.06 CLEANOUT ASSEMBLIES

- A. Cleanout plug shall be line size.
- B. Schedule Numbers:

CO-1: Iron body cleanout tee full line size up to 4 inches and round access plate, plugs shall be brass, countersunk with tapped boss for 5/16 inch No. 18 or 1/4 inch No. 20 screws. (Specify for finished walls at base of waste stack, above urinal and service sink.) AB&I and TYLER may be used as iron body cleanouts. Trim and accessories shall be Smith or Zurn or equal.

SMITH	ZURN	WATTS	MIFAB	JOSAM	OR EQUAL
4532-U	Z-1446-BP	CO-460-RD-34B	C1460-RD-6	58600-CO	

CO-2: Iron body with approved UPC plug, top and adjustable sleeve, cut-off ferrule, polished scoriated brass nickel bronze secured cover. AB&I and TYLER may be used as iron body cleanouts. Trim and accessories shall be Smith or Zurn or equal (To be specified for finished floors inside buildings, in covered areas, and in concrete paving.)

Square:

SMITH	ZURN	WATTS	MIFAB	JOSAM	OR EQUAL
4053L-U-NB	ZN-1400-T	CO-200-S	C1220-S-1-6	55000-1-SQ	

Round:

SMITH	ZURN	WATTS	MIFAB	JOSAM	OR EQUAL
4033-L-U-NB	ZN-1400	CO-200-R	C1220-1-6	55000-1	

CO-3: Secured cover, extra heavy-duty, adjustable sleeve, cut-off ferule, UPC. Brass approved type plug, scoriated tractor type cover.

(To be specified for areas outside building on concrete paving.)

SMITH	ZURN	WATTS	MIFAB	JOSAM	OR EQUAL
4233-U	ZN-1400-HD	CO-200-RX-4	C1220-4-6	55000-22	

CO-4: Tapped soil tee with brass plug, full line size.

(Specify for above grade, outside building at base of exposed downspout.)

SMITH	ZURN	WATTS	MIFAB	JOSAM	OR EQUAL
4512	Z-1445-BP	CO-460-34A	C1460	58910	

CO-5: Raised threaded head brass plug.

(To be specified for yard box YB-3.)

ZURN	WATTS	SMITH	JOSAM	OR EQUAL
Z-1470-A	CO-590	4285	58540-20	

2.07 CIRCULATING PUMPS, HOT WATER HEATING SYSTEM: NOT USED

2.08 DRINKING FOUNTAINS: NOT USED

2.09 DRUM TRAPS: NOT USED

2.10 DIELECTRIC UNIONS: NOT USED

2.11 EMERGENCY EYE WASH / EMERGENCY SHOWER: NOT USED

2.12 ELECTRIC WATER COOLERS: NOT USED

2.13 FAUCETS: NOT USED

2.14 FLOOR DRAINS

A. Schedule Numbers:

FD-1: Cast iron body, no hub with seepage pan and flat, round nickel bronze strainers not less than 5-inch diameter for 2-inch outlet bodies, 7-inch for 3-inch outlet bodies and 8-inch for 4-inch outlet bodies, with maximum of ½ inch square holes or slots not larger than ¼ inch by 1 ¼-inch.

SMITH	OR EQUAL
2005Y-A	

2.15 FLEXIBLE HOSES: NOT USED

2.16 FLUSH VALVE ASSEMBLY: NOT USED

2.17 FLOOR SINKS

A. Schedule Numbers:

FS-1: Round, cast iron, acid-resistant enamel body with bottom aluminum dome strainer, less grate.

SMITH	OR EQUAL
2005	

2.18 GREASE TRAPS (INTERCEPTORS) AND SAMPLE BOX

A. Schedule Numbers:

GI-1: Pre-fabricated reinforced concrete with cast iron fittings, with manholes brought to grade. Size and capacity as indicated on Drawings. City of Thousand Oaks approved.

JENSEN	OR EQUAL
JP750G	

SB-1:

JENSEN	OR EQUAL
EV200	

2.19 HOSE BIBBS

A. Schedule Numbers:

HB-1: For plaster or stucco wall, furnished with box and stop, exposed trim chrome-plated, with or without door and with vacuum breaker.

(To be specified for use in swimming pool area, outside eating area and at 75 feet spacing around exterior building walls.)

ACORN	WOODFORD	PRIER	OR EQUAL
8141, 8151	B75	C-633NFC	

HB-2: For brick, CMU and poured in place concrete walls, furnished with box and stop, exposed trim chrome-plated, with or without door and with vacuum breaker.

(To be specified for use in swimming pool area, outside eating and 75 feet spacing around exterior building wall.)

ACORN	WOODFORD	PRIER	OR EQUAL
8141, 8104, 8151	B75	C-633NFC	

HB-3: ASTM B 62 bronze body, rubber composition disc or renewable seat, straight nose with brass die cast or enamel iron hand wheel and with vacuum breaker.

(To be specified for use for Lath House.)

ACORN	ZURN	WOODFORD	PRIER	OR EQUAL
8131-RBVB	Z-1343-VB	Y24	C-155	

HB-4: Same as HB-3 except furnish loose key stop and lockshield.

(To be specified for use at animal wash-down areas.)

ACORN	ZURN	WOODFORD	PRIER	OR EQUAL
8131-LK-RBVB	Z-1343-VB-LK	Y24 WITH LOOSE TEE KEY	C-155	

HB-5: Same as HB-3 except furnish with bent nose.
(To be specified for use at roof top AC Unit, Mechanical Equipment Room, Boiler Rooms, etc.)

ACORN	ZURN	CHAMPION	PRIER	OR EQUAL
8126-LK-RBVB	Z-1343-VB-LK	B-401 LK	C-255NP	

HB-6: Same as HB-4 except furnish with bent nose and loose key handle.

(To be specified for use in exterior Agricultural Plot.)

ACORN	ZURN	CHAMPION	PRIER	OR EQUAL
8126-LK-RBVB	Z-1343-VB-LK	B-401LK	C-255NP	

HB-7: Renewable seat, rough chrome finish, bronze body, flanged 3/4 inch I.P.S. with Female thread inlet, loose key, and vacuum breaker.

ACORN	CHICAGO	WOODFORD	PRIER	OR EQUAL
8121-CR	No. 387-E-27	No. 24P-CH-TK	C-255CP	

HB-8: Recessed hose box furnished with wall flange and built-in drip lip. Box shall be one piece construction; door shall have a recessed cam lock. Door shall remain up and out of the way when in fully opened position. Valve shall be replaceable loose key wheel handle and screwdriver stop. Install within 2 feet above finished floor. Provide vacuum breaker.

(To be specified for use in Toilet Rooms.)

ACORN	WOODFORD	PRIER	OR EQUAL
Hose box 8104 or 8151	B75	C-634BX1	

2.20

LAVATORIES

- A. Access compliant faucets for Lavatories: Force to activate controls shall be no greater than 5 pounds. Self-closing metering, when specified, to remain open 10 seconds minimum when activated.
- B. Cast Iron Lavatories shall be acid resistant enamel and shall conform to Commercial Standards CS 77.63. Unites furnished in conjunction with strainer installation or faucet installation shall be brass. Exposed brass nuts shall be chrome plated.
- C. Exposed trim shall be free from sharp edges or points. Fixture shall be furnished with other listed manufacturer specified trim. Instead of solid supply pipe, polished chrome-plated risers, 3/8 inch outside diameter with ferrule stop end and metal nosepiece may be furnished.
- D. Insulate cold water, hot water and drain lines under all access compliant lavatories with approved type insulation.

PLUMBEREX	LAV-GUARD	OR EQUAL
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Schedule Numbers:

L-1: 20-inch by 18-inch cast iron, acid-resistant enamel lavatory, with 4-inch center set combination push button metered faucet, supplied with hot and cold water, complete with cast iron hangers. **(To be specified for non-accessible installations).**

Bowl	KOHLER K-2035-4	OR EQUAL
Faucet	CHICAGO 3300- ABCP	OR EQUAL
Drain	KOHLER K-7715	OR EQUAL

L-2: 20-inch by 18-inch cast iron, acid resistant enamel lavatory with 4-inch center set combination push button metered faucet, supplied with hot and cold water complete with cast iron hangers. **(To be specified for access compliant installations).**

Bowl	KOHLER K-2035-4	OR EQUAL
Faucet	CHICAGO 3300-ABCP	OR EQUAL
Drain	KOHLER	OR

	K-7715	EQUAL
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2.21 LABORATORY GAS VALVES: NOT USED

2.22 LAUNDRY TRAYS AND TRIM: NOT USED

2.23 PIPE HANGERS

- A. Refer to Section 22 0513: Basic Plumbing Materials and Methods.
- B. Schedule Numbers:
 - 1. PH-1: Complete with clamps, inserts, etc.

SUPERSTRUT	UNISTRUT	TOLCO	B-LINE	OR EQUAL
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2.24 P-TRAPS

- A. Schedule Numbers:
 - PT-1: Cast brass complete, chrome-plated.

	AB&A		OR EQUAL
	107		

2.25 PRESSURE REGULATING VALVE ASSEMBLIES: NOT USED

2.26 ROOF DRAINS: NOT USED

2.27 SHOWER ASSEMBLIES: NOT USED

2.28 SERVICE SINKS and TRIM

- A. Schedule Numbers:
 - SS-1: Cast iron, conforming to Commercial Standard CS 77.63 for acid-resistant enamel, 22-inch by 18-inch, with blank back, 2-inch outlet trap standard and rough-plated double faucet with top brace mounted above sink's back, furnished with vacuum breaker and hose end.

Sink	AMERICAN STANDARD 7745.811	OR EQUAL
Faucet	CHICAGO FAUCET #897-RCF	OR EQUAL
Trap Standard	KOHLER K-6672	OR EQUAL

2.29 SINKS and TRIM

- A. For rooms, offices and dining room sinks.
- B. Access compliant faucets for sinks: Force to activate controls shall be no greater than 5 pounds. where specified self closing metering to remain open 10 seconds minimum when activated.
- C. Cast iron sinks shall be acid resistant enamel, and shall conform to Commercial Standards CS 77.63. Units furnished in conjunction with strainer installation or faucet installation shall

be brass. Exposed brass nuts shall be chrome-plated. Refer to the Fixture Supplies paragraph of this section.

- D. Exposed trim shall be free from sharp edges or points. Fixture shall be furnished with other listed manufacturer specified trim. Instead of solid supply pipe, polished chrome-plated risers, 3/8-inches outside diameter with ferrule stop end and metal nosepiece may be furnished.
- E. For access compliant sinks: Insulate cold water, hot water and drain pipes under sinks with City approved type insulation.

PLUMEREX	LAV GUARD	OR EQUAL
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F. Schedule Numbers:

KS-1: Stainless steel, 25-inch by 22-inch by 6-inch, flat rim, with 3 1/2-inch flat strainer, Polished Satin finish, Rear Center drain placement, and Sound Guard.

Sink	ELKAY ECTSRAD25226BG	OR EQUAL
Faucet	AMERICAN STANDARD XAVIER MODEL 9449.301	OR EQUAL

2.30 SEWAGE EJECTORS: NOT USED

2.31 SERVICE STOP GAS VALVES: NOT USED

2.32 SUMP PUMP: NOT USED

2.33 STOP VALVES

A. Stops shall be loose key type, 1/2-inches IPS inlet and outlet chrome-plated brass casting, except as noted.

B. Schedule Numbers:

STV-1: Angle:

CHICAGO,	BRASSCRAFT	NIBCO	OR EQUAL
442-LKABCP		77	

STV-2: Partition:

CHICAGO	T& S BRASS	OR EQUAL
1771-ABCP	B-1028	

STV-3: Straight Type, with Loose Key:

CHICAGO	BRASSCRAFT	T&S BRASS	OR EQUAL
45-LKABCP (1/2 inch)		B-O418	

2.34 THERMOSTATIC MIXING VALVE ASSEMBLIES (TMVA)

A. General: Valve bodies shall be cast brass or bronze valve assembly provided with holding bracket and shall be installed on wall bracket. Valve shall be rough brass or bronze satin sprayed finish unless otherwise noted. Assembly shall include a 3 5/8-inch diameter dial thermometer, color-coded with white face and black letters. The temperature range between 100 degrees F. and 150 degrees F. shall be background in red or red line enclosed. Valve complete with fail safe feature, square shank loose key stops, checks and strainers on both

hot and cold-water inlets and shutoff valve on outlet. Valves shall be sized on a 45 psig (maximum) pressure drop at the following flow rates:

MV-1: SYMMONS MODEL 7-225 (FOR 1/2") OR 7-230 (FOR 3/4").

2.35 TRAP PRIMERS

A. Schedule Numbers:

TP-1: Automatic, multi-trap primer, cast bronze with access panel. Pressure drop of three p.s.i. shall activate trap seal primers. Manufactured by MIFAB, or equal. (Installed in accessible location.)

MIFAB	OR EQUAL
MR-500-NPB	

2.36 URINALS: NOT USED

2.37 WATER CLOSETS

A. General: Water closets shall be vitreous china with Polyvinyl chloride bolt caps. Fixtures with auto-flush valves shall be provided with manual override button.

B. Schedule Numbers:

WC-1: Floor-mounted, 15 to 17 inches height to top of seat for adult use, with flush valve at 1.28 gallons per flush and open front fire retardant white seats.

(To be specified for non-accessible use for adults use)

a. Bowl:

AMERICAN STANDARD	OR EQUAL
MADERA 3461.528	

b. Flush valve: AMERICAN STANDARD 6065.121.002

c. Seat: White, ring thickness including bumpers shall be one inch.

OLSONITE	BEMIS	CENTOCO	OR EQUAL
10SSCTFR	1955 SSFR	AMFR500STSCSS	

WC-2: Floor mounted, access compliant, 17 to 19 inches height to top of seat with flush valve at 1.28 gallons per flush and open front, fire retardant seat.

(To be specified for access compliant use in adults use.)

a. Bowl:

AMERICAN STANDARD	OR EQUAL
MADERA 3461.528	

b. Flush valve: AMERICAN STANDARD 6065.121.002

c. Seat: White, ring thickness including bumpers shall be one inch.

OLSONITE	BEMIS	CENTOCO	OR EQUAL
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10SSCTFR	1955 SSFR	AMFR500STSCCSS	
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2.38 WATER TEMPERATURE CONTROLLERS: NOT USED

2.39 WATER HEATERS / DOMESTIC BOILERS: NOT USED

2.40 WATER HAMMER ARRESTORS

WHA-1: Lead Free Water Hammer Arrestor provided for Headers for Lavatories, Wash Sinks, Wash Fountains, Kitchen Sinks, Service Sinks, Urinals and Water Closets. For sizing purposes size according to manufacturer's recommendations.

SIOUX CHIEF	PPP	JR SMITH	WATTS	JOSAM	OR EQUAL
655 and 656 SERIES	SC SERIES	5005 TO 5050 SERIES	Series LF05 and LF15M2	75000	

2.41 WATER TANKS, HOT – UNFIRED: NOT USED

2.42 YARD BOXES: NOT USED

2.43 FIXTURE CONNECTIONS

A. Branches to individual fixtures shall be of the following sizes (Inches) unless larger sizes are indicated on Drawings:

Fixture	Copper, Cold (Inches)	Copper, Hot (Inches)	Trap and Connections (Inches)	Soil/ Waste (Inches)	Vent (Inches)
WC Flush Valve	1	N/A	4	4	2
Lavatories	1/2	1/2	1-1/2 by 1-1/4	2	1-1/2
Service Sink	1/2	1/2	2	2	1-1/2
Kitchen Sink	1/2	1/2	1-1/2 by 1-1/2	2	1-1/2
Room Sink	3/8	3/8	1-1/2 by 1-1/2	2	1-1/2
Wash Sink	3/4	1/2	1-1/2 by 1-1/2	2	1-1/2
Multiple Drinking Fountains		N/A	1-1/2 by 1-1/2	2	1-1/2
Single Drinking Fountains	3/8	N/A	1-1/2	2	1-1/2

Individual Showers		1/2	2	2	2
Standard Urinals, Wall-Hung Flush Valve:		N/A	N/A	2	1-1/2
Access Compliant Urinals, Wall-Hung Flush Valve:		N/A	N/A	2	1-1/2
Sillcocks	3/4 minimum	N/A	N/A	N/A	N/A

- B. Water headers serving water closets shall be copper water tube, with following size throughout length:
 1. 1-1/2 inches for 2 flush valves.
 2. 2 inches for 3 to 9 flush valves.
- C. Water headers serving urinals shall be of following size throughout length:
 1. 1” for 1 or 2 flush valves.
 2. 1-1/4” for 3 flush valves.
 3. 1-1/2” for 4 to 8 flush valves.
- D. Water headers serving showers shall be same as listed above for urinals.
- E. Water headers serving lavatories shall be of following size throughout length:
 1. 1/2 inch for 2 lavatories.
 2. 3/4 inch for 3 and 4 lavatories.
 3. One inch for 5 and 6 lavatories.
 4. Refer to 2.02.E for fixture supplies.

2.44 HEIGHT OF FIXTURES

- A. Heights for standard fixtures.

Fixture	Adult (Inches)	Secondary (Inches)	Elementary (Inches)	Kindergarten and Younger (Inches)
Toilets, height to top of seat	15 to 17	15 to 17	15	11 to 12
Lavatories, sink top height	32	32	30	25
Drinking Fountains, bubbler height.	38 to 43	40	32	30
Wash Sinks	30	30	28	24
Urinals, lip	24	21	18	N/A

height				
Shower Heads Male (Student and Instructor) From tip of shower head to finish floor.	72	60		
Shower Heads Female (Student and Instructor) From tip of shower head to finish floor.	72	60		
Shower valves	48	48		

B. Heights for access compliant fixtures.

Fixture	Adult Ages 12 and Over (Inches)	Elementary Ages 6 to 11 (Inches)	Kindergarten and Younger Ages 3 to 5 (Inches)
Toilets, center line from wall	17 to 18	15	12
Toilets, height to top of seat	17 to 19	15	11 to 12
Lavatories, sink top height	34 maximum	29 maximum	24 maximum
Lavatories, sink knee clearance	27 minimum	24 minimum	19 minimum
Urinals, lip height	17 maximum	15 maximum	13 minimum
Urinals, flush handle height	44 maximum	37 maximum	32 maximum
Drinking fountains, bubbler height.	36 maximum	32 maximum	30 maximum
Drinking fountains, knee clearance	27 minimum	24 minimum	22 minimum
Wash Sink	Per Drawings		
Shower Valves	Per CBC		
Shower Seat	Per CBC	Per CBC	Per CBC
Shower Head (adjustable) Bar	Per CBC		

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine areas and conditions under which Work of this section will be performed. Correct conditions detrimental to proper and timely completion of Work. Do not proceed until unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. General:
 1. Unless otherwise specified, plumbing fixtures, equipment and appliances that require connections to plumbing line shall be connected. This shall include fixtures specified or indicated as furnished by others, furnished by Owner, or specified in

- other related sections. Install supplies, stops, valves, traps, wall flanges, or pipe casing for connection of this equipment.
2. Install equipment as indicated on reviewed and accepted Shop Drawings.
 3. Avoid interference with Work of other trades. Do not deviate from Drawings without review of the Architect.
- B. Examination: Check each piece of equipment in system for defects verifying that parts are properly furnished and installed.
- C. For piping Work, refer to Section 22 0513: Basic Plumbing Materials and Methods.
- D. Plumbing Fixture and Equipment Installation:
1. Unless otherwise indicated, fixtures shall be installed with 5/16 inch brass bolts or screws of sufficient length to securely fasten fixture to backing, wall, or closet ring.
 2. Fixtures installed against concrete or masonry walls shall have their hangers fastened with 5/16 inch brass bolts, Philip Shield type anchors, or 2 unit cinch anchors. Wood or plastic plugs are not permitted.
 3. Fixtures installed against wood or metal stud walls shall have their hangers fastened to metal backing plates with 5/16 inch brass bolts screwed into plate. Fixture hangers for urinals shall be fastened centered vertically on metal backing plate with three 5/16 brass bolts each for small individual hangers and six, for larger one piece hangers. Lavatories shall be hung with not less than four 5/16 inch brass bolts or not less than five 1/4 inch brass bolts. Each sink hanger shall be hung with not less than four 5/16 inch brass bolt or not less than five 1/4 inch brass bolts.
 4. Pan type drinking fountains shall be hung with 5/16 inch cadmium plated bolts with a bolt in each bolt opening in hanger. Hangers for pan type drinking fountains shall provide 2 inches (plus or minus 1/4 inch) between pan and wall. Spaces due to irregularities between fixtures and tile walls shall be neatly filled with white cement or silicone filler.
 5. Backing for hanging of plumbing fixtures and equipment shall be installed in supporting wall at time rough piping is installed. Backing for stud walls shall be steel plate 1/4 inch thick, not less than 4 inches wide. Backing for urinals shall be 1/4-inches thick by 6-inch wide steel plate. Steel plate shall be attached to stud at each end of plate and to each stud it crosses. Plate shall be attached to metal studs by bolting with two 1/4 inch U-bolts per stud with bolts through plate and around stud flange or by welding with a 1/8 inch fillet weld full width of stud flange, top and bottom of plate. At wood studs, plate shall be carefully recessed flush with face of stud and attached to each stud with 2 No. 14 flat-head wood screws, 2 inches in length into pre-drilled 1/8 inch holes. Backing for stud walls supporting wall-hung closets shall be as detailed.
 6. Rough-in for fixtures, equipment and appliances shall be as indicated on Drawings and as specified, including those items indicated as furnished by others, furnished by Owner, or future capacity. When connections to equipment from capped or plugged lines are required, caps or plugs shall be removed at time equipment is set and stops or valves installed and connections provided as specified.
 7. Piping materials for trap arms shall be Brass, Cast Iron or DWV copper
 8. Piping shall be stubbed out to exact location of fixtures and stubs shall be installed symmetrical with fixtures. Hot and cold water supplies for center set faucets on lavatories shall be installed on 8-inch centers, unless otherwise specified or required.

9. Kitchen equipment requiring backflow protection with hot and cold water connections shall be installed with approved backflow prevention assemblies; BPV-3 and drain into floor sink with air gap.
- E. Cleanouts in Drain, Waste, Vent and Sewer Lines:
1. Cleanouts shall be installed at locations stated in the California Plumbing Code and accessible at following locations:
 - a. At locations above first floor as stated on construction documents and 5 feet outside of the building.
 - b. Install an accessible main line upper terminal cleanout in all restrooms above water closet over flow. (Install above upper terminal water closet where there are more than one water closet in a restroom).
 - c. Above faucets of each sink with brass plug.
 - d. Above service sink with brass plug.
 - e. At each Drinking Fountain with brass plug.
 - f. At each urinal and locate above urinal with brass plug.
 - g. Above overflow level of pot sinks with brass plug.
 - h. In vertical line at base of each downspout connected to an underground storm drain system extend cleanout to exterior of building.
 - i. At upper end of a horizontal vent line when any part of horizontal line is below overflow level of fixture it serves.
 - j. Not to exceed 100-foot intervals in sewer and waste lines exterior of building.
 - k. At property line connection.
 - l. Where indicated on Drawings.
 2. Cleanouts shall be extended to grade as follows:
 - a. Not to exceed 100-foot intervals in straight runs of pipe outside buildings.
 - b. At horizontal changes of direction in aggregate greater than 135 degrees (underground).
 - c. At property lines.
 - d. Where cleanouts occur under concrete.
 - e. Where marked for future connections.
 3. Cleanouts in building shall be extended to floor level or above floor level or above floor level in walls or furring when cleanouts are not accessible or where clearance is less than 18 inches.
 4. Cleanouts in finished areas in building shall be concealed except that cleanouts above service sinks in janitor's rooms or closet, and cleanouts above service sinks or in exposed piping in boiler or heater equipment rooms, may be exposed. Cleanouts for urinals shall be installed above urinal and shall terminate behind an access plate.
 5. Cleanouts in floors of covered areas and those extended to grade in concrete areas shall be floor level type with extensions body brass plugs and detachable nickel-bronze or aluminum alloy scoriated.

6. Concealed cleanouts in vertical lines shall be service weight soil cleanout tees with brass plugs and round cover plates unless otherwise specified or indicated. A snug fitting sleeve of galvanized sheet metal shall be placed around hub of tee and shall extend to flush with finished soil, or cleanout shall be extended to finished wall.
7. Cleanouts extended from below floor to a wall or furring or on horizontal lines above floor that terminate at a wall or furring shall be iron body type with brass plugs and round cover plates.
8. Cover plates over cleanouts in painted walls shall be steel, bonderized and prime coated. Cover plates over cleanouts in tile walls shall be chromium-plated brass or nickel bronze. Plates shall be attached to cleanout plugs with 5/16 inch No. 18 or 1/4 inch No. 20 stainless steel vandal-proof type screws. Plates shall be one inch larger in diameter than fitting opening.
9. Cleanouts at bases of downspouts shall be tapped soil tees with brass plugs as hereinafter specified, full size of line.
10. Cleanouts extended to grade in exterior sewer lines other than floors or concrete areas shall be a cleanout assembly with secured top, extra heavy-duty, adjustable sleeve, cut-off ferrule, countersunk threaded brass plug and scoriated tractor type cover.
11. Other cleanouts shall be iron body type.
12. Cleanout extensions shall be no-hub cast iron soil pipe. Exterior cleanouts, those in concrete excepted, shall terminate in a 14-inch by 6-inch thick concrete block with cleanout assembly and top of block flush with finish grade.
13. Fittings in lines utilized as cleanouts shall be approved soil fittings including no-hub pipe. Tees and crosses in vent headers excepted.
14. Pipe joint compound shall not be installed on cleanout plug. After lines are tested and approved, each cleanout plug shall be removed, greased, and replaced.

3.03 EXCAVATION, TRENCHING AND BACKFILLING

- A. Perform trenching, excavation, and backfilling required for Work of this section as specified herein and in Section 31 2323: Excavating, Backfilling, and Compacting for Utilities.

3.04 SERVICE CONNECTIONS

- A. Determine exact location of required water, drain, and sewer connections and provide proper connections.
- B. Potable water lines shall be purged completely before connecting to sources of water for the Project. Determine quality of water supply before connection.

3.05 WATER HAMMER ARRESTORS

- A. Install water hammer arrestors indicated on Drawings and in following locations (only non-ferrous arrestors may be installed in copper water system):
 1. Water lines to lavatory headers, water closet and urinal headers, service sinks, kitchen sinks, wash fountains, drinking fountains, laboratories with medical type faucets and on wash sinks having three or more stations and all other quick closing fixture such as clothes washers, as close to fixture as possible.
 2. Between last two fixtures when three or more fixtures, other than those listed in Number 1 above, are served by a common header.

- B. When possible, arrestor shall be installed in wall or furring. When arrestor is installed in wall or furring, furnish an access plate large enough to permit removal of arrestor. Access plate shall be a minimum of 2 inches larger in each direction than the arrestor.
- C. Fixture water lines shall be provided with mechanical water arrestor hammer dampening devices. Air chambers are not approved.

3.06 CONDENSATE DRAINS - FROM AIR CONDITIONING UNITS

- A. Connect drain piping from drain pan of air conditioning unit to condensate disposal location indicated. When coil or unit housing is shock or vibration isolated, connection shall be furnished through a flexible connector not less than 10 inches long. Drain line shall pitch to flow out at not less than one inch in 8 feet. Drain line shall not be reduced smaller than unit outlet connection.
- B. Condensate drain piping installed within building whether in air conditioned space or not shall be insulated. Refer to Section 22 0700: Plumbing Insulation, for type of material required.
- C. Condensate Trap:
 - 1. A condensate trap shall be installed for each air conditioning coil. Trap shall be assembled from 2 brass unions: one between A/C unit and inlet of trap, and one at outlet of trap that connects to main drain.
 - 2. Trap configuration shall be per manufacturer's recommendations based on total unit casting static pressure (simulated plugged filter condition), but not less than 3 inch water seal.
 - 3. Running trap design is not permitted.
 - 4. Secondary drain shall not be trapped.
- D. Condensate trap shall be checked at equipment operational tests for proper water drainage flow from air conditioning unit. Cooling condensate pan shall be filled with water, filters covered with plastic (plugged filter simulated), unit panels replaced, and unit motor running at design condition. Pan shall drain without hesitation to bottom of inlet connection. Tests are made prior to installation of ceiling.
- E. Secondary Overflow Drain:
 - 1. Drain pan installed underneath air conditioning units in concealed ceiling space or units that incorporate dam fitting shall be furnished with secondary drain piped to outside planter area with outflow location clearly visible.
 - 2. If outside building location is not available or feasible, secondary drains shall be piped to a room sink, if sink is not available pipe to a room corner away from cabinets, computers, desks, door ways/entrances or stairs.
 - 3. Secondary vertical pipe that penetrates through suspended ceiling shall be furnished with a coupling or threaded adapter so ceiling tile can be removed without damage.

3.07 CONDENSATE DRAINS - FROM WINDOW TYPE HEAT PUMP AND EXTERIOR WALL MOUNT HEAT PUMP UNITS

- A. Whether indicated on Drawings or not, window units and wall mount units without built in bottom drain pan for evaporator and condenser coils shall be provided with galvanized steel condensate pan at bottom of unit with drain line that drains into approved drywell. Install copper 1/2 inch diameter pipe for window type air conditioners and 3/4 inch diameter pipe for exterior wall-mounted heat pump units.

3.08 MAKE-UP WATER SYSTEMS

- A. Provide and connect make-up water systems for equipment in other sections.

3.09 GREASE TRAPS (INTERCEPTORS)

- A. Grease traps shall be installed only when required by municipal authority. Grease traps shall be separately vented; fixtures connected to grease traps shall be trapped and vented. When grease traps are installed in concrete boxes, fill spaces between grease traps and concrete boxes with sand and place 2 inches of concrete seal over sand. Concrete seals shall pitch toward grease traps with inner edges flush with top of grease traps. Position openings for ease of cleanout.

3.10 GAS SERVICE: NOT USED

3.11 CLEANING - PLUMBING PIPING SYSTEMS AND FIXTURES

- A. Plumbing lines and fixtures shall be flushed to remove dirt and foreign material until water runs clear and no foreign substance or odor is present. Strainers and screens on faucets shall be removed during this cleaning operation.
- B. After satisfactory cleaning of strainer and screen replacements has been witnessed by the Project Inspector, post and maintain signs stating: "CAUTION - Water at this construction project has not yet been certified for human consumption." Signs shall be furnished with letters at least 1/2 inch in height and shall be conspicuously posted at entrances to the Project site. Signs shall be paneled, black and yellow, in conformance with OSHA Section 1910.1455.

3.12 DISINFECTING DOMESTIC WATER PIPING SYSTEMS

- A. Newly installed or replaced piping and/or fixtures dispensing potable water, and any additional piping and/or equipment impacting the integrity of this system shall be disinfected and undergo an approved bacteriological analysis before water system is allowed for public use.
- B. Disinfection shall commence upon complete installation of all related domestic water systems including fixtures, valves, faucets, water heating systems, etc.
- C. Work shall be performed by Technicians Certified by the American Water Works Association (AWWA) and/or the State of California Department Health Services, Grade II Water Treatment Operator Certification or higher issued by the Department of Health Services (DHS) for the State of California. Comply with Title 22, Code of Regulations Division 4, Chapter 13, and Article 2 Operator Certification Grades.
- D. Method:
1. A Physical Separation of minimum 6" or Reduced Pressure Backflow assembly shall be installed to protect from cross contamination of the local water purveyor's meter service supply when at any time there is any type of water connection with the piping to be disinfected (Chlorinated) and the water meter service supply.
 2. Install a Chlorination Port including a T fitting and a shut off valve to the proximity of the point of connection at the new piping system.
 3. System is to be flushed to remove any materials that may have entered the system.
 4. Using a chemical feed metering pump and a chlorine tank, the chlorine solution is injected into the water system.
- E. Disinfection and De-chlorination procedure (24 or 3 Hour Contact Time):
1. 24-hour Test Method:

- a. Prior to disinfection, post signs on all water outlets of the system to be disinfected. Sign or tags shall read, "Water System Being Chlorinated-
"Danger Do Not Drink Water" or similar warning.
 - b. Piping system shall then be adequately flushed with water to remove any particles and eliminate air pockets.
 - c. Using the continuous feed method, sodium hypochlorite conforming to ANSI/ AWWA B300 will be injected into the water system at a minimum of 50 PPM. A water flow meter provided by the water treatment technician will be used to determine the rate of injection and a chlorine test kit, Hach or equivalent, will be used to monitor the residual.
 - d. Chlorine residual test will be taken at all appropriate points and outlets to verify 50 PPM residual levels.
 - e. The chlorinated system shall be shut down for any use and the chlorinated water shall remain in the water system for retention of 24 hours.
 - f. After 24 hours, chlorine residual levels will again be tested at various points throughout the system to insure a minimum of 25 PPM residual. If the system has not met the minimum of a 25 PPM residual, the above disinfection process shall be repeated.
 - g. After satisfactory completion of the residual testing, flush out system until Hach or equivalent test reveal the water outlets have a free chlorine residual concentration less than 0.5 PPM. The procedure shall be in accordance with the AWWA standard C651-05.
 - h. The OAR may allow temporary use of the water system for construction purposes pending results of the bacteriological test analysis. Sign or Tags shall be left on all outlets stating water system is not safe for consumption until laboratory results are complete and meet these specifications.
2. 3 Hour Test Method:
- a. If the water systems must be turned on for use as soon as possible, a 3 hours chlorine contact time to allow for disinfection is permitted with the OAR's approval.
 - b. Prior to disinfection, post signs on all water outlets of the system to be disinfected. Sign or tags shall read, "Water System Being Chlorinated-
"Danger Do Not Drink Water" or similar warning.
 - c. Piping system shall be then adequately flushed with water to remove any particles and eliminate air pockets. Using the continuous feed method, sodium hypochlorite conforming to ANSI/ AWWA B300 will be injected into the water system at a minimum of 200 PPM. A water flow meter provided by the water treatment technician will be used to determine the rate of injection and a chlorine test kit, Hach or equivalent, will be used to monitor the residual.
 - d. Chlorine residual test will be taken at all appropriate points and outlets to verify 200 PPM levels. The chlorinated system shall be shut down for any use and the chlorinated water shall remain in the water system for retention of 3 hours.
 - e. After satisfactory completion of a 3 hour disinfection period, flush out system until Hach or equivalent test reveal the water outlets have a free

chlorine residual concentration less than 0.5 PPM. The procedure shall be in accordance with the AWWA standard C651-05.

- f. The OAR may allow temporary use of the water system for construction purposes pending results of the bacteriological test analysis. Sign or Tags shall be left on all outlets stating water system is not safe for consumption until laboratory results are complete and meet these specifications.

F. Bacteriological Test:

1. After final flushing and satisfactory results from the residual free chlorine concentration test, Bacteriological test samples shall be collected. The intent of the following is to provide insurance for an accurate representation to a complete Bacteriological test of the water system. At least two samples shall be taken from each floor of each building.
2. Bacteriological test samples shall be delivered to a State of California Department of Health Services Certified Laboratory to perform qualitative and quantitative bacterial analyses on the water samples for the presence of any Total Coliform bacteria and Plate Count. This count must be less than 500 cfu/mL.
3. The procedure shall be repeated if it shown by bacteriological examination made by an approved agency that the level of Disinfection does not meet these specifications.
4. After satisfactory results for the bacteriological test are provided to the OAR, the physical barrier or temporary reduce pressure back flow devise shall be removed, and the new piping shall be connected to the point of connection. All the connecting piping and fittings shall be disinfected prior to installation. Chlorination Port shall be capped water tight. Warning sign or tags shall be removed.

- G. Drinking Fountain and Bottle Filler Lead Test: After installation of Drinking Fountain or Bottle Filler, and successful Bacteriological Test, shut off domestic water supply line feeding the fixture, and inform OAR. OAR will coordinate with the Drinking Water Quality Program (DWQP) Supervisor in local Project Unit and M&O's Plumbing Technical Unit Supervisor to conduct lead detection test and mitigate as necessary. Do not remove related construction warning sign and tags.

3.13 VALVES ON PLUMBING SYSTEM

- A. Furnish and install gates, ball, globes, angles, and check valves on plumbing Work at following locations whether indicated on drawings or not.
- B. Hot and cold valves shall be:
 1. Lead free complying with AB1953.
 2. Above the ground copper water system, 2-inch and larger, may utilize Victaulic butterfly valves and fittings for their connections. A 2-inch or larger Victaulic valve may be in a wall if an adequately sized access panel is provided for maintenance or removal.
- C. Valves shall be accessible and installed within an access panel approximately 3 feet above floor and no more than 7 feet above floor, or in a marked yard box to prevent tampering.
 1. Immediately after each water meter, in addition to any valve furnished by utility company, there shall be an accessible valve on the inlet side for a strainer assembly, dual backflow device assembly and/or possibly a dual pressure reducing valve assembly.

2. A gate or ball valve on each water supply before it enters building. Valves shall be accessible from outside building and shall be installed in a marked yard box, unless otherwise indicated on drawings. Ball valves 2 ½-inch size or larger shall omit gate valve handle and furnish 2-inch square operating nut.
3. At multi story buildings, provide an isolation-valve or multiple valves for both hot and cold water in access panel to isolate and control each floor level.
4. For rooms, shops, offices and boiler or mechanical room, install a gate or ball valve to control hot and cold water lines to each group of fixtures, a group of fixtures shall be considered to be 2 or more fixtures in the same room. When practical, valves shall be installed on the same wall as group of fixtures. Valves shall control only fixtures in rooms in which they are installed.
5. For restrooms, a gate or ball valve shall be installed in each restroom to isolate the hot and cold water supply into a restroom regardless of the number of fixtures. These valves shall control and be accessible only from within the restroom in which fixtures are installed. Valves shall be installed on the same wall as the group of fixtures it serves. Valves shall control only fixtures in restroom in which they are installed. Back to back restrooms shall be isolated separately and individually.
6. Install a gate or ball valve on each building branch line, which serves two or more fixtures, when these fixtures are not provided with a group isolation valve as specified above. These valves shall be located approximately 3 feet but not more than 7 feet above finish floor.
7. Install a gate, ball valve or partition stop for a drinking fountain or a group of drinking fountains.
8. Install a gate, ball valve or partition stop for hot and cold water supply to plumbing fixtures with no accessible supply stops, such as wall mounted faucets.
9. Install a gate, ball valve or partition stop for stops adjacent to, and controlling water flow to each sill cock and hose bib except as follows:
 - a. A sill cock immediately below an exterior drinking fountain may be controlled by the same gate, ball valve or partition stop as drinking fountain.
 - b. Valves or stops will not be required for individual hose bibs when these hose bibs are on a branch line serving only hose bibs and branch line is furnished with a shut-off valve.
10. Install a lose key angle stop, on each exposed fixture supply, and for each flush valve unless otherwise specified,
11. Install gate or ball valve at each location where a water line is connected to a piece of equipment other than items mentioned above.
12. Install a check valve on each hot water return line where it connects to a hot water storage tank or a water heater.
13. Handles, hand wheels (including dishwasher fill valve handles) and operating nuts shall be furnished of steel, brass, or cast iron and shall be removable. Unless specified to be loose key type, handles shall be securely fastened to their stems. On exposed outdoor valves, omit operating handles and provide operating nuts.
14. Provide a handle or a key for each five, or fraction thereof, loose key valves, bibs, or stops and deliver them to the project OAR.

3.14 VALVES - GAS SERVICE: NOT USED

3.15 ELECTROLYSIS PREVENTION

- A. Brass nipples, 6 inches, with recognized brass unions; flanges shall be furnished and installed at locations described herein. Flanges shall be installed with complete insulating component consisting of gasket bolt sleeves and bolt washers. Dielectric insulators shall be installed at following locations:
 - 1. Where special applications indicated on Drawings require an insulation flange or brass union, with 6-inch brass nipple to be installed in a condensate line, or steam line, flange insulation shall be of a high temperature type, suitable for continuous operation at temperatures up to 220 degrees F. for condensate and 400 degrees F. for steam.
 - 2. Where steel or cast iron in ground connects to copper or brass piping above ground, transition from steel or cast iron pipe to copper or brass pipe shall be provided in an accessible location.
 - 3. Underground dielectric connections shall be furnished in accessible yard boxes.
 - 4. Above ground dielectric connections shall be exposed; or if in finished rooms shall be located in accessible access boxes.

3.16 UNDERGROUND PIPE MARKERS

- A. Pipe markers shall be furnished according to Section 22 0553: "Plumbing Identification"
- B. Underground Caution Tape shall be placed 12 to 18 inches above the utility line. The Caution Tape shall be a designated color and marked with the appropriate name for the specific type of utility pipe as follows:
 - 1. Yellow – with the words: CAUTION GAS LINE BELOW
 - 2. Blue – with the words: CAUTION WATER LINE BELOW

3.17 HOT WATER CIRCULATING PUMPS: NOT USED

3.18 WATER TEMPERATURE CONTROLLERS: NOT USED

3.19 COMPRESSED AIR SYSTEMS: NOT USED

3.20 DEPTH OF SEWER LINES

- A. Minimum depth of below grade sewer lines shall be 24 inches to centerline of pipe. Sewer lines shall slope ¼ inch per foot minimum, unless otherwise indicated. Minimum depth at Owner property line shall be 6 feet, unless otherwise required.

3.21 BACKFLOW PREVENTION DEVICES: NOT USED

3.22 CLEANUP

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

3.23 PROTECTION

- A. Protect Work of this section until Substantial Completion.

End of Section

SECTION 23 0500

COMMON WORK RESULTS FOR HVAC

PART 1 – GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. This Section provides the basic mechanical requirements that apply to the Work of Division 23.
- B. Related Requirements:
 - 1. Division 01: General Requirements.
 - 2. Division 26: Electrical.

1.02 REGULATORY REQUIREMENTS

- A. Materials, fabrication, equipment, and installation shall comply with industry standards and code requirements. Where manufacturer's recommendations exceed industry standards, the manufacturer's recommendation shall establish the minimum standard. As a minimum, standards from the following organizations shall apply:
 - 1. AMCA - Air Movement and Control Association.
 - 2. ANSI - American National Standards Institute.
 - 3. ASME - American Society of Mechanical Engineers.
 - a. ASME Boiler and Pressure Vessel Code.
 - b. ASME B31 - Code for Pressure Piping.
 - 4. AHRI - Air-Conditioning, Heating, and Refrigeration Institute.
 - 5. ASHRAE - American Society of Heating, Refrigerating and Air-Conditioning Engineers.
 - 6. ASTM - American Society for Testing and Materials.
 - a. ASTM A53 - Specification for Welded and Seamless Pipe.
 - 7. CSA - Canadian Standards Association.
 - 8. FM Global - Factory Mutual Global
 - 9. IAPMO - International Association of Plumbing and Mechanical Officials.
 - 10. NFPA - National Fire Protection Association.
 - 11. OSHA - Occupational Safety and Health Administration.
 - 12. SMACNA - Sheet Metal and Air Conditioning Contractors' National Association.
 - 13. UL - Underwriters Laboratories Inc.
 - 14. Intertek (ETL Certification).
- B. Materials, fabrication, equipment, and installation shall comply with federal, state, and local codes including, but not limited to, the following:
 - 1. CBC, California Building Code, and CMC, California Mechanical Code.
 - a. Latest edition as adopted by the City of Los Angeles, the County of Los Angeles, and the State of California including amendments effective on the Effective Date of the Contract.

2. California Code of Regulations, Title 8, Industrial Relations, Division 1, Chapter 4, Division of Industrial Safety.
 3. OSHA - Occupational Safety and Health Administration.
 4. CDPH – California Department of Public Health.
 5. SCAQMD - South Coast Air Quality Management District.
- C. Specifications or Drawings shall not be construed to permit deviation from the requirements of governing codes unless approval has been obtained from legally constituted authorities having jurisdiction, and the Architect. The Contract Documents may contain more stringent requirements than those legally required.
- D. Permits and Fees: Refer to the General and Supplementary Conditions.

1.03

SUBMITTALS

- A. Provide submittals in accordance with Section 01 3300: Submittal Procedures and with specific requirements of Division 23 sections, as applicable.
- B. After Architect's approval, the above information shall become the basis for inspecting and testing materials and actual installation procedures performed in the Work.
- C. Shop Drawings: Submit one additional copy when control diagrams having line voltage connections are indicated. Shop Drawings shall be specifically prepared for the Work of this Project. Drawings prepared in accordance with requirements of Section 01 3113: Project Coordination and Section 01 3300 may be provided by the Architect to serve as a background for the Shop Drawings. Shop Drawings shall comply with the requirements of Section 01 3113 and Section 01 3300 and shall indicate at a minimum:
1. Complete system layout of equipment, components, ductwork, and piping, indicating service clearances, duct and pipe sizes, fitting types and sizes, top or bottom of duct and pipe elevations, distances of ducts, pipes and equipment from building reference points and hanger / support locations. All the above items shall be coordinated on the shop drawings according to the requirements of Section 01 3113.
 2. Schedule and description of equipment, ductwork, piping, fittings, valves, dampers, and controllers.

1.04

PROJECT RECORD DOCUMENTS

- A. Comply with provisions of Section 01 7700: Contract Closeout.
- B. Project Record Drawings:
1. Provide a complete set of mechanical and control system drawings in AutoCAD and, if available, BIM, complete with external reference drawings, fonts, blocks and plotter pen color/line thickness settings on CD-ROM. Also submit one set of full size reproducible plots on vellum and three sets of prints.
 2. Before Contract Completion, deliver corrected and completed prints to the OAR. Delivery of project record documents to the OAR does not relinquish responsibility of furnishing required information omitted from project record documents.
- C. Operation and Maintenance Manuals:
1. Submit operation and maintenance manuals in required form and content. If no revisions are required, furnish one additional copy. If revisions are required, one copy shall be returned with instructions for changes; perform such changes and return manuals. Manuals shall be bound in accordance to Section 01 7700. Deliver manuals to the OAR. Submit an electronic copy of the entire manual in PDF file format.

2. Contents of Manual:
 - a. Title sheet with Project name, including names, addresses and telephone number of Contractor, installer, and related equipment suppliers.
 - b. Manufacturer's operating instructions including, but not limited to, the following:
 - 1) Identification of components and controls.
 - 2) Pre-start checklist and start-up procedures.
 - 3) Normal operation settings and checklists.
 - 4) Pre-shut down checklist and shut down procedures.
 - 5) Trouble shooting checklist and guidelines.
 - 6) Recommendations for optimum performance.
 - 7) Warnings and safety precautions on improper or hazardous operational procedures or conditions
 - c. Manufacturer's product data and parts and maintenance booklet for each item of equipment furnished under Division 23 that includes the following as a minimum:
 - 1) Manufacturer's model, identification and serial numbers.
 - 2) Exploded view of assembly drawings identifying each component or part with the relevant part number.
 - 3) Directory of manufacturer's representatives, service contractors and part distributors.
 - 4) Maintenance and trouble-shooting instructions, including schedule for preventive maintenance, periodic inspection and cleaning criteria.
 - d. Project Record Drawings: Complete set of mechanical and control system drawings in 50 percent reduced print format shall be furnished with the manual. Submit the above record drawings on CD-ROM in AutoCAD and, if available, BIM, complete with external reference drawings, fonts, blocks, and plotter pen color/line thickness settings.
 - e. Testing, Adjusting, and Balancing reports: Submit as specified in Section 01 4525.
 - f. South Coast Air Quality Management District (SCAQMD) permits to install and operate boilers, water heaters and other fuel burning equipment and third-party source test reports as required by SCAQMD to allow start-up and operation of equipment.
 - g. Los Angeles County industrial waste permits.
 - h. Valve directory complete with location, function, size, and model of each valve with reference to the project record drawings.
 - i. Equipment and component identification chart complete with location, function, size, and model of each equipment or component with reference to the project record drawings.

- A. Contract Documents indicate extent and general arrangement of Work under Division 23. Contractor shall coordinate work in accordance with Section 01 3113 requirements and make adjustments as required to provide maximum headroom, a neat arrangement to keep passageways and openings clear to provide accessibility and provisions for maintenance, and to meet code requirements.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Delivery and Storage: Deliver materials to Project site in their original unopened containers with labels intact and legible at time of delivery. Store in strict accordance with manufacturer's recommendations.
- B. Do not store plastic pipe or materials in direct sunlight.

1.07 PRELIMINARY OPERATION

- A. OAR may require any portion of mechanical Work to be operated before Substantial Completion. Such operation shall be in addition to regular tests, demonstrations and instructions required under the Contract Documents, and shall be performed as required.
- B. Notify the Project Inspector at least 24 hours in advance of lighting or re-lighting pilots.

1.08 TRAINING OF OWNER PERSONNEL

- A. Training of Owner's personnel shall include:
 - 1. A minimum of 8 hours of on-site overview of the overall Mechanical System.
 - 2. Refer to Division 23 sections for specific training on each of the components of the Mechanical System.
 - 3. A minimum of 8 hours of on-site overview identifying location and function of all Control Valves and Actuator assemblies.
 - 4. A minimum of 40 hours of (in classroom) software training for a minimum of 20 LAUSD personnel on EMS/BMS if such systems are utilized in the project. Training shall be conducted at control contractor training facility with computer setup for each person attending.
- B. Contract shall include the cost of training Owner operation and maintenance personnel in operating, adjusting, maintenance, trouble-shooting, and Project site repair of each component, equipment, or system provided under this Contract.
- C. Operational and maintenance training shall be conducted on the Project site, unless indicated otherwise.
- D. Upon completion of Owner training, a completion certificate indicating the nature of the training and a description of the systems, complete with equipment and component lists shall be issued to each trainee. The certificate should be issued in duplicate with one copy retained by OAR.
- E. An attendance sheet with the names and signatures of all participants attending the training shall be submitted to the OAR and kept as part of the project documents.

1.09 GUARANTEES AND DAMAGE RESPONSIBILITY

- A. Sound of water flowing in piping shall not be transmitted to building structure. Operation of mechanical system shall not produce operational sounds that can be heard outside of rooms enclosing apparatus or equipment.

PART 2 – PRODUCTS

2.01 MATERIALS AND EQUIPMENT

- A. Unless otherwise specified, materials and equipment shall be new, in good and clean condition. Equipment, materials, and components shall be of the make; type and model number noted on Drawings or specified. Pieces of equipment of the same type shall be by the same manufacturer.
- B. Whenever an item is listed by a single proprietary name, with or without model number and type, it shall be for purpose of design only, to indicate characteristics and quality desired. Proprietary designation listed on Drawings, or listed first in Specifications, is used as a basis for design to establish a standard for quality and performance and space requirements.
- C. HVAC equipment products from different manufacturers are never identical. Equipment approved as being equal is interpreted as being equivalent in capacity, performance and quality. The dimensions, weight, configuration and utility requirements could be quite different from the equipment used as the basis of design. Due to these differences, additional coordination and adjustments by the Contractor are required. For the equipment to be deemed truly equal, the additional coordination and adjustments by the Contractor should not incur any additional cost to the Owner and any additional labor to the design team.
- D. Equipment and materials indicated or required to be installed outdoors shall be of the type that is designed, manufactured, listed or approved by authorities having jurisdiction for outdoor installation by being resistant to the adverse effects of weather. All the additional protective measures against outdoor weather required by the manufacturers' installation instructions and prevalent practice shall be provided.
- E. For substitution of materials or products, refer to the General Conditions.

PART 3 – EXECUTION

3.01 SERVICE INTERRUPTIONS, OFF-SITE, GAS AND WATER

- A. Schedule Work so there shall be no service interruptions of existing systems or systems during normal hours of operation of affected systems and facilities.
- B. When service interruptions are mandatory, arrange in advance with the OAR as to time and date of such interruptions.
- C. Systems, which are interrupted, shall be returned back into operation in such manner that they will function as originally intended.

3.02 CUTTING, NOTCHING, AND BACKING

- A. Conform to California Building Code, Title 24, Part 2, for notches and bored holes in wood and for pipes and sleeves embedded in concrete and for cuts in steel, as detailed on structural Drawings.
- B. Where pipes or ducts pass through, or are located within one inch of any construction element, install a resilient pad, 1/2 inch thick minimum, to prevent contact.
- C. Furnish all necessary provisions for recesses, chases, and accesses and provide blocking and backing as necessary for proper reception and installation of mechanical Work.

3.03 LOCATION OF PIPING AND EQUIPMENT

- A. Location of piping, apparatus and equipment as indicated on Drawings is approximate and shall be altered to avoid obstructions, preserve headroom, and provide free and clear openings and passageways.
- B. Trenches parallel to footings shall not be closer than 18 inches to the face of footings and shall not be below a plane having a downward slope of 2 horizontal to one vertical, from a line 9 inches above bottom of footing.
- C. Pipe in tunnels shall be installed close to one side of tunnel to provide maximum space for passage. Pipe shall not be installed through crawl hole unless otherwise specified or detailed on Drawings.

- D. Place equipment in locations and spaces indicated, disassemble and/or reassemble equipment as required by Project conditions.

3.04 TESTS AND TESTING

- A. Tests shall be as required under the applicable sections of Division 23, including this Section.
- B. Tests required by other sections of the Contract Documents include the following:
 - 1. Test and balance of mechanical equipment and systems: Refer to Section 01 4525: Testing, Adjusting, and Balancing for HVAC.
 - 2. Hydrostatic test of boilers: Refer to Section 01 4525: Testing, Adjusting, and Balancing.
 - 3. Test of smoke and fire detectors: Refer to Division 26: Electrical.
- C. Additional tests may be required in the case of products, materials, and equipment if:
 - 1. Submitted items are altered, changed, or cannot be determined as exactly conforming to the Contract Documents.
 - 2. Performance testing and results may also be required on certain items which are as specified, including fan, and pump performance.
- D. Piping Tests:
 - 1. Perform tests required to demonstrate that operation of mechanical systems and their parts are in accordance with Specifications covering each item or system, and furnish materials, instruments and equipment necessary to conduct such tests. Tests shall be performed in presence of the Project Inspector, and representatives of any governmental agency having jurisdiction. Work shall not be concealed or covered until required results are provided.
 - 2. If required tests are not performed, Owner may provide in accordance with the Contract Documents.
 - 3. Pressure gages furnished in testing shall comply with CPC. Air shall be bled from lines requiring hydrostatic or water tests.
 - 4. Systems shall be pressure-tested in accordance with pipe testing schedule below. Pipe test shall indicate no loss in pressure after a minimum duration of 4 hours at test pressures indicated. Where local codes require higher test pressures than specified herein for fire sprinkler systems, local codes shall govern.
 - 5. Fuel gas lines shall be first tested with piping exposed, before backfilling trenches or lathing; second with piping in finished arrangement, backfilled and paved where required, and walls finished.
 - 6. Refrigerant piping may be tested with a halide detector or calibrated electronic testing equipment.
 - 7. Piping systems may be tested as a unit or in sections, but entire system shall successfully meet requirements specified herein, before final testing by the Project Inspector.
 - 8. Repair of damage to pipes and their appurtenances or to any other structures resulting from or caused by these tests, shall be provided.

E. Pipe Testing Schedule:

System Tested	Test Pressure (psig)	Test With:
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Steam piping, hot water heating system piping and chilled water piping	150	Water
Vacuum pump or condensate pump discharge and condensate return piping	150	Water
Refrigeration piping		
R-22	400	Dry nitrogen
R-134a	300	Dry nitrogen
R-401a	300	Dry nitrogen
R-401b	300	Dry nitrogen
R-404a	500	Dry nitrogen
R-407c	500	Dry nitrogen
R-410a	600	Dry nitrogen
R-507	500	Dry nitrogen
Radiant panel piping	150	Water

F. Equipment Performance Assurance Tests:

1. Before operating any equipment or systems, a thorough check shall be performed to determine that systems have been flushed and cleaned as required and that equipment has been properly installed, aligned, lubricated, and serviced. Factory instructions shall be checked to verify installations have been completed and recommended lubricants have been installed in bearings, gearboxes, crankcases, and similar equipment. Particular care shall be furnished in lubricating bearings to avoid damage by over-lubrication and blowing out seals. Equipment shall also be checked for damage that may have occurred during shipment, after delivery, or during installation. Damaged equipment, products, and materials shall be replaced or repaired as required.
2. Upon completion of the above, adjust the system settings to within normal operating conditions to prevent the system from being damaged upon start-up.
3. Run-test the equipment after start-up for five consecutive days. Tests shall include operation of heating, ventilating, and air conditioning equipment and systems for a period of not less than two 8 hour periods at 90 percent of the full specified heating and cooling capacities. If equipment passes, install new filters. If equipment fails, it shall be adjusted and retested until system meets all applicable codes.
4. Equipment Start-up Reports: For each equipment or system on which start-up is performed, submit 8 copies of start-up report for review by the Architect.
 - a. The start-up report shall include the manufacturer's standard start-up form completed and signed by the start-up technician.
5. Provide, maintain, and pay costs for equipment, instruments, and operating personnel as required for specified tests.
6. Provide electric energy and fuel required for tests.
7. Final adjustment to equipment or systems shall meet specified performance requirements.
8. Equipment, systems, or Work deemed defective during testing shall be replaced or corrected as required. Test until satisfactory results are provided.

G. Specific Coordinated Plan for Test and Balance:

1. Provide a narrative of the operational intent that clearly describes the function and sequence of operation of each component, equipment, or system installed. Instruct designated Owner personnel in the operation of the installed systems.
2. Prior to final test and balance, mechanical equipment and systems shall be operated and tested as indicated in Paragraph 3.04.F above to demonstrate satisfactory overall operation of the installed systems.
3. Immediately before starting tests, air filter media shall be cleaned or renewed. Roll-type filters shall be advanced to provide new clean media. Cleanable type media shall be thoroughly cleaned and re-oiled with new, clean oil as recommended by manufacturer if they are of viscous impingement type. Disposable type filters shall be replaced with new filters. Replaceable media shall be replaced with new media.
4. An accurate means of measuring air flow and temperatures shall be furnished to balance air supply, return, and exhaust systems so uniform temperatures occur in every room and design airflow is obtained through registers, diffusers, and grilles.
5. Systems shall be adjusted to provide airflows indicated including maximum fresh air and maximum return air. Dampers shall be checked for proper settings and operation. Air and water inlet and leaving temperatures at coils shall be checked. Complete operational data including airflows, room temperatures, fan speeds, motor currents, plenum, and duct static pressures shall be tabulated.
6. Welding performed as part of this Division may be subject to radiographic inspections at random in accordance with requirements specified in Section 23 0513: Basic HVAC Materials and Methods.

3.05 NOISE AND VIBRATION REDUCTION

- A. Correct noise or vibration caused by mechanical systems. Provide all necessary adjustments to specified and installed equipment and accessories to reduce noise to the lowest possible level
- B. Correct noise or vibration problems caused by failure to install work in accordance with Contract Documents. Include all labor and materials required as a result of such failure. Pay for re-testing of corrected noise or vibration problems by the project acoustical consultant including travel, lodging, test equipment expenses, etc.

3.06 PROTECTION, CARE AND CLEANING

- A. In addition to storage criteria of the General Conditions, and provisions under Section 01 5000: Construction Facilities and Temporary Controls, the following shall be provided:
 1. Provide for the safety and good condition of materials and equipment until Substantial Completion. Protect materials and equipment from damage.
 2. Protect installed Work.
 3. Replacements: In case of damage, immediately provide repairs and/or replacements as required.
 4. Protect covering for bearings, open connections to tanks, pipe coils, pumps, compressors and similar equipment.
 5. Interior of ductwork shall be maintained free of dirt, grit, dust, loose insulation, and other foreign materials.
 6. Air handling equipment shall not be operated until building is cleaned and air filters are installed.
 7. Fixtures, piping, finished brass or bronze, and equipment shall have grease, adhesive, labels, and foreign materials removed. Chromium, nickel plate, polished bronze or brass Work shall be polished. Glass shall be cleaned inside and out.

8. Before initial start-up and again before Substantial Completion, piping shall be drained and flushed to completely remove grease and foreign matter. Pressure regulating assemblies, traps, strainers, boilers, flush valves, and similar items shall be thoroughly cleaned. Tag system with an information tag listing responsible party and date of element, before initial start-up and again before Substantial Completion. Compressed air, oil, and gas piping shall be blown out with oil-free compressed air or inert gas. Refrigerant piping shall be cleaned as specified.

END OF SECTION

SECTION 23 0513

BASIC HVAC MATERIALS AND METHODS

PART 1 – GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. This Section prescribes basic materials and methods generally common to the Work of Division 23.
- B. Related Requirements:
 - 1. Section 01 4525 Testing, Adjusting, and Balancing for HVAC
 - 2. Section 23 3000: Air Distribution.
 - 3. Section 23 8000: Heating, Ventilating and Air Conditioning Equipment.

1.02 SUBMITTALS

- A. Provide in accordance with Division 01, Section 23 0500 and specific requirements of each section of Division 23.

1.03 QUALITY ASSURANCE

- A. Standards: Comply with applicable national, state, and local codes and standards: ASTM, ASME, and ANSI. Federal Specifications, AWWA, CISPI, NFPA, FM Global, UL, CPC (California Plumbing Code), CMC (California Mechanical Code), CSA.
- B. Qualifications of Manufacturer: Products used in the Work of this Section shall be produced by manufacturers regularly engaged in manufacture of similar items and with a history of successful production as reviewed by the Architect.

1.04 COORDINATION

- A. Coordinate related Work in accordance with provisions of Section 01 3113: Project Coordination.

PART 2 – PRODUCTS

2.01 GENERAL

- A. Provide the following products if they are indicated in the Contract Documents or if they are required for the proper installation, function or operation of equipment, systems or components indicated in the Contract Document.
- B. Provide the following products as a complete assembly with required accessories for a complete and functioning entity in compliance with governing codes and applicable standards as specified in Section 23 0500, manufacturer's instructions or as required.
 - 1. Omission of minor details in the Contract Documents does not waive and/or otherwise relinquish compliance with the above requirements.

PART 3 – EXECUTION

3.01 EXAMINATION

- A. Examine areas and conditions under which Work of this Section shall be performed. Correct conditions detrimental to proper and timely completion of Work. Do not proceed until unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Provide all materials and equipment for the Work. Furnish and install necessary apparatus, parts, materials, and accessories.

- B. Flashings:
1. Each pipe, duct, or gas-fired equipment vent passing through roof shall be installed with waterproof flashing.
 2. Flashing or flanges on pipes, vents, and ducts passing through a tile or slate roof shall be constructed of sheet lead. Flashing for pipes and heater vents passing through a roof shall be 4 pound soft sheet lead. Flashing and flanges for ducts and heater vents passing through exterior walls shall be 22 gage sheet metal. Flanges and flashing shall be installed waterproof at point of connection with pipe or duct. No soldered joints on roof flashings will be allowed.
 3. Lead flashing and flanges shall be constructed of 4 pound sheet lead with burned joints. Flange of lead flashing or lead flange on a duct shall extend out onto roof a minimum of 12 inches from pipe or duct. Lead flashing shall extend up the pipe or duct not less than 7 inches.
 4. Sheet metal flashing shall be constructed of 24 gage galvanized sheet steel. Flanges on these flashings shall extend out onto roof a minimum of 10 inches from pipe or duct. Flanges on ducts through exterior walls shall extend out from duct a minimum of 2 ½ inches. Flanges on gas-fired equipment single-wall vents shall be of ventilated type. Type B gas vents through a roof shall be furnished with non-ventilated flashing as per NFPA Pamphlet 211.
 5. Cast iron, steel, brass, and copper pipe, which terminate less than 18 inches above roof, shall be furnished with a combination counter-flashing and vandal-proof hood for protection against water, birds and foreign matter. Cast iron, steel, brass and copper pipe, which does not terminate within 18 inches of roof, shall be furnished with a counter-flashing sleeve. Pipe, which terminates more than 18 inches above roof, shall be furnished with protection against entrance of water, birds, and foreign matter.
 6. Counter-flashing and combination counter-flashing sleeves and vandal-proof hoods shall be cast iron, vandal-proof, threaded, sealed or approved gas-heated sleeve type. Counter-flashing sleeves on each of these items shall extend down over flashing a minimum of 3/4 inch.
 7. Flashing and flanges on ducts shall be installed waterproof at point of connection to the duct by riveting and soldering. Storm collars shall be securely screwed and installed waterproof around appliance vent pipe immediately above flashing.
 8. Vent piping above roof shall be furnished with a combination counter-flashing sleeve and vandal-proof hood.
- C. Equipment Installation: Install roof or floor mounted equipment on level platforms, housekeeping pads or curbs and provide sound, vibration and seismic control measures per Section 23 0548, unless indicated otherwise whether indicated on drawings or not.

END OF SECTION

SECTION 23 0700
HVAC INSULATION

PART 1 – GENERAL

1.01 SUMMARY

- A. Section Includes:
1. Condensate drain piping from air conditioning equipment.
 2. Vacuum and condensate pump discharge lines over 50 feet in length.
 3. High and low temperature equipment.
 4. Refrigerant piping.
 5. Supply and return air ducts for heating and cooling systems air ducts.
- B. Related Requirements:
1. Division 01: General Requirements.
 2. Section 23 0500: Common Work Results for HVAC.
 3. Section 23 0513: Basic HVAC Materials and Methods.
 4. Section 23 0553: Mechanical Identification.
 5. Section 23 2013: HVAC Piping.
 6. Section 23 3000: Air Distribution.
 7. Section 23 8000: Heating, Ventilating and Air Conditioning Equipment.

1.02 REFERENCES

- A. American Society for Testing and Materials International (ASTM):
1. ASTM C167 - Standard Test Methods for Thickness and Density of Blanket or Batt Thermal Insulations.
 2. ASTM C209 - Standard Test Methods for Cellulosic Fiber Insulating Board.
 3. ASTM C302 - Standard Test Method for Density and Dimensions of Preformed Pipe-Covering-Type Thermal Insulation.
 4. ASTM C411 - Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.
 5. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
 6. ASTM C533 - Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation.
 7. ASTM C534 - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.
 8. ASTM C547 - Standard Specification for Mineral Fiber Pipe Insulation.
 9. ASTM D5116 - Standard Guide for Small-Scale Environmental Chamber Determinations of Organic Emissions from Indoor Materials/Products.
 10. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
 11. ASTM E96 - Standard Test Methods for Water Vapor Transmission of Materials.

12. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.
 13. ASTM G22 - Standard Practice for Determining Resistance of Plastics to Bacteria.
- B. Underwriters Laboratories Inc.:
1. UL 181 - Standard for Factory-Made Air Ducts and Air Connectors.
 2. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials.
- C. National Fire Protection Association:
1. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems .
 2. NFPA 90B - Standard for the Installation of Warm Air Heating and Air-Conditioning Systems.
 3. NFPA 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials.

1.03 SUBMITTALS

- A. Submit in accordance with Division 01 and Section 23 0500: Common Work Results for HVAC.
1. Complete material list of items to be furnished and installed under this Section.
 2. Manufacturer's specifications and other data required demonstrating compliance with the specified requirements.
 3. Shop Drawings, catalog cuts and manufacturer's data indicating insulation, jacketing, adhesives, and coating. Insulating materials shall be certified by manufacturer to comply with the California quality standards for insulating materials.
 4. Display sample cutaway sections.
 5. Manufacturer's recommended method of installation procedures, which will become part of this Section.

1.04 QUALITY ASSURANCE

- A. Qualifications of Manufacturer and Installer, Materials, Fabrication, Execution, and Standard of Quality: Comply with provisions stated under Section 23 0500: Common Work Results for HVAC and Section 23 0513: Basic HVAC Materials and Methods.
- B. Test Ratings:
1. Comply with provisions stated under Section 23 0500 and 23 0513 with emphasis on ASTM E84, NFPA 255, or UL 723. ASTM C167, ASTM C302, UL label or listing of satisfactory test results from the National Institute of Standards and Technology, or a satisfactory certified test report from an acceptable testing laboratory. Approval by the State Fire Marshal is required.
 2. Furnish labels, legibly printed with the name of the manufacturer or listings indicate that fire hazard ratings do not exceed those specified for materials proposed for installation. Flame spread index of not more than 25 and smoke developed rating not exceeding 50.

3. Tests shall be performed on each item individually when insulation, vapor barrier covering, wrapping materials, or adhesives are installed separately at the Project site.
 4. Test insulation, vapor barrier covering, wrapping materials and adhesives as an assembly when they are factory composite systems.
- C. Regulatory Requirements: Insulation furnished and installed under this Section shall conform to the requirements of the California Building Code Parts 4, Mechanical Code, Part 5, Plumbing Code and Part 6, Energy Code.
- D. All chemically based products such as sealers, primers, fillers, adhesives, etc. shall meet the California air quality regulations.

1.05 PRODUCT HANDLING

- A. Protection, Replacement, Delivery and Storage: Comply with provisions stated under Sections 23 0500: Common Work Results for HVAC and 23 0513: Basic HVAC Materials and Methods.

PART 2 – PRODUCTS

2.01 MATERIALS

- A. General:
1. Piping insulating material shall be fire resistant, non-corrosive, shall not break, settle, sag, pack or disintegrate under vibration, nor absorb more than 1 percent moisture by weight.
 2. Piping insulating material shall be furnished with thickness indicated in Table 1, unless otherwise noted on the drawings, and shall furnish thermal resistance in the range of R-4.0 to 4.6 in accordance with inch at 75 degrees F. For any other value of R, insulation thickness shall be calculated accordingly and submitted for review.
 3. Asbestos in any quantity in insulating material is not permitted.
 4. Provide insulation materials, adhesives, coatings, sealants, fitting covers, and other accessories with a fire hazard rating not to exceed 25 for flame spread, 25 for fuel contributed and 50 for smoke developed, except for materials listed as follows:
 5. Nylon anchors for installing insulation to ducts or equipment.
 6. Treated wood blocks.
 7. Flame-proofing treatments subject to moisture damage are not permitted.

TABLE 1 - MINIMUM PIPING INSULATION THICKNESS (1)

Insulation Thickness Required (in inches)
 Space Heating Systems (Steam, Steam Condensate and Hot Water)

Piping System Type	Temp. Range (degrees F)	Run-outs up to 2 (2)	1 and less	1.25 to 2	2.5 to 4	5 to 6	8 and larger
Hi Pres Temp	Above 350	1.5	2.5	2.5	3.0	3.5	3.5
Med Pres Temp	251 to 305	1.5	2.0	2.5	2.5	3.5	3.5
Low Pres Temp	201 to 250	1.0	1.5	1.5	2.0	2.0	3.5

Hot Water	Up to 200	0.5	1.5	1.5	1.5	1.5	1.5
Steam Cond.	-	0.5	1.0	1.0	1.0	1.5	1.5

Service Water Heating Systems (recirculating, piping supply and return)

Hot Water	Up to 180	0.5	1.0	1.0	1.5	1.5	1.5
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Space Cooling Systems (Chilled water, Brine and Refrigerant)

Chilled Water	40-60	0.5	0.5	0.75	1.0	1.0	1.0
Refrigerant/Brine	Below 40	1.0	1.0	1.5	1.5	1.5	1.5
Condensate Drain	½-inch Minimum insulation thickness.	0.5	0.5	0.5	0.5	0.5	0.5
From Air Conditioning Equipment:	Insulate condensate drain lines within building, in room, inside walls and above ceilings.	0.5	0.5	0.5	0.5	0.5	0.5

NOTES:

- (1) For Underground HVAC Piping refer to section 23 2016 Underground HVAC Piping.
 - (2) For piping exposed to ambient temperatures, increase thickness by 0.5 inch.
 - (3) Run-outs to individual terminal units, not exceeding 12 feet in length.
- B. Lagging Adhesives: Shall be nonflammable and fire-resistant and shall have a maximum flame spread index of 25 and a maximum smoke developed index of 50 when tested in accordance with ASTM E84. Insulation finished with canvas shall be provided with laps adhered in accordance to manufacturer's recommendation. A finish coat of same material shall be applied to entire outer surface of lagging cloth at coverage specified by manufacturer.
- C. Canvas Jackets: Furnish 6 ounce in accordance with square foot minimum, 48 by 48 thread count canvas jacketing.
- D. Insulation Jackets:
1. Exterior insulation exposed to weather shall be weatherproofed with Childers aluminum jacketing as basis of design, or Pabco, RPR, or equal. Jacketing shall be manufactured from 1100, 3105 or 5010 aluminum alloy with 3/16-inch corrugations. Smooth or embossed jackets may be permitted in special situations to match an existing installation. Jacketing shall be furnished with an integrally bonded moisture barrier over entire surface in contact with insulation. A minimum thickness of 0.016 aluminum jacketing is to be provided on ducts and piping. A minimum thickness of 0.020 shall be provided on tanks, equipment, and heat exchangers.
 2. Insulated elbows, of 90 degrees and 45 degrees, with a nominal iron pipe size of ½-inch to 8-inch shall be provided with Childers aluminum Ell-Jacs insulation covers as basis of design, or Pabco, RPR, or equal, manufactured from 1100 aluminum alloy of 0.024-inch thickness. Insulated elbows with a nominal pipe size of 10 inches to 18 inches shall be provided with Childers 4-piece aluminum Ell-Jacs as basis of design, or Pabco, RPR, or equal.

- 3. Tees, Flanges, and Valve Insulation in Conjunction with Aluminum Jacketing: Furnish Childers Aluminum Special Fabrications Insulation Covers as manufactured by Childers Products Company, Pabco, RPR, or equal.
- E. Adhesives: Adhesives shall be water based, UL Classified, meet the requirements of NFPA 90A and NFPA 90B, have been tested according to relevant ASTM requirements, and be acceptable to the State Fire Marshal. Name, type and method of installation shall be submitted for review.
- F. Valve and Fitting Cover: When installed in conjunction with PVC jacketing, furnish Zeston 25/50 rated polyvinyl chloride fitting covers as manufactured by Johns Manville, Knauf Insulation, Speedline, or equal.

2.02
2.02

COOLING PIPING SYSTEM INSULATION

- A. General: Insulate chilled water supply and return piping and refrigerant piping.
- B. Materials:
 - 1. Classes of Insulation:
 - a. Class A: Expanded polystyrene pipe insulation, self-extinguishing type, either molded or extruded; Dow Chemical Co. STYROFOAM, ITW Insulation Systems XPS PIB, Foam-Control EPS, or equal.
 - b. Class B: Glass fiber molded pipe insulation ASTM C547. Pipe insulation shall be one piece, preformed, and provide a minimum R factor of 4 at 75 degrees F mean temperature. Insulation shall be faced with all-purpose fire-retardant vapor barrier jacket. Pipe insulation shall be Johns Manville Micro-Lok, CertainTeed Snap-On, Owens Corning FIBERGLAS SSL II-ASJ, or equal.
 - c. Class C: Expanded (foamed) urethane (polyurethane) or polyisocyanurate pipe insulation of self-extinguishing type molded or fabricated, Dyplast Products, LLC ISO-C1/2.0, ITW Trymer, Specialty Products & Insulation Co. Polyisocyanurate Pipe Insulation, Armacell Armalok, or equal.
 - d. Class D: Foamed plastic pipe insulation, self-extinguishing type, ASTM C534 Type 1 - tubular. Pipe insulation shall be one-piece preformed, flexible tubing type and provide a maximum K factor of 0.28 at 75 degrees F mean temperature. Pipe insulation shall be Armacell Armaflex, Aeroflex Aerocel, Rubatex INSUL-TUBE 180, or equal.
 - 2. Locations and Class of Insulation Required: For thickness required, refer to Table 1 of this Section.

TABLE 3 – SERVICE, LOCATION AND CLASS OF INSULATION REQUIRED

<u>SERVICE</u>	<u>LOCATION</u>	<u>CLASS OF INSULATION</u>
Condensate drains from air conditioning equipment	Indoors at all locations including above ceilings and between stud walls	D
Refrigerant suction Liquid line as required	All locations except underground	D

All other piping, except underground	All locations except underground	A, B, C
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3. Adhesives:
 - a. Polystyrene adhesives: Synthetic rubber and resin adhesives specifically designed to adhere extruded and expanded rigid polystyrene and urethane insulation to themselves and to other porous and non-porous substrates.
 - b. Vapor barrier laps and penetrations: Furnish protective coating and lagging adhesive on butt joints of foil-faced vapor barriers, and where pins and staples puncture facings.

2.03 DUCTWORK AND PLENUM INSULATION

A. General: Insulate ductwork and plenums with not less than the amount of insulation tabulated in Table 4, unless noted otherwise on the drawings. Insulation may be omitted under the following conditions:

1. Exposed return air ductwork in conditioned space.
2. Return air ductwork between wall studs inside an interior wall.

TABLE 4 - INSULATION OF DUCTS AND PLENUM

<u>Duct Location</u>	<u>Insulation Type</u>
Exposed interior round and oval supply air ductwork located at Gyms and MPR Stages	DW-1
Exposed interior rectangular supply air ductwork located at Gyms and MPR Stages	L-1
Exterior locations of Health Units and Clinics	DW-2
Exterior locations other than Health Units and Clinics	L-2
In walls, within floor/ ceiling spaces	F-1 or L-1 See note 3
Hot and cold plenums	F-2, DW-1 or L-2 See note 3
Attics, Garages, and Crawl Spaces, within unconditioned space or in basement	F-3 or L-2 See note 3

- B. Insulation Types:
1. DW-1: 1-inch thick insulation sandwiched inside double-wall type ducts and fittings.
 2. DW-2: 2-inch thick insulation sandwiched inside double-wall type ducts and fittings. Duct joints shall be waterproofed.
 3. F-1: 1½-inch blanket fiberglass, factory-laminated with all-service jacket vapor barrier.
 4. F-2: 2-inch blanket fiberglass, factory-laminated with all-service jacket vapor barrier.
 5. F-3: 3-inch blanket fiberglass, factory-laminated with all-service jacket vapor barrier.
 6. L-1: 1½-inch Internal duct lining.

7. L-2: 2-inch Internal duct lining.
- C. Notes:
1. Minimum insulation provided shall be as required by the current California Mechanical Code Title 24 for the most restrictive condition.
 2. Refer to the materials indicated in this section for external insulation & Internal Lining.
 3. External insulation shall be replaced with internal duct lining (of equivalent thermal resistance value unless noted otherwise) where indicated on the drawings or specified elsewhere for sound attenuation.
 4. Provide internal duct lining (1 ½-inch unless noted otherwise) where indicated on the drawings or specified elsewhere for sound attenuation.
 5. All exterior insulated ductworks shall be water proofed at joints, seams and duct penetrations.
- D. Materials:
1. Fire-Resistive Insulation Materials and Coatings: Submit State Fire Marshal pre-approved materials only.
 2. Adhesives: See Paragraph 2.01.E for applicable products.
 3. External Insulation: Provide glass fiber blankets that are factory-laminated with Foil Reinforced Kraft (FRK) vapor barrier facing; Johns Manville Microlite, Owens-Corning SOFTR Duct Wrap, Knauf Insulation Friendly Feel Duct Wrap, or equal. Provide a minimum installed R value as required by the CEC Building Energy Efficiency Standards; but not less than scheduled on Table 5:

TABLE 5
INSULATION OF DUCTS AND PLENUM INSTALLED
THERMAL RESISTANCE "R" VALUES

Type	Labeled Thickness (in inches)	Installed R Value (hr.ft ² .°F/Btu)
F-1	1 ½	4.2
F-2	2	5.6
F-3	3	8.3
DW-1	1	4.2
DW-2	2	5.6
L1	1 ½	6.0
L2	2	8.0

4. Internal Lining: Internal Lining shall be of the type that inhibits the growth of mold, mildew and fungi and shall not contain harmful VOC's or contain glass fiber. Approved Material:
 - a. Polyester Duct Liner:
 - 1) Polyester duct liner shall be an engineered nonwoven, thermally bonded Polyester with a smooth and durable FSK facing.
 - 2) Polyester duct liner must be able to withstand a constant internal temperature up to 250°F must be compliant with Greenguard

Environmental Institute and contain zero VOCs per ASTM D5116. Liner must comply with all applicable standards including ASTM E84, ASTM C411, ASTM C518, ASTM G21, NFPA 90A and 90B, and UL 181.

- 3) Approved Manufacturer: Ductmate Industries “PolyArmor” duct liner or approved equal.
- b. Elastomeric duct liner:
 - 1) Closed-cell, sponge- or expanded-rubber materials. Elastomeric liner must be able to withstand a constant internal temperature up to 300°F and must comply with all applicable standards including ASTM E84, ASTM E96, ASTM C209, ASTM C534 - Type II sheet materials, ASTM C411, ASTM C518, ASTM G21, ASTM G22, NFPA 90A and 90B, and UL 181.
 - 2) Approved Manufacturer: Armacell LLC “AP Armaflex FS” duct liner or approved equal.
 - c. Duct liner must be attached per manufacturer’s requirements using a non-flammable, low VOC water-based adhesive. When applicable, apply a non-flammable, low VOC water-based lagging adhesive to the exposed leading edge of the insulation. Install fasteners per SMACNA HVAC Duct Liner installation instructions.
 - d. Duct liner must be installed per SMACNA Manual, “HVAC Duct Construction Standards, Metal and Flexible,” Third Edition unless otherwise specified.

PART 3 – EXECUTION

3.01 INSTALLATION

- A. Except as specified herein, install material in accordance with recommendations of manufacturer. Do not install insulation materials until tests specified in other sections are completed. Remove foreign material such as rust, scale, or dirt. Surfaces shall be clean and dry. Maintain insulation clean and dry at all times.
- B. On cold surfaces where a vapor barrier must be provided and maintained, insulation shall be installed with a continuous, unbroken moisture and vapor seal. Hangers, supports, anchors, or other projections that are fastened to cold surfaces shall be insulated and vapor sealed to prevent condensation.
- C. Surface finishes shall be extended in such a manner as to protect raw edges, ends, and surfaces of insulation.
- D. Pipe or duct insulation shall be continuous through walls, ceiling or floor openings, or sleeves; except where fire-stop or fire-safing materials are required.
- E. Metal shields shall be installed between hangers or supports and the piping insulation. Rigid insulation inserts shall be installed between the pipe and the insulation shields. Inserts shall be of equal thickness to adjacent insulation and shall be vapor sealed accordingly.
- F. Insulation shall not be installed in the following locations unless otherwise noted:
 1. On vacuum return lines less than 50 feet long.
 2. On unions, flanged connections or valve handles.

3. Over edges of any manhole, clean-out hole, clean-out plug, access door or opening to a fire damper, so as to restrict opening or identification of access.
4. Over any label or stamp indicating make, approval, rating, inspection, or similar data, unless provision is made for identification and access to label or stamp.

3.02 INSTALLATION OF COOLING PIPING SYSTEM INSULATION

- A. General: Chilled water supply and return piping, refrigerant piping and condensate drain lines, after having been tested, shall be cleaned and insulated.
- B. Application: Insulation on chilled water lines, refrigerant suction lines and liquid lines, if indicated, and air conditioner interior drain lines shall be jacketed with fire-resistant vapor barrier of laminated aluminum foil consisting of 2 plies with glass-yarn reinforcing. Jacket joints shall be lapped and sealed with an approved adhesive. Insulation shall be secured with aluminum bands not less than 0.005-inch thick by 3/4-inches wide, spaced not over 12-inch on centers, or as recommended by manufacturer.
 1. Longitudinal Seams: Butt hinged sections of covering tightly together and seal down jacket flap with adhesive, or with factory-applied, self-sealing lap with pressure-sensitive sealer protected with release paper.
 2. End Joints: Wrap joint with a 3-inch wide (minimum) self-sealing tape.
 3. Fittings and Valves: Fittings and valves shall be covered with same material of same thickness as pipe insulation, sealed with an approved, vapor-sealing tape or compound and covered with Johns Manville Zeston polyvinyl-chloride cover, Knauf Insulation Proto PVC Fitting Cover, Speedline Polyco Smoke Safe, or equal.
 4. Pipe hangers shall be insulated or attached to pipe by an insulating insert, butted between adjoining insulation sections.
- C. Additional Jackets:
 1. Exposed Indoor Insulation: Cover with 26 gage galvanized sheet metal jacket to 8 feet above floors, except in mechanical equipment rooms and accessible pipe tunnels.
 2. Exposed Outdoor Insulation: In addition to canvas or fiberglass cloth cover, provide 0.016-inch thick aluminum jacket with 1-inch wide aluminum bands and seals. Install appropriate jackets on valves and fittings.

3.03 INSTALLATION OF DUCTWORK AND PLENUM INSULATION

- A. External Covering:
 1. Before installing duct insulation, sheet metal ducts shall be clean, dry, and tightly sealed at joints and seams, inspected pressure tested, and accepted by LAUSD OAR/ Inspector.
 2. Duct exterior insulation shall be firmly wrapped around ductwork with joints lapped a minimum of 2-inch. Insulation shall be securely fastened with 18 gage copper-lined steel wire, or 16 gage soft-annealed galvanized wire spaced approximately 12-inch on centers and at loose ends, presenting a neat and workmanlike appearance. Where duct width is such that wiring will not fasten insulation firmly against duct an adhesive shall be furnished to fasten insulation to duct with wiring being installed at ends of insulation segment.

3. Insulation on ductwork transporting conditioned air, both supply and return, and outside air intake ducts when pre-conditioned, shall be furnished with a factory-applied, fire-resistant vapor barrier.
4. Exposed Ducts or Plenum:
 - a. Install insulation to ducts or plenum furnished with butt joints, without voids and with adhesive over entire surface of duct. Cover insulation with canvas jacket, fastened tightly to insulation with lagging adhesive. Install 2 finish coats of undiluted adhesive.
 - b. When installing jacket, finished covering shall be even and level, without humps, with constant diameters on round ducts maintained.
- B. Interior insulation - lining:
 1. Dimensions of ducts indicated are net inside dimensions and must include thickness of duct liners to obtain the required duct size.
 2. Install insulation in square turns, where required, to cover interior surfaces before duct turns are installed.
 3. Install lining material during fabrication of duct with sealed face only exposed to air stream.
 4. Interior insulation in ducts or plenums shall not have exposed edges. Edges open to entering or leaving air streams shall be covered, secured in place and sealed with approved duct liner edge sealers.
 5. Insulation shall be fastened to sheet metal with an approved fire-retardant adhesive, with minimum 90 percent coverage and edges firmly adhered.
 6. Mechanical fasteners shall supplement the adhesive on top sections of ducts more than 12-inch wide and on sides of ducts more than 24-inch high and shall be spaced on 16-inch centers maximum. Fastener posts shall be cut off approximately ¼-inch from metal disc.

3.04 CLEANUP

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

3.05 PROTECTION

- A. Protect the Work of this Section until Substantial Completion.

END OF SECTION

SECTION 23 3000
AIR DISTRIBUTION

PART 1 – GENERAL

1.01 SUMMARY

- A. Section Includes: Ductwork and appurtenances required for a complete air transmission and distribution system for the heating, ventilating, and air conditioning systems indicated on Drawings and as specified.
- B. Related Requirements:
 - 1. Section 01 4525 Testing, Adjusting, and Balancing for HVAC
 - 2. Section 23 0513: Basic HVAC Materials and Methods.
 - 3. Section 23 3000: Air Distribution.
 - 4. Section 23 8000: Heating, Ventilating and Air Conditioning Equipment.

1.02 SUBMITTALS

- A. Provide in accordance with Division 01 and Section 23 0500: Common Work Results for HVAC.
- B. Manufacturer's Data:
 - 1. Complete list of items to be furnished and installed under this Section. Material lists that do not require performance data shall include manufacturer names, types and model numbers.
 - 2. Manufacturer's specifications and other data required to demonstrate compliance with specified requirements.
 - 3. Literature shall include descriptions of equipment, types, models, sizes, capacity tables or curves marked to indicate performance characteristics, electrical requirements, options selected, space requirements, including allowances for servicing, and other data. Data shall include name and address of nearest service and maintenance organization that regularly stocks repair parts. Listings of items that function as parts of an integrated system shall be furnished at one time.
 - 4. Submit complete acoustical test reports showing that proposed products have been tested in accordance with latest editions of relevant ASHRAE and AHRI Standards (ANSI/ASHRAE Standard 70 for air inlets and outlets; ANSI/ASHRAE Standard 130 and AHRI 880 for terminal units) and will be suitable for operation in Project spaces with specified maximum noise criteria (NC) requirements. The results of all testing shall be certified by an independent testing agency and submitted to the ARCHITECT for approval. The submittal shall include a complete description of the test conditions, methods and procedures.
 - 5. Submittals shall include a tabulation of proposed products, identification of Project spaces where proposed products are to be installed, maximum allowable NC for all Project spaces, and product NC (at specific design air volume) for all Project spaces.
 - 6. Shop Drawings: Shop Drawings indicating methods of installation of equipment and materials, sizes and gages of ducts, and details of supports. Items to be covered shall include but not be limited to following:
 - a. Layout of ductwork and equipment drawn to scale to establish that equipment will fit into allotted spaces with clearance for installation and maintenance. Indicate proposed details for attachment, anchoring to, and hanging from

structural framing of building. Indicate vibration isolation units, foundations, supports, and openings for passage of pipes and ducts.

- b. Drawings indicating locations and sizes of sleeves and prepared openings for pipes and ducts.
- c. Typical details of supports for equipment and ductwork.

1.03 QUALITY ASSURANCE

- A. Installer's and Manufacturer's Qualifications: Comply with provisions stated under Section 23 0500: Common Work Results for HVAC.
- B. Sound power level measurements and Manufacturers' NC value calculations shall be conducted in complete accordance with the latest version of ANSI/ASHRAE Standards 70 and 130 and AHRI 880.

1.04 DELIVERY, STORAGE AND HANDLING

- A. Comply with provisions stated in Section 23 0500: Common Work Results for HVAC.
- B. Ensure ducts are clean and free of dirt, dust, moisture, oils and other contaminants that can lead to poor air quality. Cover openings of ductwork with a self-adhering protective film. Film shall not leave a residue on metal after removal, and shall be highly resistant to tears and punctures.

1.05 COORDINATION

- A. Coordinate activities in accordance with provisions of Section 23 0500: Common Work Results for HVAC.

PART 2 – PRODUCTS

2.01 GENERAL

- A. Unless otherwise noted, provisions, including amendments thereto, of the latest edition of the HVAC Duct Construction Standards of Sheet Metal and Air Conditioning Contractor's National Association (SMACNA) and the California Mechanical Code (CMC), are hereby made part of this Section.
- B. Rectangular, round and flat oval ducts shall be manufactured and installed in accordance with requirements of the latest edition of the HVAC Duct Construction Standards – Metal and Flexible of SMACNA.
- C. Sheet metal ducts shall be fabricated from galvanized steel, aluminum or stainless steel.
- D. Galvanized steel ducts shall be fabricated of galvanized steel sheet, lock forming grade, conforming to ASTM A653 and A924.
- E. Galvanized steel ducts gage thickness and permissible joints and seams of ductwork shall conform to requirements of the latest edition of the HVAC Duct Construction Standards – Metal and Flexible of SMACNA and the CMC unless noted otherwise on the drawings. The more stringent requirements shall prevail.
- F. Button punch snap-lock seams, using Lockformer or equal, shall be permitted only in concealed areas using 20 and 22 gage galvanized steel ducts with screws added at the ends. Button punch snap-lock is not permitted for aluminum or duct lighter than 22 gage.
- G. Ducts shall be reinforced in accordance with the latest edition of the SMACNA HVAC Duct Construction Standards: Cross-broken Duct: Duct sizes 19 inches wide and larger which have more than 10 square feet of unbraced panel shall be beaded or cross-broken. This requirement is applicable to 20 gage or less thickness and 3 inches w.g. or less pressure. For details, refer to SMACNA manual.

- H. Round and Oval Galvanized Steel and Aluminum Ducts:
1. Round Spiral Ducts and Fittings: Fabricated from galvanized sheet steel shall be machine-formed spiral pipe with sealed spiral locking joints. Fittings shall be furnished with continuous corrosion-resistant welds. Provide gages of ducts and fittings recommended by manufacturer.
 2. Details of seams and transverse joints for round duct and fittings shall conform to SMACNA standards.
 3. Flat oval ducts shall be provided as indicated on the Drawings. Reference standard details in SMACNA manual.
 4. Minimum duct wall thickness, and permissible joints and seams of ductwork for flat oval duct construction shall conform to requirements in the latest edition of the HVAC Duct Construction Standards – Metal and Flexible of SMACNA and the CMC. The more stringent requirements shall prevail.
 5. These provisions apply for ducts furnished for indoor comfort heating, ventilating and air conditioning service only.
- I. Flexible Ducts
1. Flexible duct shall be non-metallic, insulated for conditioned air supply and return. The flexible ducts shall be factory fabricated with exterior reinforced laminated vapor barrier, 1 ½-inch thick fiber glass insulation (K = 0.25 at 75 degrees F), encapsulated zinc-coated spring steel wire helix and impervious, smooth, non-perforated interior vinyl liner and factory fabricated steel connection collars. For the composite assembly, including insulation and vapor barrier, comply with NFPA Standard 90A or 90B and tested in accordance with UL Standard, UL 181. Non-insulated metallic ducts shall be provided for exhaust only.
 2. Methods of installations, standards for joining and attaching, and supporting flexible duct shall conform to applicable provisions of SMACNA manual.
 3. Specifications herein shall not supersede installation requirements by flexible duct manufacturer if those are more stringent.
- J. Aluminum Ducts:
1. Material for aluminum duct shall be of 3003-H14 alloy aluminum sheets, with such designation embossed or stenciled on each sheet. Minimum tensile strength shall be 19,000 psi.
 2. Aluminum duct thickness and permissible joint and seams shall conform to requirements of the latest edition of the HVAC Duct Construction Standards-Metal and Flexible of SMACNA, and CMC.
 3. Aluminum ductwork shall be furnished to transport moisture-laden air from shower rooms, shower drying rooms, dishwashers and discharge ducts from evaporative condenser and cooling towers.
 4. Unless otherwise noted, follow SMACNA Duct Construction Details for steel construction standards as indicated for unreinforced duct, reinforced duct, or cross-broken duct.
 5. Button punch snap-lock seams on aluminum ducts are not permitted.
- K. Stainless Steel Duct:
1. Materials for stainless steel duct shall be stainless steel conforming to ASTM A167 and A480.

2. Stainless steel ducts shall be provided as required and indicated on the Drawings.
 3. Fume hood exhaust shall be stainless steel Type 304.
 4. Kitchen exhaust duct system shall be stainless steel Type 304.
 5. Stainless steel ducts shall be constructed with welded joints except for connections to equipment which shall be flanged joints with gaskets.
 6. Entire stainless steel duct systems shall comply with current CMC requirements for product conveying ducts except where the requirements of this Section are more stringent.
- L. Fittings and Other Construction Details: Details of fittings such as elbows, turning vanes, branch take-off and connections, duct access doors, connections for grilles, registers and ceiling diffusers, flexible connector at fan, etcetera, shall conform to applicable provisions of this Section or SMACNA manual.
- M. Duct Seam and Joint Sealant: Provide sealant for metal ducts at duct joints which are defined as transverse joints between duct sections including girth joints, branch and sub-branch intersections, duct collar tap-ins, fitting subsections, louver and air terminal connections, access doors and frames, and abutments to building structure. Also provide the same at duct seams which are defined as longitudinal joint between duct sections. Spiral lock seams in factory fabricated round or oval ducts are excluded.
1. Sealant for low-pressure ducts shall be: Design Polymerics DP1010 or DP1020, Childers CP-145A/CP-146 Chil-Flex, Foster's 32-19 Duct-Fas, Miracle-Kingco Glenkote Seal-Flex, Ductmate Industries PROseal or FIBERseal, or equal.
 2. Provide sealing material for medium-pressure ducts as described in the SMACNA manual for those pressures.
 3. Sealant materials shall comply with the flame spread and smoke developed rating of current CMC when tested in accordance with ASTM E84.
 4. Sealant for exposed to weather ducts shall pass the Weather Resistance Test per ASTM G154 at 2000 hours QUV.
- N. Restrictions:
1. Zinc-coated steel duct shall not be installed for ductwork transporting moisture-laden air. Flexible duct may only be furnished where specifically indicated on Drawings. Aluminum ducts shall not be installed for internal pressures above 2 inches of water.
 2. Fiberglass duct is not permitted as a substitute for sheet metal duct.

2.02

DAMPERS

- A. Manually Operated Volume Control Dampers:
1. VD-1, Rectangular: Multi-blade type, opposed blade operation, 16 gage galvanized steel blades; center pivoted on 3/8 inch diameter steel trunnions; interlocking edges; dampers shall be in own angle frame, full duct size as indicated on Drawings; frame of minimum 16 gage steel channel construction. Provide with damper operator and axles positively locked to blade. Ruskin MD35, Pottorff MD-42, Greenheck MBD-15 or equal.
 2. VD-2, Round: Frame shall be constructed of not less than 20 gage galvanized steel, blades of not less than 20 gage galvanized steel channel construction with factory neoprene seals, 1/2 inch diameter axle shafts and locking hand quadrant. Ruskin MDRS25, Greenheck MBDR-50, or equal.

3. VD-3, Oval: Frame shall be constructed of not less than 14 gage galvanized steel channels with factory blade seals of not less than 12 gage galvanized steel with not less than ½ inch diameter axle shafts. Provide Ruskin standard construction for frame, blade and axle size, thickness and material variation. Provide adjustable locking hand quadrant. Ruskin CDO25, or equal.
- B. Automatic Fire Dampers:
1. FD, Fire Dampers: Shall conform to requirements of and be listed by State of California Fire Marshal and NFPA 90A. Dampers shall provide airflow resistance not to exceed 0.05 inch water gage static pressure at 900 fpm or 0.25 inch water gage at 2,000 fpm. Dampers shall be installed in required steel sleeve at each penetration of a rated partition.
 - a. Vertical-mounted fire dampers: Fire damper shall be curtain type with blades removed from the air stream to allow for maximum free area. Dampers will be provided in factory sleeves as tested and listed by manufacturer. Dampers shall be rated for 1 ½ hours for installation in one or 2-hour partitions. Provide UL listed fusible links of adequate size and temperature rating. Dampers will be installed according to the manufacturer's recommended installation instructions provided with units. Provide suitable access for inspection and servicing of each damper. Pottorff VFD-10/VFD-10D Series, Ruskin IBD/DIBD Series, Greenheck FD/DFD Series, or equal.
 - b. Ceiling fire dampers: Ceiling fire dampers shall be butterfly type with ceramic material to minimize heat radiation. Dampers shall be rated for one hour and shall be furnished as a part of an integral sleeve ceiling box that will accept air distribution, have a UL listed and pre-mounted hanger tabs. Dampers shall be installed according to the manufacturers recommended installation instructions. Pottorff CFD-15 Series, Ruskin CFD Series, Greenheck CRD-1 Series/CRD-2, or equal.
 - c. Combination fire and smoke dampers: Combination fire and smoke dampers shall be louver bladed type. Units shall be tested and listed under UL 555 and UL 555S. Rating 1 ½ hours for installation in one or 2-hour partitions. The seals shall be non-degradable steel to steel. Leakage shall not exceed 15 cfm/sq. ft. at one inch w.g. and shall be tested at 850 degrees F. Dampers shall be capable of being remotely controlled and reset for pressurization and smoke evacuation. Fire-releasing device shall be UL 33 listed melting fusible links. Dampers shall be provided in sleeves with pre-mounted non-stall motor actuators and dual-position indicators for remote annunciation, if required. The complete assembly shall be factory cycled and tested prior to shipment. Provide suitable access for inspection and servicing of each damper. Pottorff FSD-141 with non-stall motor, Ruskin FSD37 or FSD60 with electric fuse link Model EFL 200, with electric non-stall motor, Greenheck FSD Series, with non-stall motor, or equal.
 2. Electronic Damper Actuators: Refer to Sub-paragraph 2.04.B.3.
- C. Relief Dampers: Parallel multi-blade, counter balanced type with adjustable counter weights. Constructed of 20 gage galvanized sheet steel or extruded aluminum with solid stops all around. Bearings shall be dust proof, ball bearings. Damper shall open on a positive pressure of 0.01 inch within space and close to a backdraft. Interlocking edges shall prevent dust infiltration when closed. Air Balance, Inc., Pottorff, Ruskin, Metal Form Manufacturing Co. Inc., or equal.

- D. Duct Access Panels: Provide factory fabricated access panels in ducts where required for servicing fire or smoke dampers, and at other locations as specified in this Section. Units shall consist of removable panel, gasketed and pressure sealed by controlled spring tension locks. Construct unit, including interior parts, of same material as duct. Units shall be constructed to be suitable for installation in systems of up to 5 inches water gage static pressure.

2.03

AIR DISTRIBUTION DEVICES

A. General:

1. Grilles, registers, diffusers and appurtenances shall conform to requirements specified herein and shall be of type and sizes as specified and indicated on Drawings. Performance shall be in accordance with ANSI/ASHRAE Standard 70 including airflow velocity, pressure, temperature, and sound measurements.
2. Sponge neoprene, rubber, vinyl or felt border gaskets shall be provided for surface-mounted registers, grilles or diffusers.
3. The noise generating characteristics of all specified grilles, registers, and diffusers shall be tested to, and comply with, all requirements of this specification. Representative samples shall be subjected to tests in accordance with applicable standards and procedures in order to demonstrate such compliance. A special test for this project is not required if the manufacturer has previous certified test results that can be made applicable to this project. Maximum Sound Levels of diffusers, grilles and registers shall be as follows:

Administrative office area:	NC 30
Rooms:	NC 20
Libraries and other noise sensitive areas:	NC 25
Gymnasiums, cafeterias, lockers areas:	NC 30

4. Provide suitable frame types to match the ceiling types as specified or indicated on the Architectural Drawings.
5. Ceiling diffusers shall be provided with equalizing grids.
6. Ceiling mounted grilles, registers and diffusers shall be provided with a factory applied, baked enamel, dull finish, bone white to match acoustical ceiling tile.
7. Grilles or registers mounted on painted walls or other surfaces shall be furnished with a baked prime coat and finish painted in accordance with Section 09 9000: Painting and Coating.
8. Do not provide opposed blade dampers at diffusers and registers to balance the airflow, as they tend to create noise. Provide a manual volume damper at each branch take-off and also at branch duct to each diffuser and register upstream of the flexible duct connections. Air throw patterns shall be as indicated on the drawings.
9. Diffusers, registers and grilles indicated or scheduled on the drawings to comply with special requirements shall take precedence over the standard items specified.

B. Ceiling Diffusers - Round, Square, Rectangular:

1. CD-1 For room areas of less than 10 feet ceiling height only. Units shall be square or rectangular modular core type as indicated on the drawings. Anemostat QC Series, Krueger Model 1240, Price SMCD Series, or equal.
2. CD-3 For non-classroom areas of higher than 10 feet ceiling height. Units shall be square or rectangular louver faced type. Anemostat D Series, Krueger Model SH, Price SMD/AMD Series, or equal.

3. CD-4: Units shall be round, adjustable pattern, and surface-mounted type. Anemostat C-27, Krueger RM Series, Price RCDE Series, or equal.
4. CD-5: Units shall be adjustable linear slot type. Anemostat SLAD Series, Krueger Model 1900, Price AS Series, or equal.
- C. Grilles - Return, Exhaust, Ceiling, Square, Rectangular:
 1. GR-1 Acoustical Tile on Plaster Ceiling: Return and exhaust grilles shall be single deflection type with horizontal fixed face bars set at straight or 45 degree angle, ½ inch spacing and flush and flanged for surface mounting. Anemostat S3HD Series, Krueger Model S80/S85, Price 500/600 Series, or equal.
 2. GR-2 Prefabricated Acoustical Tile Ceiling with Inverted Exposed T-Bars: Return and exhaust grilles shall be with single deflection horizontal fixed face bars, set at straight or 45 degree angle, ½ inch spacing and flush, lay-in panel type with nominal overall dimension of 24-inch by 24-inch. Anemostat Type SAC3L Series, Krueger Model S80/S85, Price 500/600 Series, or equal.
- D. Registers, Supply, Return, Wall:
 1. WR-1: Sidewall supply register shall be double deflecting type with loose key-operated opposed blade volume control. Anemostat S2 Series, Krueger Model 80/880, Price 500/600 Series, or equal.
 2. WR-2: Sidewall return register shall be single deflecting type with horizontal fixed face bars set at 45 degree angle flush and flanged for surface mounting and complete with loose key-operated opposed blade volume control. Anemostat S3 Series, Krueger Model S80/S85, Price 500/600 Series, or equal.

PART 3 – EXECUTION

3.01 EXAMINATION

- A. Examine areas and conditions under which Work of this Section will be performed. Correct conditions detrimental to proper and timely completion of Work. Do not proceed until unsatisfactory conditions have been corrected.

3.02 DUCTWORK

- A. Construct ductwork according to details of fabrication and methods of support, as indicated in the SMACNA manuals and CMC, unless specified or indicated otherwise in this Section or on Drawings. In event of conflict, the most stringent requirement shall be provided.
- B. Unless otherwise required, construct ducts to conform accurately to dimensions indicated and to be straight and smooth on inside, with joints neatly finished.
- C. Duct dimensions indicated are net inside dimensions.
- D. Where aluminum is welded, provide a minimum thickness of 16 gage, and use gas inert tungsten process of welding.
- E. Anchor ducts to building structural slab, framing and roof decking and detail method of anchoring and fastening if not indicated on Drawings. Supports shall be seismically constructed as required by the latest edition of the SMACNA guidelines.
- F. Construct and install ducts to be completely free from vibration under operating conditions.
- G. Indicate on layout drawing, required for suspended ductwork, location of supports, loads imposed on each fastening or anchor, typical details for anchorage, and details for special anchorage for supports attached to metal roof decking.
- H. Attach supports only to building structural framing members and concrete slabs.

- I. Where supports are required between structural framing members, detail and install suitable intermediate metal framing.
- J. Ducts transporting air-conditioned or heated supply air shall be insulated in accordance with requirements of Section 23 0700: HVAC Insulation.
 - 1. Ducts exposed to weather shall be prefabricated double wall type from HVAC equipment through building envelope.
- K. Ferrous angles and structural members and joining collars specified for construction and support of ductwork and plenums shall be primed with one heavy coat of required asphaltic aluminum paint before installation or fabrication. Metal surfaces shall be thoroughly cleaned before installation of paint. Galvanizing may be provided instead of painting. Installed duct hanger rods concealed in furred ceilings and walls are not required to be primed or painted.
- L. Broken places in galvanized coating shall be acid washed and then completely soldered over or painted with galvanizing paint.

3.03 DUCT CONSTRUCTION

- A. Minimum ductwork gages, joints, reinforcing, and bracing of ductwork shall conform to SMACNA and CMC. The most stringent standards shall prevail. Additional bracing shall be provided to prevent objectionable panel vibration.
- B. Button punch snap-lock seams, using Lock-former or equal, shall be permitted only in non-accessible areas using 20 and 22 gage galvanized steel ducts with screws added at the ends. Button punch snap-lock is not permitted for aluminum or duct lighter than 22 gage.
- C. Provide longitudinal seams of the grooved snap lock, or Pittsburg and standing, sealed spiral or continuously welded.
- D. Ferrous angles and structural members and joining collars specified for the construction and support of ductwork and plenums shall be primed with one heavy coat of asphalt aluminum paint before installation or fabrication. The metal surface shall be thoroughly cleaned before application of the paint. Galvanizing may be provided instead of painting. Installed duct hanger rods concealed in furred ceilings and walls is not required to be primed or painted.
- E. Broken places in galvanized coating shall be acid washed and then completely soldered over or painted with galvanizing paint.
- F. S-type or drive-slip type girths or longitudinal seams shall not be furnished for ductwork installed outdoors or mounted on roofs.
- G. Broken places in galvanized coating shall be acid washed and then completely soldered over or painted with galvanizing paint.

3.04 DUCT ELBOWS AND TURNING VANES

- A. Duct elbows, including supply, exhaust, and return, shall be provided with a centerline radius of 1.5 times duct width parallel to radius whenever possible; centerline radius shall not be less than width of duct parallel to radius.
- B. Where space does not permit above radius, or where square elbows are indicated on Drawings, turning vanes shall be installed whether indicated on Drawings or not.
- C. Turning vanes shall conform to SMACNA and CMC.

3.05 DUCT JOINTS AND SEAMS

- A. Conditioned air supply ducts shall be furnished with joints and seams sealed, welded for air tightness, except spiral seam factory machine formed duct components. Spiral seam is exempted. Joints between slip-fit components may be assembled with all seams and joint connections fastened with screws.

- B. Other ducts shall be furnished with joints and seams sealed by using sealant, taping, soldering, or welding. Ducts for grease hood exhaust shall be furnished with grease-tight welding or brazing on external surface for joints and seams. Fiberglass ducts shall be provided with a thermally activated closure system, Johns Manville Fortifiber Therm-Lock with Automatic Bond Indicator dots, or equal.
- C. S-slip or drive-slip type girths or longitudinal seams are not permitted on exterior or exposed rooftop mounted ductwork.
- D. Caulking, taping, or other joint or seam treatment shall be provided in accordance with recognized standards.
- E. Seams around fan, coil housing and plenums shall be sealed with gaskets or sealing compound to provide an airtight assembly.
- F. Stainless steel ductwork connected to range hoods and fume hoods shall be provided with grease-tight, gas tight welded seams, and shall be constructed and installed so that grease or other material cannot become pocketed in any portion thereof, and system shall slope downward toward hood not less than 1/4 inch per lineal foot. Gasketed flanged joints with sealing compound shall be used only at fan and fume hood connections.
- G. Alternative duct connectors such as Ductmate Industries, Mez Industries, or equal may be used if the following conditions are met:
 - 1. One of the specifically listed connectors is submitted and approved by the ARCHITECT and OAR.
 - 2. The correct size connector, application, and gage of material conform to SMACNA Standards.
 - 3. The connector is installed per manufacturer's specifications.

3.06 DUCT TRANSITION

- A. Slopes in sides of transition pieces shall be no greater than 1 to 5. Abrupt changes or offsets in duct system are not permitted, except when reviewed by the ARCHITECT.

3.07 DUCT TEST HOLES

- A. Holes in ducts and plenums shall be provided for pilot or static tubes for obtaining air measurements to balance or check air systems. Holes shall be covered with neoprene gasketed sheet metal cover or plugged with a fitted neoprene plug chained to duct.

3.08 FLEXIBLE CONNECTIONS

- A. At points where sheet metal connections are installed to fans or air handling units, or where ducts of dissimilar metals are connected, a flexible connection of commercial grade, Duro Dyne Durolon, Ventfabrics Ventglas, Ductmate Industries Proflex, or equal, non-combustible material shall be installed and securely fastened by zinc-coated steel clinch-type bands or a flange type connection. Inlet and outlet openings shall be axially in-line, maximum deviation of centerline shall be less than 5 percent of diameter or shortest dimension of a rectangular inlet of fan or air handling unit, with system at rest. Duct end of connection shall be seismically restrained if more than 4 feet from last support.

3.09 AIR TERMINAL DEVICES

- A. General: Install supply devices after ducts, plenums, and casings have been cleaned and blown free of small particles, as specified. Devices shall be aligned to be parallel to ceiling construction or walls and ceiling surfaces, and shall be pulled tightly to compress gaskets and to fit neatly against surfaces.

- B. Diffusers: Support surface mounted ceiling diffusers from angles or channels resting on and fastened to ceiling construction. Do not support from ducts. Install lay-in diffusers on T-bar ceilings with hanger wires from each corner and not supported by ceiling structure. Provide sheet metal adaptor box above each diffuser to allow space for volume controller with round collars for connection to round ducts where indicated on Drawings. Fasten duct-mounted diffusers to duct collars.
- C. Registers and Grilles:
 - 1. Install wall supply registers at least 6 inches below ceiling, unless otherwise indicated. Locate return and exhaust registers 6 inches below ceiling unless otherwise indicated.
 - 2. Support ceiling diffuser type inlets, registers, and grilles as required above for ceiling diffusers.
 - 3. Fasten wall mounted and duct mounted registers and grilles to flanges of duct collars.

3.10 DAMPERS

- A. Manually operated dampers, gravity dampers, fire dampers, and motor operated dampers shall be furnished and installed as specified and indicated. Upon completion of installation, dampers shall be checked, lubricated, and adjusted so that they operate freely, without binding. Dampers shall be of standard commercial manufacture, complete with damper frame. Where painting is required, they shall be shop finished unless otherwise noted.
 - 1. Provide and install manual volume dampers per SMACNA standards to allow balancing per AABC, NEBB or TABB Procedures and Standards whether indicated on the drawings or not.
 - 2. Balancing dampers shall be installed in main supply ducts from fan discharge plenums, where two or more ducts are connected to each plenum, although such balancing dampers may not be indicated. Each zone shall be provided with a manual volume damper. Sheet metal screws shall be installed through handles and into ducts to lock damper in place after test and balance.
 - 3. Each supply, return, and exhaust branch shall be provided with manual volume dampers.
 - 4. Do not provide opposed blade dampers at air inlets and outlets.
 - 5. Each supply, return, and exhaust inlet or outlet shall be provided with a manual volume damper. This damper shall be a minimum of 5 feet upstream of the air outlet and inlets. An acoustic flexible duct should be provided between the outlet and inlet and the damper for concealed ducts.
 - 6. Dampers installed in accessible locations shall be provided with locking and indicating quadrants. Ventfabrics Ventlok, Duro Dyne, Young Regulator Co., or equal.
 - 7. Dampers installed in ductwork in furred ceiling spaces or in roof spaces with less than 30 inches of clearance below beams, joists, or other construction, and where access panels are not provided shall be furnished with damper rods extended below ceiling and terminated with a concealed damper regulation. Ventfabrics Ventlok, Young Regulator Co., Duro Dyne, or equal.
 - 8. Dampers not identified as splitter, extractor, or butterfly dampers shall be of multi-louver type arranged for opposed blade operation. Damper shall be same dimension as adjoining duct and be tight closing. Blades shall not be greater than 9 inches. Dampers shall be not less than 18 gage steel.

9. Motor operated dampers shall be furnished by temperature control manufacturer as part of temperature control equipment and shall conform to requirements of Section 23 0900: HVAC Instrumentation and Controls.
10. Dampers shall be provided with accessible operating mechanisms. Where operators are exposed in finished portions of building, operators shall be chromium-plated with exposed edges rounded. Splitter dampers are not permitted unless specified and reviewed by the ARCHITECT.
11. Dampers shall not be installed in combustion air ducts.
12. Access panels shall be installed for access at each damper's operating mechanism.

3.11 FIRE AND SMOKE DAMPERS

- A. Fire dampers or combination fire and smoke dampers shall be installed and accessible at duct penetrations of rated walls and partitions and as required by State Fire Marshal and NFPA 90A, 92A, 92B, and 101.
- B. Fire dampers shall be sized, and adjoining duct enlarged, to assure full size air passage of connecting ductwork.
- C. Install smoke dampers as indicated on Drawings and as required in ducts penetrating smoke isolation separations.
- D. Fire dampers or combination fire and smoke dampers shall be electrically actuated, power open-fail close type, UL 555 and UL 555S classified for 1-1/2 hours.
- E. Provide a service disconnect switch for each and every combination smoke and fire damper.

3.12 DETECTORS

- A. Smoke detectors shall be installed in accordance with requirements of the California Mechanical Code.
- B. Smoke detectors shall be installed in systems of over 2000 CFM capacity to detect presence of smoke and automatically shut down air handling units or fans unless it has been verified with the electrical installer that Exception 1 to CMC 609.0: Automatic Shutoffs, regarding automatic shutdown of systems with total coverage smoke detection systems is applied.
- C. Smoke detectors shall be installed in supply system downstream of filters.

3.13 BACKDRAFT DAMPERS

- A. Backdraft dampers shall be installed at locations indicated in accordance with the State of California Building Energy Efficiency Standards, Title 24, CCR.

3.14 DUCT SLEEVES AND PREPARED OPENINGS

- A. Furnish duct sleeves for 15-inch diameter ducts or less passing through floors, walls, ceilings, or roof and install during construction of the floor, wall, ceiling, or roof. Install round ducts larger than 15 inches diameter and square and rectangular ducts passing through floors, walls, ceilings or roof through prepared openings. Provide duct sleeves and prepared openings for duct mains and duct branches.
- B. Provide one inch clearance between duct and sleeve or between insulation and sleeves for insulated ducts, except at grilles, registers and diffusers.
- C. Provide prepared openings for round ducts larger than 15 inches in diameter and for square and rectangular ducts with one inch clearance between duct and openings or between insulation and opening for insulated ducts, except at grilles, registers and diffusers.
- D. Provide closure collar of galvanized sheet metal not less than 4 inches wide unless otherwise indicated on Drawings on each side of walls or floors where sleeves or prepared openings are

provided except where grilles or diffusers are installed. Install collar tight against surface. Fit sharp edges of collar installed around insulated duct to preclude tearing or puncturing insulation covering vapor barrier. Fabricate collars from round ducts in steel. Provide not less than 4 nails to attach collar where openings are 12 inches in diameter or less and not less than 8 nails where openings are 20 inches in diameter or less.

- E. Pack space between sleeve or opening and duct or duct insulation with commercial grade packing yarn.

3.15 FLEXIBLE DUCT RUNOUTS

- A. Runouts from branches, risers or mains to air terminal units and outlets may be pre-insulated, factory fabricated flexible ducts complying with NFPA 90A. Flexible ductwork shall not exceed 7 feet in length. When required to suspend flexible ducts, furnish hangers of type recommended by manufacturers of pre-insulated flexible duct and install at intervals recommended. Method of attachment to other components of air distribution system for a vapor-tight joint shall be in accordance with printed instructions of flexible duct manufacturer. Bend radius shall be 1-1/2 times diameter of duct, measured from centerline. Bends greater than 90-degree angle are not permitted. Non-metallic flexible duct shall be permitted only in T-bar suspended ceilings.

3.16 DUCT HANGERS AND SUPPORTS

- A. Exposed or easily accessible ductwork: All exposed ducts shall be supported by all-thread Rod as a single hanger and or a trapeze support for rectangular duct work in accordance with requirements of the latest edition of the HVAC Duct Construction Standards – Metal and Flexible of SMACNA.
- B. Non-accessible ductwork: Non-exposed and hidden from sight during regular operations ductwork, rigid round, rectangular, and flat oval metal ducts, shall be installed with support systems conforming to SMACNA Standards.
- C. Where ducts are installed one above the other, they shall be individually supported on a trapeze of steel angles with 3/8 inch supporting steel rods securely fastened to overhead construction. A minimum distance of 3 inches shall be maintained between ducts wherever possible, but in no event shall distance be less than 2 inches. Minimum sizes of steel angles shall be 1 1/2-inch by 1 1/2-inch by 1/8 inch for duct sizes through 60 inches in greatest dimension, 2-inch by 2-inch by 1/8 inch for duct sizes 61 inches through 84 inches, 2-inch by 2-inch by 3/16 inch for duct sizes 85 inches through 96 inches, and 2-inch by 2-inch by 1/4 inch for duct sizes over 97 inches.
- D. Ducts six square feet area and greater and or minimum 28" round or greater shall be seismically restrained. Refer to Section 23 0548: HVAC Sound, Vibration and Seismic Control.
- E. Hangers shall not be supported by, or fastened to, non-structural members including blocking. Toggle or Molly type bolts are not permitted.
- F. Vertical ducts shall be supported with suitable angles on each side of each duct located at each floor and at intervals not to exceed 8 feet. Angles shall be sized and installed according to SMACNA Standards for required span so that they will be rigid, without bending or sagging.
- G. Roof-mounted ductwork shall be installed a minimum 12 inches above roof and shall be supported by galvanized welded pipe, one on each side, fastened to roof structure, flashed and sealed to roof membrane. Install supports at each turn, unit connections, and each penetration, and space at maximum 6 feet off-center in general. Pitch pockets are not allowed.

3.17 ACCESS PLATES AND DOORS

- A. Access plates and doors shall be furnished and installed where stops, valves, fire dampers, fusible links, coils, damper operating mechanism, control equipment, lubrication fittings, air filters, air handling equipment and similar items normally requiring adjustment or servicing are installed in concealed spaces.
- B. Access plates and doors shall be located to permit convenient access to equipment sized to permit removal of equipment for servicing. Access plates shall be no less than 12-inch by 12-inch in clear opening. Proper servicing of equipment requires adequate access for maintenance personnel. Access doors shall not be less than 24-inches by 24-inch, unless otherwise detailed. Two or more valves shall not be located in same access area unless sufficient clearance is provided for operation, servicing and removal of each valve.
- C. Openings in ducts or plenums whose longer dimension does not exceed 12 inches may be covered by a plate of same material as duct, gasketed and fastened to duct or plenum with sheet metal screws.
- D. Access plates in floors shall not be less than 8-inch by 8-inch and shall be carborundum surface brass with cast brass frames anchored into concrete. Access plates in tile walls shall be chromium plated brass and polished. Serrated plates furnished as part of a clean-out assembly are permitted in floors instead of a separate plate.
- E. Access plates and doors in walls and ceilings of finished rooms and in locations normally accessible to students shall be furnished with continuous piano hinges, unless otherwise specified, and a special flush type spring-loaded latch requiring an Allen wrench to operate. Access devices shall be installed after plastering in plaster ground openings.
- F. Access panels or doors penetrating one-hour fire resistive ceilings shall meet code requirements for such openings.
- G. Access panels shall be fire-rated; Milcor, or equal. Access doors shall be as required for installation in openings penetrating one-hour fire resistive ceilings. Access doors shall be furnished with a flush, key-operated cylinder lock, furnished with two keys each, instead of Allen headlock for non-rated ceilings.
- H. Access panels that are part of an integrated ceiling are specified in Section 09 8433: Cementitious Wood Fiber Acoustical Units. Identification markers shall be affixed to adjacent supports, under this portion of Work, to indicate location and type of mechanical device to be serviced.
- I. Access panels installed in ducts or plenums located in heater or equipment rooms containing gas-fired equipment shall be furnished with heavy-duty spring closing hinges and refrigerator door type catches unless otherwise required. When these panels are intended for maintenance personnel access, catches shall be operable from both interior and exterior.
- J. Other access panels, except those specified above, shall be furnished with suitable hinges and one or more sash fasteners.
- K. Panels located in ducts and plenums shall be installed with gaskets made of synthetic rubber, felt, or similar material to provide an airtight installation. Panels shall be constructed and reinforced to prevent vibration.
- L. Label the words "FIRE DAMPERS" on panels over fire dampers and words "DO NOT OPEN - HEATER IS OPERATING" on panels located in heater or equipment rooms. Letters shall be approximately 3 inches high, if space is available.
- M. Furnish a key to operate latch access plates, one for each access plate, but not to exceed five keys for any one Project.
- N. Access plates and panels shall be furnished with manufacturer's name or trade mark and model number cast or stamped thereon, or upon a label permanently affixed thereon.

- O. Provide duct through roof flashing as detailed in the SMACNA standards or as indicated on Drawings.
- P. Refer to SMACNA for access plate and door construction.

3.18

CLEANUP

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

3.19

PROTECTION

- A. Protect the Work of this Section until Substantial Completion.

END OF SECTION

SECTION 23 3813
KITCHEN VENTILATION SYSTEM

PART 1 – GENERAL

1.01 SUMMARY

- A. Section Includes: Kitchen ventilation system. Including, but are not limited to:
 - 1. Make-up Air Unit with Heating and Cooling.
 - 2. Exhaust Fan.
 - 3. Ductwork and Appurtenances.
 - 4. Controls.
- B. Related Requirements:
 - 1. Division 01: General Requirements.
 - 2. Division 26: Electrical.
 - 3. Section 11 4013: Food Service Equipment (Middle and Senior High Schools).
 - a. Kitchen hood including fire suppression system.
 - b. Fly fans.
 - 4. Section 22 1000: Plumbing.
 - 5. Section 23 0500: Common Work Results for HVAC.
 - 6. Section 23 0513: Basic HVAC Materials and Methods.
 - 7. Section 23 0548: HVAC Sound, Vibration and Seismic Control.
 - 8. Section 23 2013: HVAC Piping.
 - 9. Section 23 3000: Air Distribution.
 - 10. Section 23 8000: Heating, Ventilating and Air Conditioning Equipment.

1.02 SYSTEM DESCRIPTION

- A. Kitchen ventilation system shall provide heating, ventilating and cooling to prevent extreme temperatures in the kitchen. Kitchen temperature shall be controlled by room thermostat. Supply air fan shall automatically shut off when kitchen fire alarm is activated.

1.03 SUBMITTALS

- A. Provide in accordance with Division 01 and Section 23 0500: Common Work Results for HVAC.
- B. Manufacturer's Data:
 - 1. Complete list of items to be furnished and installed under this Section.
 - 2. Manufacturer's specifications and other data required to demonstrate compliance with specified requirements, three sets of operation and maintenance manuals, and service, parts list, and installation instructions.
- C. Shop Drawings:

1. Submit Shop Drawings and layout drawings of complete kitchen ventilation system, including, but not limited to, dimensioned location of exhaust hood, exhaust fan, heating, ventilating, cooling, make-up air unit, and ductwork.
 2. Provide Drawings for the kitchen ventilation system in accordance with requirements of NFPA 96.
- D. Closeout Submittals: Submit Project Record Documents and Operations and Maintenance Manuals in accordance with Section 23 0500: Common Work Results for HVAC.

1.04 QUALITY ASSURANCE

- A. Standards: Kitchen ventilation system fabrication and installation shall comply with NFPA 96 standards, applicable provisions of Section 23 0500: Common Work Results for HVAC, and the California Mechanical Code (CMC).
- B. Qualifications of Manufacturers: Products used in the Work of this Section shall be produced by manufacturers regularly engaged in manufacture of similar items and with a minimum of 5-year history of successful production.
- C. Qualification of Installers: Provide adequate number of skilled workmen, thoroughly trained and experienced in necessary crafts, and completely familiar with specified requirements and methods needed for proper performance of the Work of this Section.

1.05 INSTRUCTIONS

- A. Prior to Substantial Completion, provide a 2 hour instruction period on system and equipment operation and maintenance procedure before or during completion test, in compliance with Section 23 0500: Common Work Results for HVAC, to designated Owner personnel. Coordinate and arrange for instruction period.
- B. Instructions shall be provided by an individual who has been thoroughly trained and experienced to demonstrate proper operation and maintenance procedure of particular system and equipment.

1.06 PRODUCT HANDLING

- A. Comply with provisions stated under Section 23 0500: Common Work Results for HVAC.

1.07 COORDINATION

- A. Coordinate activities in accordance with provisions of Section 01 3113: Project Coordination.

PART 2 – PRODUCTS

2.01 KITCHEN HOOD DUCTWORK

- A. Make-up air supply and exhaust duct connections for kitchen hood shall be furnished in parallel configuration only. Exhaust duct shall have a minimum velocity of 1,500 fpm and a maximum velocity of 2,100 fpm. Exhaust duct shall be constructed of stainless steel Type 304, 18 gage minimum with welded joints. Make-up supply ductwork shall be constructed of stainless steel Type 304, 18 gage minimum with welded joints on parallel duct arrangement. Duct installation shall conform to NFPA 96. Exhaust duct connecting collars shall be of heat expansion type. Field weld exhaust duct to mating flange at canopy, in accordance with CMC requirements. Factory fabricated ductwork, when approved, shall be furnished by duct manufacturer and shall be UL listed as grease duct for restaurant cooking appliances.
- B. Clean-outs and other openings: Refer to CMC requirements.
- C. Duct enclosure: Refer to CMC requirements.

- D. Prevention of grease accumulation: Refer to CMC requirements.
- E. Other requirements of CMC and Section 23 3000: Air Distribution.

2.02 KITCHEN HOOD EXHAUST FANS (KEF)

- A. Exhaust fan shall be roof-mounted, upblast, belt-driven type, complete with centrifugal backward inclined blades, UL listed for removal of smoke and grease laden air. Unit shall be rated for continuous service at 300 degrees F conforming to UL 762 and shall be rated in accordance with ANSI/AMCA 210. Unit shall be compatible for installation with kitchen hood specified. Utility type fans may be furnished where building configuration does not permit the installation of upblast roof exhausters.
- B. Unit shall be Loren Cook Company, Greenheck, or Supreme Fan, or equal.

2.03 KITCHEN MAKE-UP AIR UNIT (MU)

- A. Make-up air unit shall be roof mounted type factory built-up assembled and wired in accordance with NFPA 70: NEC and ETL listed to ANSI Z83.8 and CSA 2.6 standards as a package. The energy usage shall be designed to meet ANSI/ASHRAE Standard 90.1
- B. The unit shall be Reznor, Sterling, Modine, Trane, or equal, designed for 80 percent or better thermal efficiency with power vented natural gas furnace, and shall be furnished with the following:
 - 1. Centrifugal fan, permanently lubricated bearings, EE motor and adjustable link belt drive. Motor and blower shall be rubber in shear vibration isolated.
 - 2. Disposable media type air filters 2 inches thick of MERV 8 efficiency, shall be provided in the air stream, unless indicated otherwise in the drawings. Units provided with evaporative cooler shall be provided with aluminum mesh cleanable filters.
 - 3. Outside air shall enter unit through an outside air hood with moisture elimination louvers and bird screen or evaporative cooler with 1" pre-filter unless otherwise indicated on the Drawings.
 - 4. Heat exchanger shall be manufactured from 409 (E-3) stainless steel. Furnace section shall have a factory-installed condensate drain. Furnace shall be provided with a constant discharge temperature heating control with modulated control. Discharge air set point shall be adjustable from 50 to 120 degrees F.
 - 5. Factory-installed mixing box shall be supplied with flanged 100 percent return air opening in bottom and 100 percent outside air opening in back. Manufacturer shall provide factory-installed motors, dampers, linkage and actuators for outside air and return air inlets with a potentiometer. This configuration shall provide 100 percent outside air during EF On mode. When system switch (EF Off) is activated, mixture of outside air and return air as controlled with a minimum amount of outside air as determined by the potentiometer setting. On shut down, the outside damper shall close.
 - 6. Cabinet shall have through-the-base utility knockouts. Control, burner and blower service compartment doors shall be hinged. Blower door hardware shall be heavy duty stainless. Control and burner door hardware shall be heavy duty external hardware. Unit cabinet shall be supplied with double wall steel construction with factory installed 1 ½ pound density insulation. R value of insulation shall be 3.8 or greater. Insulation with foil backing is not acceptable. The packaged system shall have a pre-coat RAL 1001 white paint finish. Finish shall be a minimum 60 gloss on

G90 galvanized steel. Painted metal shall pass 1,000 hour salt spray test per ASTM B117. Unit shall be designed with heavy 16 gage pre-painted steel rail perimeter base. Base shall feature provisions for corner lifting, with lifting strap holes to facilitate handling and installation.

7. Cooling of outside air shall be provided by either evaporative cooling or DX cooling coil depending on mode of operation.
 - a. Evaporative cooling manufacturer shall supply 12-inch glass fiber evaporative cooling media. Unit shall have a water hammer arrester for the water flow metering device. Evaporative cooling unit shall be all stainless steel construction provided with a factory-installed water distribution system. Re-circulating system shall be equipped with auto drain down upon unit shut down. System shall also include a water hammer arrester.
 - b. For cooling, unit shall be provided with a DX split system when indicated on the drawings. Manufacturer shall provide a factory-installed cooling coil in a cabinet. Manufacturer shall also provide a remote condensing unit section for DX cooling. The condensing unit shall be designed for outdoor mounting. Unit shall use non-ozone depleting R-410a refrigerant. Units 7.5 tons and above shall have dual circuits with independent scroll compressors. Dual circuits shall have independent liquid line receivers. Condensing units shall be Carrier, Reznor, Trane, York, or equal.
 - 1) Evaporator coils:
 - a) Aluminum plate fins mechanically bonded to enhanced copper tubes with joints brazed.
 - b) Tube sheet openings shall be belled to prevent tube wear.
 - c) Evaporator coil shall be of full-face active design.
 - d) Dual circuit models shall have face-split type evaporator coil.
 - 2) Condenser coils Type A, B or C are acceptable.
 - a) Type A: Copper-tube, aluminum-fin coil, with liquid subcooler. Internally enhanced 3/8 inch OD seamless copper tubing mechanically bonded to aluminum fins.
 - b) Type B: Spine Fin™ condenser coil shall be continuously wrapped, corrosion resistant aluminum with minimum brazed joints. This coil is 3/8 inch OD seamless aluminum tubing glued to a continuous aluminum fin. Coils are lab tested to withstand 2,000 pounds of pressure per square inch. The outdoor coil provides low airflow resistance and efficient heat transfer. The coil is protected on four sides by louvered panels.
 - c) Type-C: Coil shall be air-cooled Micro-Channel heat exchanger technology (MCHX) and shall have a series of flat tubes containing a series of multiple, parallel flow microchannels layered between the refrigerant manifolds. Coils shall consist of a two-pass arrangement. Coil construction shall consist of aluminum alloys for fins, tubes,

and manifolds in combination with a factory applied corrosion-resistant coating .

- C. Unit shall be supplied from factory with EPAAct compliant premium efficiency ODP blower motor and factory installed VFD for two speed operation.
- D. Unit shall be provided with a remote control panel that will provide the control functions that are indicated on the drawings including but not limited to the following:
 - a. Thermostat for space temperature control.
 - b. Fan on/off and speed indicator lights.
 - c. Manual on/off switch.
- E. Make up air unit shall be provided with an automatic cut-off through a field furnished detector in the event of fire.
- F. Electrical wiring, components and connections including electrical grounding shall be made in accordance with the National Electrical Code (NFPA 70). A separate line voltage supply shall be run directly from the main panel to a fused disconnect switch, at the unit, and then making connection to leads in the unit junction box. External wiring shall be made within approved conduit and shall have a minimum temperature rise rating of 60 degrees C. The unit shall be electrically grounded in accordance with the National Electrical Code (NFPA 70) when installed if an external source is utilized. Units shall be equipped with a 24 volt control transformer; protective air proving switch; resiliently isolated venter motor and a high temperature limit control. Operation shall be controlled through an integrated circuit board. The circuit board shall monitor heater operation and have LED diagnostic lights to identify abnormalities in control functions.

PART 3 – EXECUTION

3.01 EXAMINATION

- A. Examine areas and conditions under which Work of this Section will be performed. Correct conditions detrimental to proper and timely completion of Work. Do not proceed until unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Kitchen ventilation system shall be installed in accordance with manufacturer's instructions and shall comply with NFPA 96 and CMC.
- B. Exterior surfaces of roof-mounted equipment shall be weatherproofed.

3.03 COMPLETION TEST

- A. Project Inspector shall be notified 48 hours in advance of testing. Notify fire authorities and test components of system and sequence of operation in presence of and for observation of the Project Inspector and fire inspectors.

3.04 CLEANUP

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

3.05 PROTECTION

- A. Protect the Work of this Section until Substantial Completion.

END OF SECTION

SECTION 23 8000

HEATING, VENTILATING AND AIR CONDITIONING EQUIPMENT

PART 1 – GENERAL

1.01 SUMMARY

- A. Section Includes: Air conditioning and air handling equipment including but not limited to:
- B. Related Requirements:
 - 1. Section 01 4525 Testing, Adjusting, and Balancing For HVAC
 - 2. Section 23 0513: Basic HVAC Materials and Methods.
 - 3. Section 23 3000: Air Distribution.

1.02 DESIGN REQUIREMENTS

- A. Work of this Section is based on HVAC equipment units indicated as Basis of Design in Part 2 of this Section. Products from different HVAC equipment manufacturers listed are never identical, although equivalent in capacity, performance and quality. In the cases where dimensions, weight, configuration and utility requirements differ from the products used as a basis of design, the Contractor, at no additional cost to the Owner, shall coordinate and submit, for Architect review, revisions to the design.

1.03 SUBMITTALS

- A. Provide in accordance with Division 01 and Section 23 0500: Common Work Results for HVAC.
- B. For products listed that are not the basis of design, submit the following in addition to above requirements:
 - 1. Title 24 Calculations: Replace HVAC unit values in calculation files provided by the Architect and submit for review.

1.04 QUALITY ASSURANCE

- A. Provide submittals in accordance with Section 23 0500: Common Work Results for HVAC.

1.05 PROJECT RECORD DOCUMENTS

- A. Provide Owner instructions on equipment operation and maintenance procedures, as indicated in Section 23 0500: Common Work Results for HVAC.

1.06 WARRANTY

- A. Compressors shall be provided with manufacturer's five-year warranty, replacement only.
- B. Manufacturer shall warrant parts, except heat exchangers, for a period of five years.
- C. Heat exchangers shall be provided with manufacturer's ten-year warranty, replacement only.

PART 2 – PRODUCTS

2.01 CEILING CABINET FANS

- A. CCF-1:
 - 1. Manufacturer:

CARNES	GREENHECK	LOREN COOK	PENNBARRY	TWIN CITY & BLOWER	OR EQUAL
VCDK or VCDD Series	SP or CSP Series	GC 200 or 900 Series	Zephyr Fans	T or TL Series	

2. Provide ceiling, wall, or inline mounted, direct driven, centrifugal exhaust fans of sizes, capacities and configurations indicated on drawings, complete with accessories for installation of fans. Also, provide accessories for proper operation and balancing of fans in accordance with design intent and sequence of operation.
3. Certification: Fan shall be listed by Underwriters Laboratories (UL 507 & 705). Fan shall bear AMCA Certified Ratings Seal for Sound and Air Performance.
4. Housing: The fan housing shall be minimum 22 gage galvanized steel and acoustically insulated. Blower and motor assembly shall be mounted to a minimum 16 gage reinforcing channel and shall be easily removable from housing. Motor shall be mounted on vibration isolators. Unit shall be supplied with integral wiring box and disconnect receptacle shall be standard. Discharge position shall be convertible from right angle to straight through by moving interchangeable panels. The outlet duct collar shall include a reinforced aluminum damper with continuous aluminum hinge rod and brass bushings. To accommodate different ceiling thickness, an adjustable prepunched mounting bracket shall be provided. A powder painted white steel grille shall be provided as standard.
5. Wheel: Wheel shall be centrifugal forward curved type, constructed of galvanized steel. Wheel shall be balanced in accordance with AMCA Standard 204, Balance Quality and Vibration Levels for Fans.
6. Motor: Motor shall be ECM type with permanently lubricated bearings, built-in thermal overload protection and disconnect plug. Motor shall be furnished at specified voltage.

3.02 CLEANUP

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

3.03 PROTECTION

- A. Protect Work of this Section until Substantial Completion.

END OF SECTION

SECTION 26 0126

TEST AND ACCEPTANCE REQUIREMENTS

PART 1 - GENERAL

1.01 SUMMARY

- A. Principal items of work in this section include but are not limited to:
1. Ensure quality assurance, testing and final acceptance requirements for premises cabling installations comply with industry standards and Project Construction Documents.
 2. The City wants to improve the quality of its network installations. In order to achieve this objective, the guidelines specified below are to serve as a technical reference for the Owner's infrastructure verification of the Installer's testing. The appendix of this section describes specific test procedures that the Owner shall perform during the acceptance testing, particularly those involving LAN, PABX, VTC, Convergence and WLAN equipment, and associated cable plants. The procedures provide a comprehensive series of visual, electronic, and optical tests to ensure the infrastructure installation complies with the standards set forth in the specifications. The successful culmination of these tests shall be used to document a physical configuration audit (PCA) as part of the Owner's Quality Assurance (Q/A) Report. Testing shall include physical Q/A review of installation and performance testing of components.
- B. Responsibilities for this specification are as follows:
1. Installer: The Installer shall follow CEC, CANSI/EIA/TIA and BICSI installation standards. The Installer shall perform horizontal cable installation including Category 5e and Category 6a unshielded twisted pair (UTP) cable runs terminated in the communications cabinet and cable terminations at each work area outlet, as well as vertical cable installation, including fiber optic cable runs and terminations. During installation the Installer shall perform tests as required by the Parent Specification and in compliance with testing standards found in Appendixes B, C, and D of this Section. The Installer shall notify the Project Inspector 48 hours in advance of any required testing so that the Project Inspector can notify the Owner's Quality Assurance Team to observe the Installer's test procedures. The Installer shall forward test documentation to the OAR prior to the Owner's formal acceptance testing.
 2. Contractor's Site Responsibilities during formal Owner's Quality Assurance: During formal Owner's Quality Assurance, the Contractor and his/her Subcontractor shall comply with testing standards and requirements detailed in Appendixes A through F. Under the guidance of the Project Inspector and in coordination with the Owner's Quality Assurance Team, the Installer shall:
 - a. Verify LAN connectivity and WAN extension cabling to MDF.
 - b. Configure the router(s) and switch(es) in compliance with the Contract Documents.
 - c. Aid the Owner's Quality Assurance Team with network cut over. (e.g., existing systems with internet connectivity and administration systems including but not limited to SIS and payroll)

- d. Provide labor, materials, and testing equipment (e.g., Power Meter, OTDR) to correct any deficiencies with labeling, cable charts, terminations, and Installer supplied test results.
- e. Provide keys and access to installed network equipment.
- 3. Owner's Quality Assurance Team Responsibilities: Using the procedures specified in the Appendixes of this guideline, the Owner's Quality Assurance Team shall verify that the infrastructure installed under the Contract complies with the installation standards detailed in the Specifications. Specifically, testing shall be performed by the Owner on vertical and horizontal cable (e.g., fiber optic, Category 5e UTP and Category 6a UTP) along with component installations performed under the scope of the overall infrastructure effort (e.g., Ethernet switches and routers). Generally, testing specifications and procedures cover the following:
 - a. Q/A review of equipment rack installation; including placement in the communications cabinets, attachment to the floor, and seismic bracing.
 - b. Q/A review of fiber terminations, patch panel installation, cable labeling, and cable bundling.
 - c. Q/A review of Category 5e and Category 6a, T568B terminations, including cable end connections at the patch panel and work area outlets.
 - d. Q/A review of the Contractor's Redlines for accuracy.
 - e. Industry standard for fiber optic, Category 5e and Category 6a cable performance testing.
 - f. Network equipment performance verification.
 - g. Uninterruptible power supply performance verification.
 - h. Communications cabinet layout and facility drop count verification.
- C. Related Requirements:
 - 1. Division 01 - General Requirements.
 - 2. Section 00 7000: General Conditions.
 - 3. Section 01 7700: Contract Closeout.
 - 4. Section 06 1000: Rough Carpentry.
 - 5. Section 26 0500: Common Work Results for Electrical.
 - 6. Section 26 0513: Basic Electrical Materials and Methods.
 - 7. Section 26 0526: Grounding and Bonding.
 - 8. Section 26 0533: Raceways and Boxes Fittings and Supports.
 - 9. Section 26 2416: Panelboards and Signal Terminal Cabinets.
 - 10. Section 26 5000: Lighting.
 - 11. Section 26 5200: Emergency Power Systems.
 - 12. Section 26 0536: Cable Tray.

13. Section 27 4113: Closed Circuit TV (CCTV) and Audio Surveillance Systems (New Facilities).
14. Section 27 4116: Closed Circuit TV (CCTV) and Surveillance Systems (Existing Facilities).
15. Section 27 1513: Communications Wiring.
16. Section 27 1514: Communications Wiring.
17. Section 27 5115: Public Address and Intercommunication Systems.
18. Section 27 5116: Public Address Systems (Small Gyms, Multipurpose Rooms)(ES).
19. Section 27 5117: Public Address Systems (Auditoriums, Performing Art, M-P Rooms)(MS and HS).
20. Section 27 5118: Public Address Systems (Gymnasiums).
21. Section 27 5119: Public Address Systems (Athletic Fields).
22. Section 27 1515: Television Systems – Coaxial Distribution.
23. Section 27 1516: Television Systems -Fiber Optic Distribution.
24. Section 28 1600: Intrusion Detection Systems.
25. Section 31 2323: Excavation, and fill(Utilities).

D. Acronyms:

dB	Decibel
IDF	Intermediate Distribution Facility
ITD	Information Technology Division
LAN	Local Area Network
LDC	Local Distribution - Classroom
LDF	Local Distribution Facility
MDF	Main Distribution Facility
MPOE	Minimum Point of Entry
NVP	Nominal Velocity of Propagation
OAR	Owner Authorized Representative
PA	Public Address
PBX	Private Branch Exchange
QA	Quality Assurance
UTP	Unshielded Twisted Pair
VoIP	Voice over Internet Protocol
WLAN	Wireless Local Area Network

1.02 SYSTEM REQUIREMENTS

- A. Will be found in Parent Specification.

1.03 SUBMITTALS

- A. Will be found in Parent Specification.

1.04 CODES AND STANDARDS

- A. Telecommunications Industry Association (TIA)/Electronic Industries Association (EIA)-568, Commercial Building Telecommunications Cabling Standard, current issue.
- B. EIA/TIA-569, Commercial Building Standard for Telecommunications Pathways and Spaces.
- C. ANSI/EIA/TIA-598-A, Optical Fiber Cable Color Coding, current issue.
- D. EIA/TIA-606 (2002), Administration Standard for the Telecommunications Infrastructure of Commercial Buildings.
- E. EIA/TIA-607, Commercial Grounding and Bonding Requirements for Telecommunications.
- F. EIA/TIA-OFSTP-14A, Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant.
- G. ANSI/TIA/EIA-758, Customer-Owned Outside Plant Telecommunications Cabling Standard, current issue.
- H. EIA/TIA-OFSTP-7, Optical Power Loss Measurements of Installed Singlemode Fiber Cable Plant.
- I. American National Standards Institute (ANSI)/EIA/TIA-455-59, Field Testing
- J. FCC Part 68.50.
- K. National Electrical Manufacturer's Association (NEMA).
- L. National Fire Protection Association (NFPA), NFPA-70.
- M. CCR Part 3 - California Electrical Code (CEC).
- N. CCR Part 2 - Uniform Building Code (UBC).
- O. Building Industry Consulting Services International (BICSI) TDMM, most recent revision.
- P. Institute of Electrical and Electronic Engineers (IEEE).
- Q. Other Codes and Standards as defined in the Parent Specification.

1.05 SYSTEM DESCRIPTION

- A. System will be found in Parent Specification.

1.06 QUALITY ASSURANCE

- A. Will be found in Parent Specification.

1.07 WARRANTY

- A. Will be found in Parent Specification.

PART 2 - PROCEDURES

2.01 EQUIPMENT INSTALLATION

- A. The Installer is responsible for basic installation and cross connection of LAN equipment required by the Contract Documents. The Owner's Quality Assurance Team shall verify that basic installation is complete and functional.

2.02 PUNCH LIST

- A. Per OAR request, The Owner's Quality Assurance Team shall assist in the Punch List for IT and low voltage systems and provide it to the OAR.

2.03 CLOSEOUT DOCUMENTATION

A. Will be found in Parent Specification.

2.04 QUALITY ASSURANCE

A. Owner's Quality Assurance Test Schedule

1. The Project Inspector shall schedule the Owner's Quality Assurance test after review of the Installers complete Test Results of the site.

PART 3 - EXECUTION AND INSTALLATION

3.01 INSTALLATION

A. Will be found in Parent Specification.

3.02 OWNER'S QUALITY ASSURANCE CERTIFICATION AND TESTING

A. Will be found in Parent Specification.

3.03 PROJECT RECORD DOCUMENTS

A. Will be found in Parent Specification.

3.04 PROTECTION

A. Will be found in Parent Specification.

3.05 CLEANUP

A. Will be found in Parent Specification.

3.06 OWNER ORIENTATION

A. Will be found in Parent Specification.

Quality Assurance Guidelines

APPENDIX A - QUALITY ASSURANCE PROCEDURES

A.1 Overview of Quality Testing Procedures

This appendix provides guidelines for visual Quality Assurance reviews of each site. The Owner's Quality Assurance Team shall examine the Work based upon the guidelines outlined in the following appendixes and their associated forms.

1. Communications Cabinet Review. Verify the design and compliance with contract documents. This may include: EIA/TIA and BICSI cabling practices, standard and specific labeling practices, and safe and logical equipment and wire management placement.
2. Cable Plant Review. Cabling from the Communications cabinet, at various points along the cable path, and in functional work areas for compliance with TIA/EIA installation specifications including TIA/EIA-568-B and TIA/EIA-569 and documents referenced therein and professional installation practices.
3. User Work Area Quality Assurance Review. Cabling at the user wall plate location in the functional work areas for compliance with TIA/EIA installation specifications including TIA/EIA-568-B and TIA/EIA-569 and documents referenced therein and professional installation practices.
4. Redline As-Built Documentation shall be compared to physical installation. Deviations shall be noted and the Quality Assurance procedure halted until discrepancies have been rectified.

A.2 General Quality Assurance Guidelines

The Owner's Quality Assurance Team visually reviews the installation to verify that cabling is supported properly. Cable trays or structural ties shall support cable. No cable shall have been installed in pathways near sharp edges or objects that might cause damage. Cable shall not be supported by, on, or attached to a dry wall ceiling, ceiling tiles, ceiling grid, routed over pipes, conduit, lighting fixtures, or other wiring. The Owner's Quality Assurance Team should be able to determine the total number of drops dispersed from each communications cabinet, the number of drops for each supported room, and the agreed-upon labeling scheme for the site. The Installer should have met the following general labeling guidelines:

1. Clearly labeled each drop number and Communications cabinet on the wall jack faceplate.
2. Label each horizontal cable jacket using a permanent label at the workstation end, inside the wall, and the patch panel end no more than two inches from each end.
3. At workstation end: communications cabinet, drop, and termination panel.
4. At patch panel end: drop and cabinet numbers.
5. Label each patch panel port with drop number and cabinet number.

Because work area room numbers may have been modified since the design, the installer shall provide as built documentation for each communications cabinet; reflecting the room numbers used in the labeling scheme as a reference point. The Contractor and his/her Subcontractor shall use these working prints to produce post-installation as-built drawings.

A.3 Deficiency Reports

Before beginning any test, the Owner's Quality Assurance Team shall view any deficiency report(s) (DR) that have been filed with the OAR and Project Inspector. The Owner's Quality Assurance Team shall review the DR(s) as part of the Quality Assurance review to ensure the required corrective actions have been taken.

Quality Assurance Guidelines

A.4 Quality Assurance Test Procedures

The Owner's Quality Assurance Team shall follow the acceptance test and performance criteria outlined in TIA 568B, OFSTP-14A, OFSTP-7 and shall conduct acceptance and performance testing following each manufacturer's specification on their respective network components to verify compliance with manufacturer's installation instructions.

The Owner's Quality Assurance Team shall also follow any specific local policy directives or instructions regarding installation practices and/or acceptance testing identified during the site orientation visit. The details for the design of a particular location shall also comply with any related State, County and Municipal standards.

A.5 Construction Quality Assurance of Work:

During the installation of low voltage systems, upon request by the OAR, the Owner's Quality Assurance Team shall examine the following:

1. General to Low Voltage Systems:
 - a. Conduit and raceway layout and installation for each low voltage system and verify that they meet project specifications.
 - b. Equipment rack installation, including placement in the communications room, seismic bracing, and attachment to the floor.
 - c. Cable punch-downs, patch panel installation, cable cross-connection, cable labeling, and cable bundling.
 - d. Verify proper equipment installation, cable cross connection, system configuration, and testing.
 - e. Verify system layout and device location(s) match the locations shown on the as-builds.
 - f. Active components, terminal cabinets, cross connects, splices, etc. are located in a secure interior location.
 - g. Verification of Uninterruptible power supply performance.
 - h. Verification of proper air conditioning in MDF and IDFs. Room temperature should maintain between 65 - 72 degrees 7 days per week, 24 hours per day.
 - i. Terminations punched down singly and cross-connected on 66 blocks. 66 blocks are primarily used in Public Address systems and Intercom. PBX cable plants are specified to use 110-blocks exclusively.
2. LAN, verify the following:
 - a. Examine Category 5e and Category 6a, T568B terminations, including cable end connections at the patch panel and wall drop receptacles.
 - b. Examine fiber terminations and fiber termination boxes.
 - c. Examine Installer's basic network components installation and operation.
 - d. Review customized configuration and test results.
 - e. Test overall network operation to ensure it meets Owner's strategic planning and acceptable performance level.

A.6 Start Up

Start-up work is to be completed as a condition for Substantial Completion. Start-Up is to include the testing and commissioning of equipment and systems.

Quality Assurance Guidelines

1. After start up has been completed but prior to Substantial Completion, the Project Inspector shall schedule the Owner's Quality Assurance Team site visit.
2. The Owner's Quality Assurance Team shall review documentation and test results for completeness.
3. The Owner's Quality Assurance Team shall visit the site and verify the Contractor's test results by the Quality Assurance procedures detailed herein.

A.7 Contract Completion and Process Review

The Quality Assurance Team shall review the entire Quality Assurance process and recommend changes to improve it on an as needed basis.

A.8 Test Procedures

1. Visual Q/A Reviews
 - a. The Owner's Quality Assurance Team shall conduct a visual review of the installation including the communication cabinet, cable runs, and user work areas. Appendix A documents these Q/A review procedures.
2. Cable Performance Testing
 - a. The Owner's Quality Assurance Team shall test 100% of the fiber optic Backbone cable, a random sample of Category 5e and Category 6a UTP cable and the fiber optic Horizontal cable. Appendix C outlines these specific tests.
 - (1) Test Cable Sampling: The Owner's Quality Assurance Team shall randomly test 10% of installed horizontal cables from each communication cabinet on site. For example, if a communications cabinet has 100 drops, the Owner's Quality Assurance Team shall test a minimum of 10 drops for each cabinet. Where random testing shows a failure rate of more than 1% of the drops (2 in 10 of the random sample), an additional 10% of the installed horizontal cabling shall be tested. Appendix B outlines these specific tests.
 - (2) Cable Testing: The Owner's Quality Assurance Team shall perform the following industry-standard operational and performance cable testing detailed in TIA/EIA 568B.1:
 - (a) Wire map
 - (b) Length verification
 - (c) Insertion loss (attenuation)
 - (d) Near-end crosstalk (NEXT)
 - (e) Power sum near-end crosstalk (PSNEXT)
 - (f) Equal level far-end crosstalk (ELFEXT)
 - (g) Power sum equal level far-end crosstalk (PSELFEXT)
 - (h) Return loss
 - (i) Propagation delay
 - (j) Delay skew
3. Network Equipment Testing
 - a. The Owner's Quality Assurance Team shall perform network tests on hardware components for proper installation, per manufacturer's recommendations and configuration. Components shall be tested separately

Quality Assurance Guidelines

for initial power up and their ability to maintain system configuration. The specific test for network equipment components is described in Appendix D.

A.9 Acceptance Criteria

1. An overall Pass or Fail condition shall be determined by the results of the required individual test. Any Fail and Fail* shall result in an overall Fail. In order to achieve an overall Pass condition, individual results shall be Pass or Pass*. A Pass or Fail result for each parameter is determined by the allowable limits for that parameter. The test result of a parameter is marked with an asterisk (*) when the result is closer to the test limit than the accuracy of the field tester. The field tester manufacturer shall provide documentation as an aid to interpret results marked with asterisks.
2. Cable plant acceptance by the Owner requires 100% passing results for cable samples and corrected cabling deficiencies. Acceptance of other components is based upon satisfactory completion of a test configuration scenario, as defined in the appropriate appendix to this plan.

A.10 Corrective Procedures

1. EIA/TIA testing specification details a pass/fail criterion, i.e., if a fiber optic cable is outside of specifications, the test fails, The Owner's Quality Assurance Team shall identify any deficiencies found during Quality Assurance (e.g., a cable or component failing a test) to site personnel before the Owner's Quality Assurance Teams departure and shall document these deficiencies in the Quality Assurance Report. If the link attenuation for any fiber optic cable strand is outside acceptable loss as specified in TIA/EIA-568-B, the Installer shall re-complete the terminations required to reduce the amount of attenuation. If re-termination fails, the Installer shall be required to take steps up to and including the replacement of the cable to eliminate the testing deficiency. After corrective action, the Owner's Quality Assurance Team shall retest repaired fiber runs and document the results in the Quality Assurance Report.
2. The Owner's Quality Assurance Team shall identify to the Owner in writing any deviation from acceptable EIA/TIA specifications for cabling resulting in a test failure. The Owner may choose to accept the deficiency via a written waiver. For example, if a fiber optic connection exceeds the allowable termination attenuation by 0.1 decibels (dB), but the total link attenuation is within the length attenuation budget, the Owner may choose to waive the specification. Other components (e.g., switches or routers) must function according to the specified configurations in the final Work Plan for Owner LAN projects.

A.11 Quality Assurance Reporting

1. Acceptance Recommendation
 - a. At the conclusion of testing, the Owner's Quality Assurance Team shall provide a recommendation to Owner to accept or not accept the installation.
2. Quality Assurance Report
 - a. The Owner's Quality Assurance Team shall deliver a Quality Assurance Report to the project OAR no later than seven (7) working days after completion of testing. This report shall include:
 - (1) A written test report for visual installation tests.
 - (2) Electronic test results of cable testing including verified cable lengths, test personnel, test date, and individual test description.

Quality Assurance Guidelines

- (3) Each detected deficiency with its correction date and retest results, if accomplished.
- (4) Network operational test results for the switch(s) and router connections.
- (5) Any condition(s) precluding strict adherence to NEC, EIA/TIA, and BICSI installations or Quality Assurance standards shall be marked for potential Owner waiver before system acceptance.
- (6) A summary confirming the acceptance recommendation given.

A.12 Test Equipment

1. The Owner's Quality Assurance Team shall use the following test equipment or their equivalent during testing.
 - a. Fluke DSP 4300 Level III, or equal, tester with single-mode and multi-mode power meter and light source heads.
 - b. Fluke Optifiber Optical Time Domain Reflectometer (OTDR)
 - c. Personal computer with Transmission Control Protocol/Internet Protocol (TCP/IP) protocol stacks.
 - d. Thermometer

Quality Assurance Guidelines

Table 2.6.1 T & A Checklist for Owner's Quality Assurance Team Projects

Site Location Code / Name _____ OAR _____
 Network Engineer _____ Inspector _____
 OAR Recommendation _____ Electrical Inspector _____

Review Item	Yes	No	N/A	Pass/Fail
Have deficiencies been cleared by the Project Inspector or OAR?				
Has the vendor provided cable charts in the cabinets?				
Are there any horizontal cables over 90m?				
Do the cable runs used agree with the cable routing drawings?				
Are the cables routed and terminated per specification?				
Are cable run penetrations terminated to preclude strain on the installed cable?				
Are the copper and fiber optic cables installed per the manufacturer's recommendation?				
Is each cable clearly labeled at the user's location?				
Is each port on the patch panel labeled with the corresponding user outlet location?				
Are cable and patch panel labels securely fastened and easily readable?				
Are the fiber cables in the fiber termination box labeled per the approved labeling scheme and immediately adjacent to each termination within the fiber termination box?				
Is the cable for each drop identified with the correct labeling scheme at or near the point of termination?				
Does the user outlet plate display the correct labeling scheme and match the distant end label?				
Are connectors free of exposed metal, loose connectors, or other problems?				
Is the cable jacket stripped back only as far as required to terminate on connecting hardware?				
Is the physical plant installed in accordance with specifications of this project?				
For traditional, hierarchical star cable plants following 25568 specifications, are there at least 50% spare Backbone strands, in multiples of 6 strands, to each IDF from the MDF ?				
For new fiber optics cable plant installations following 25569 specifications, are there at least 15 percent spare Backbone strands, in multiples of 6 strands, to each IDF from the MDF ?				
Does this site have an existing Local Area Network?				

Quality Assurance Guidelines

Is the T1 line correctly installed and ready to cut over? Also, has the extension to the MDF been installed?				
Will the site reutilize an existing router? If yes, specify exact model / serial number.				
Is the router configured and ready for cut over?				
Are the required amounts of GB Uplinks provided to accommodate the equipment installed including port expansion?				
Are classroom and administration switches mounted, connected, and operational?				
Has the vendor provided inventory and the drop count been verified or has an Inventory document been completed? If so, please attach.				

A.13 Visual Q/A Review Worksheets

The following pages provide the three visual Quality Assurance worksheets:

1. Communications Cabinet Quality Assurance Review Form
2. Cable Routing Quality Assurance Review Form
3. User Work Area Quality Assurance Review Form

Quality Assurance Guidelines

A.13.1 Communications Enclosure Quality Assurance Review Form

Site _____ Date _____ Quality Assurance Rep(s) _____

Q/A REVIEW ITEM	PASS	FAIL
Is the cabinet ready for a Q/A review? If not, list discrepancies (e.g., debris, punch- list, or un-terminated cable).		
Is the installation performed in the planned communications cabinet?		
Are there clearly identified final or redlined drawings showing the “as-built” installation?		
With all devices operating, are ambient cabinet and room temperatures within 50-80° F? The temperature is: _____.		
Are heating, ventilation, and air conditioning (HVAC), lighting, and electrical outlets installed per contract? Are the requirements addressed in the Site Concurrence Memorandum or other documentation?		
Are cabinet rails and wire managers installed so as to preclude any space problems with the UPS?		
Are the cabinets seismically braced to the floor and/or wall?		
Is there adequate space around the racks and fiber termination panel for maintenance?		
Are patch panels, wire management panels, and network equipment properly affixed to the rack?		
Is debris cleaned from inside of cabinets?		
Are cable run penetrations installed so fire barriers are maintained in cabinet locations?		
Are cable run penetrations properly and securely fastened to supporting structures?		
Are cable run penetrations terminated to preclude strain on the installed cable in cabinet locations?		
Are cables routed and punched per specification and industry standards?		
Is each cable clearly labeled with the corresponding user location per specification?		
Is each port on the patch panel labeled with the corresponding user location per specification?		
Are cable and patch panel labels securely fastened and easily readable per specification?		
Is there ½-inch or less of untwisting on any cable pair at the termination point?		
Is the UTP cable jacket stripped back only as far as required to terminate on connecting hardware?		
Is a bend radius of at least 1-inch maintained for sheathed UTP cable?		
Is the fiber optic cable free from excessive strain or stress, sharp bends, or kinks?		
Are service loops in place at each end of the cable?		
Are the fiber cables in the fiber termination unit? Is the box labeled per the approved labeling scheme and immediately adjacent to each termination within the fiber termination box?		
Is excess fiber optic cable coiled in the termination box so it does not exceed the minimum		

Quality Assurance Guidelines

bend radius per manufacturer's recommendations and specifications?		
Are fiber optic patch cords neatly routed to the network equipment via wire management?		

A.13.2 Cable Routing Q/A Form

Site _____ Date _____ Q/A Rep(s) _____

Q/A REVIEW ITEM	PASS	FAIL
Are cable bundles either secured to the wall or to a non-electromagnetic interference-producing source or hung from the ceiling (e.g., suspended via cable trays, inner duct, J-hooks, D-rings, or ladder rack) per specification or best industry standards?		
Do the cable runs used agree with the redline drawings?		
If not, are accurate redlined drawings available showing the cable routing?		
Is debris from the cable run penetrations adequately cleaned up per specification?		
Is the fiber optic cable runs completely contained within inner duct? Where?		
Notes:		

Quality Assurance Guidelines

A.13.3 User Work Area Q/A Review Form

Site _____ Date _____ Q/A Rep(s) _____

Q/A REVIEW ITEM	PASS	FAIL
Are wall jack faceplates professionally installed and finished?		
Is cabling precluded from view on the external surface of walls (e.g., ducting used on solid core walls)?		
Does the user outlet plate display the correct labeling scheme?		
Is the cable for each drop identified with the correct labeling scheme and within 2 inches of termination per specification?		
Is the cable installed in a manner that precludes cable strain?		
Are connectors insulated from surrounding cable and objects (e.g., are cable barrel adapters, connectors, devices, and terminators insulated from any earth ground or current-conducting surfaces of the building structure)?		
Are connectors free of exposed metal, loose connectors, or other problems?		
Is there ½-inch or less of untwisting on any cable pair at the termination point?		
Is the cable jacket stripped back only as far as required to terminate on connecting hardware?		
Is a bend radius of at least 1-inch maintained for sheathed UTP cable?		
Is the 4 or 6 strand fiber secured properly in the LDFs and LDCs?		
Notes:		

Quality Assurance Guidelines

APPENDIX B - CATEGORY 5E AND CATEGORY 6 UTP CABLE PERFORMANCE TESTS

B.1 Overview of Cable Tests

This appendix provides guidelines for electronic testing of Horizontal Category 5e UTP wiring. The Owner's Quality Assurance Team shall meet the guidelines outlined in the following Q/A review and its associated forms.

- Electronic Testing. This testing verifies that the standard performance parameters for the UTP cable as outlined in TIA/EIA 568-B are within the specifications as noted below. TIA/EIA 568-B addresses specific field-tests for post-installation performance measurements of the designed cable plants. Owner only uses Category 5e, or Category 6a UTP cables for its LAN installations. Refer to Premise Wiring Specification.

B.2 Test and Support Equipment

1. The types of cable to be tested are as follows :
 - a. Category 5E UTP shall be tested based on TIA/EIA 568-B.1 section 11.2.3 specifications
 - b. Category 6a UTP shall be tested based on TIA/EIA 568-B.2-1

Note: Sections B2 through B6 address Category 5E related tests, requirements, and specifications. Sections B7 through B11 address Category 6a related tests, requirements, and specifications.

B.3 Electronic Tests

The Owner's Quality Assurance Team randomly selects cables for testing and every effort shall be made to avoid a typical testing pattern from communications cabinet to work area outlet, so that no testing pattern is discernible. The testing personnel shall inspect drops on the faceplate in multiple cases to ensure cables are labeled and no cross connects are visible, etc. The testing personnel shall perform a Q/A review of the cable termination(s) in the Communications cabinet(s) and the corresponding user location of selected cables (e.g., the faceplate labels or terminations behind the termination panel). The personnel must be consistent in testing selected cables.

The *permanent* link test configurations described in TIA/EIA 568-B.1 section 11.2.4.1, performance parameters include wire map, length, Insertion loss (attenuation), NEXT, PSNEXT, ELFEXT, PSELFEXT, Return loss, Propagation delay and Delay Skew for 100 W 4-pair Category 5e cabling. 568-B.1 section 11.2.4.3 thru .11 identifies acceptable ranges of test results, test equipment checks, diagnostic information, and specific test procedures.

TIA/EIA 568-B.1 section 11.2.4.1, also specifies laboratory measurement methods, component and field test methods and computation algorithms over the specified frequency range. To ensure verifiable equipment calibration, the Owner's Quality Assurance Team shall certify test equipment accuracy in compliance with 568-B.1 section 11.2.4.3 thru .10 each time a new list of tests is performed.

The Owner's Quality Assurance Team shall consider cable(s) and cabling components as pre-tested by the manufacturer to meet TIA/EIA-568-B Category 5e specifications. Therefore, individual testing of connectors and other cabling components is not required.

B.4 Data Accuracy

Tests shall be conducted on the premise that TIA/EIA-568-B and other applicable specifications were applied to the cable installation. Further, the Owner's Quality Assurance Team shall be provided the test result book to verify the Installer tested 100 percent of their work, so the sampling tests performed ensures system operability and customer satisfaction.

Quality Assurance Guidelines

B.5 Data and Test Reporting

The Quality Assurance Report shall clearly identify the test environment, test equipment used, name of each tester, acceptable results (as specified in 568-B), and actual results for each test performed. If a failure occurs, the test shall proceed, with the failure reported to the responsible Installer for repair at test end.

B.6 Communications Wiring Electrical Tests

B.6.1 Wire Map

Wire Map shall report Pass if the wiring of each wire-pair from end to end is determined to be correct. The Wire Map results shall include the continuity of the shield connection if present.

B.6.2 Length

The field tester shall be capable of measuring length of all pairs of a permanent link or channel based on the propagation delay measurement and the average value for Nominal Velocity of Propagation (1). The physical length of the link shall be calculated using the pair with the shortest electrical delay.

This length figure shall be reported and shall be used for making the Pass/Fail decision. The Pass/Fail criteria are based on the maximum length allowed for the Permanent Link configuration (90 meters – 295 feet) plus 10% to allow for the variation and uncertainty of NVP.

B.6.3 Insertion Loss (Attenuation)

Insertion Loss is a measure of signal loss in the permanent link or channel. The term “Attenuation” has been used to designate “Insertion Loss.” Insertion Loss shall be tested from 1 MHz, through the highest applicable frequency. It is preferred to measure insertion loss at the same frequency intervals as NEXT Loss in order to provide a more accurate calculation of the Attenuation-to-Crosstalk ratio (ACR) parameter.

Minimum test result documentation (summary results): Identify the worst wire pair (1 of 4 possible). The test results for the worst wire pair must show the highest attenuation value measured (worst case), the frequency at which this worst case value occurs, and the test limit value at this frequency.

B.6.4 NEXT Loss

Pair-to-pair near-end crosstalk loss (abbreviated as NEXT Loss) shall be tested for each wire pair combination from each end of the link (a total of 12 pair combinations). This parameter is to be measured from 1 through the highest applicable frequency. NEXT Loss measures the crosstalk disturbance on a wire pair at the end from which the disturbance signal is transmitted (near-end) on the disturbing pair. The maximum step size for NEXT Loss measurements shall not exceed the maximum step size defined in the draft standard as shown in Table 1, column 2.

Minimum test results documentation (summary results): Identify the wire pair combination that exhibits the worst case NEXT margin (2) and the wire pair combination that exhibits the worst value of NEXT (worst case).

Table 1

Frequency (MHZ)	Range	Maximum Step Size (MHz)
----------------------------	--------------	------------------------------------

Quality Assurance Guidelines

1 – 31.25	0.15
31.26 – 100	0.25
100 – 250	0.50

NEXT is to be measured from each end of the link-under-test. These wire pair combinations must be identified for the tests performed from each end. Each reported case shall include the frequency at which it occurs as well as the test limit value at this frequency.

B.6.5 PSNEXT Loss

Power Sum NEXT Loss shall be evaluated and reported for each wire pair from both ends of the link-under-test (a total of 8 results). PSNEXT Loss captures the combined near-end crosstalk effect (statistical) on a wire pair when other pairs actively transmit signals. Like NEXT this test parameter must be evaluated from 1 MHz through the highest applicable frequency and the step size may not exceed the maximum step size defined in the draft standard as shown in Table 1, column 2.

Minimum test result documentation (summary results): Identify the wire pair that exhibits the worst case margin and the wire pair that exhibits the worst value for PSNEXT. These wire pairs must be identified for the tests performed from each end. Each reported case shall include the frequency at which it occurs as well as the test limit value at this frequency.

B.6.6 ELFEXT Loss, pair-to-pair

Pair-to-pair FEXT Loss shall be measured for each wire-pair combination from both ends of the link under test. FEXT Loss measures the crosstalk disturbance on a wire pair at the opposite end (far-end) from which the transmitter emits the disturbing signal on the disturbing pair. FEXT is measured to compute ELFEXT Loss that must be evaluated and reported in the test results. ELFEXT measures the relative strength of the far-end crosstalk disturbance relative to the attenuated signal that arrives at the end of the link. This test yields 24 wire pair combinations. ELFEXT is to be measured from 1 through the highest applicable frequency and the maximum step size for FEXT Loss measurements shall not exceed the maximum step size defined in the draft standard as in Table 1, column 2. Minimum test result documentation (summary results): Identify the wire pair combination that exhibits the worst-case margin and the wire pair combination that exhibits the worst value for ELFEXT. These wire pairs must be identified for the tests performed from each end. Each reported case shall include the frequency at which it occurs as well as the test limit value at this frequency.

B.6.7 PSELFEXT Loss

Power Sum ELFEXT is a calculated parameter that combines the effect of the FEXT disturbance from three wire pairs on the fourth one. This test yields 8 wire-pair combinations.

Each wire-pair is evaluated from 1 MHz through the highest applicable frequency in frequency increments that do not exceed the maximum step size defined in the draft standard as shown in Table 1, column 2.

Minimum test result documentation (summary results): Identify the wire pair that exhibits the worst case margin and the wire pair that exhibits the worst value for PSELFEXT. These wire pairs must be identified for the tests performed from each

Quality Assurance Guidelines

end. Each reported case shall include the frequency at which it occurs as well as the test limit value at this frequency.

B.6.8 Return Loss

Return Loss (RL) measures the total energy reflected on each wire pair. Return Loss is to be measured from both ends of the link-under-test for each wire pair. This parameter is also to be measured from 1 through the highest applicable frequency in increments that do not exceed the maximum step size defined in the draft standard as shown in Table 1, column 2.

Minimum test result documentation (summary results): Identify the wire pair that exhibits the worst case margin and the wire pair that exhibits the worst value for Return Loss. These wire pairs must be identified for the tests performed from each end. Each reported case shall include the frequency at which it occurs as well as the test limit value at this frequency.

B.6.9 Propagation Delay

Propagation delay is the time required for the signal to travel from one end of the link to the other.

This measurement is to be performed for each of the four wire pairs.

Minimum test result documentation (summary results): Identify the wire pair with the worst case propagation delay. The report shall include the propagation delay value measured as well as the test limit value.

B.6.10 Delay Skew

This parameter shows the difference in propagation delay between the four wire pairs.

Minimum test result documentation (summary results): Identify the wire pairs with the worst-case propagation Delay skew. The report shall include the Delay skew value measured as well as the test limit value.

B.6.11 ACR (Attenuation to crosstalk ratio)

This parameter is not required by TIA standards but may be expected in order to obtain the premise wiring manufacturer's warranty.

ACR provides an indication of bandwidth for the two wire-pair network applications. ACR is a computed parameter that is analogous to ELFEXT and expresses the signal to noise ratio for a two wire-pair system. This calculation yields 12 combinations – six from each end of the link. Minimum test result documentation (summary results): Identify the wire pair combination that exhibits the worst-case margin and the wire pair combination that exhibits the worst value for ACR. These wire pair combinations must be identified for the tests performed from each end. Each reported case shall include the frequency at which it occurs as well as the test limit value at this frequency.

B.6.12 PSACR

This parameter is not required by TIA standards but may be required in order to obtain the premise wiring vendor's warranty. The Power Sum version of ACR is based on PSNEXT and takes into account the combined NEXT disturbance of adjacent wire pairs on each individual pair. This calculation yields 8 combinations – one for each wire pair from both ends of the link.

Minimum test result documentation (summary results): Identify the wire pair that exhibits the worst case margin and the wire pair that exhibits the worst value for

Quality Assurance Guidelines

PSACR. These wire pairs must be identified for the tests performed from each end. Each reported case shall include the frequency at which it occurs as well as the test limit value at this frequency.

Quality Assurance Guidelines

B.8 Electronic Tests

The Owner's Quality Assurance Team randomly selects cables for testing and every effort shall be made to avoid a typical testing pattern from communications cabinet to work area outlet, so that no testing pattern is discernible. The testing personnel shall inspect drops on the faceplate in multiple cases to ensure cables are labeled and no cross connects are visible, etc. The testing personnel shall perform a Q/A review of the cable termination(s) in the Communications cabinet(s) and the corresponding user location of selected cables (e.g., the faceplate labels or terminations behind the termination panel). The personnel must be consistent in testing selected cables.

The *permanent* link test configurations described in TIA/EIA 568-B.2-1, performance parameters include wire map, length, Insertion loss (attenuation), NEXT, PSNEXT, ELFEXT, PSELFEXT, Return loss, Propagation delay and Delay Skew for 100 W 4-pair Category 6a cabling. 568-B.2 identifies acceptable ranges of test results, test equipment checks, diagnostic information and specific test procedures as related to Category 6a cabling. TIA/EIA 568-B.2-1 also includes laboratory measurement methods, component and field test methods, and computation algorithms over the specified frequency range. The test equipment (tester) shall comply with the accuracy requirements for level III field testers as defined in TIA/EIA 568-B.2-1. The tester including the appropriate interface adapter must meet the specified accuracy requirements. The accuracy requirements for the permanent link test configuration (baseline accuracy *plus* adapter contribution) are specified in Table B.2 of Annex B of e TIA/EIA 568-B.2-1 standard. (Table B.3 in this TIA document specifies the accuracy requirements for the Channel configuration.)

The Owner's Quality Assurance Team shall consider cable(s) and cabling components as pre-tested by the manufacturer to meet TIA/EIA-568-B.2-1 Category 6a specifications. Therefore, individual testing of connectors and other cabling components is not required.

B.9 Data Accuracy

Tests shall be conducted on the premise that TIA/EIA-568-B.2 and other applicable specifications were applied to the cable installation. Further, the Owner's Quality Assurance Team shall be provided the test result book to verify the Installer tested 100 percent of their work, so the sampling tests performed ensures system operability and customer satisfaction. The tester interface adapters must be of high quality and the cable shall not show any twisting or kinking resulting from coiling and storing of the tester interface adapters. In order to deliver optimum accuracy, preference is given to a permanent link interface adapter for the tester that can be calibrated to extend the reference plane of the Return Loss measurement to the permanent link interface. The contractor shall provide proof that the interface has been calibrated within the period recommended by the vendor. To ensure that normal handling on the job does not cause measurable Return Loss change, the adapter cord cable shall not be of twisted-pair construction.

B.10 Data and Test Reporting

The Quality Assurance Report shall clearly identify the test environment, test equipment used, name of each tester, acceptable results (as specified in 568-B Category 6a related), and actual results for each test performed. If a failure occurs, the test shall proceed, with the failure reported to the responsible Installer for repair at test end.

B.11 Communications Wiring Electrical Tests

Quality Assurance Guidelines

The test parameters for Category 5e and Category 6a are defined in TIA/EIA-568-B.2 standard. The test of each link shall contain of the following parameters as detailed below. In order to pass the test, measurements (at each frequency in the range from 1 MHz through 350 MHz) must meet or exceed the limit value determined in the above-mentioned standard.

B.11.1 Wire Map

Wire Map shall report Pass if the wiring of each wire-pair from end to end is determined to be correct. The Wire Map results shall include the continuity of the shield connection if present.

B.11.2 Length

The field tester shall be capable of measuring length of pairs of a permanent link or channel based on the propagation delay measurement and the average value for Nominal Velocity of Propagation. The physical length of the link shall be calculated using the pair with the shortest electrical delay.

This length figure shall be reported and shall be used for making the Pass/Fail decision. The Pass/Fail criteria are based on the maximum length allowed for the Permanent Link configuration (90 meters – 295 feet) plus 10% to allow for the variation and uncertainty of NVP.

B.11.3 Insertion Loss (Attenuation)

Insertion Loss is a measure of signal loss in the permanent link or channel. The term “Attenuation” has been used to designate “Insertion Loss.” Insertion Loss shall be tested from 1 MHz, through the highest applicable frequency. It is preferred to measure insertion loss at the same frequency intervals as NEXT Loss in order to provide a more accurate calculation of the Attenuation-to-Crosstalk ratio (ACR) parameter.

Minimum test result documentation (summary results): Identify the worst wire pair (1 of 4 possible). The test results for the worst wire pair must show the highest attenuation value measured (worst case), the frequency at which this worst case value occurs and the test limit value at this frequency.

B.11.4 NEXT Loss

Pair-to-pair near-end crosstalk loss (abbreviated as NEXT Loss) shall be tested for each wire pair combination from each end of the link (a total of 12 pair combinations). This parameter is to be measured from 1 through the highest applicable frequency. NEXT Loss measures the crosstalk disturbance on a wire pair at the end from which the disturbance signal is transmitted (near-end) on the disturbing pair. The maximum step size for NEXT Loss measurements shall not exceed the maximum step size defined in the draft standard as shown in Table 2, column 2.

Minimum test results documentation (summary results): Identify the wire pair combination that exhibits the worst case NEXT margin (2) and the wire pair combination that exhibits the worst value of NEXT (worst case).

Table 2

Frequency Range (MHZ)	Maximum Step Size (MHZ)
1 – 31.25	0.15
31.26 – 100	0.25
100 – 250	0.50

Quality Assurance Guidelines

250-350	1.00
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NEXT is to be measured from each end of the link-under-test. These wire pair combinations must be identified for the tests performed from each end. Each reported case shall include the frequency at which it occurs as well as the test limit value at this frequency.

B.11.5 PSNEXT Loss

Power Sum NEXT Loss shall be evaluated and reported for each wire pair from both ends of the link-under-test (a total of eight results). PSNEXT Loss captures the combined near-end crosstalk effect (statistical) on a wire pair when other pairs actively transmit signals. Like NEXT this test parameter must be evaluated from 1 MHz through the highest applicable frequency and the step size may not exceed the maximum step size defined in the draft standard as shown in Table 2, column 2.

Minimum test result documentation (summary results): Identify the wire pair that exhibits the worst case margin and the wire pair that exhibits the worst value for PSNEXT. These wire pairs must be identified for the tests performed from each end. Each reported case shall include the frequency at which it occurs as well as the test limit value at this frequency.

B.11.6 ELFEXT Loss, pair-to-pair

Pair-to-pair FEXT Loss shall be measured for each wire-pair combination from both ends of the link under test. FEXT Loss measures the crosstalk disturbance on a wire pair at the opposite end (far-end) from which the transmitter emits the disturbing signal on the disturbing pair. FEXT is measured to compute ELFEXT Loss that must be evaluated and reported in the test results. ELFEXT measures the relative strength of the far-end crosstalk disturbance relative to the attenuated signal that arrives at the end of the link. This test yields 24 wire pair combinations. ELFEXT is to be measured from 1 through the highest applicable frequency and the maximum step size for FEXT Loss measurements shall not exceed the maximum step size defined in the draft standard as in Table 2, column 2.

Minimum test result documentation (summary results): Identify the wire pair combination that exhibits the worst-case margin and the wire pair combination that exhibits the worst value for ELFEXT. These wire pairs must be identified for the tests performed from each end. Each reported case shall include the frequency at which it occurs as well as the test limit value at this frequency.

B.11.7 PSELFEXT Loss

Power Sum ELFEXT is a calculated parameter that combines the effect of the FEXT disturbance from three wire pairs on the fourth one. This test yields 8 wire-pair combinations.

Each wire-pair is evaluated from 1 MHz through the highest applicable frequency in frequency increments that do not exceed the maximum step size defined in the draft standard as shown in Table 2, column 2.

Minimum test result documentation (summary results): Identify the wire pair that exhibits the worst case margin and the wire pair that exhibits the worst value for PSELFEXT. These wire pairs must be identified for the tests performed from each end. Each reported case shall include the frequency at which it occurs as well as the test limit value at this frequency.

Quality Assurance Guidelines

B.11.8 Return Loss

Return Loss (RL) measures the total energy reflected on each wire pair. Return Loss is to be measured from both ends of the link-under-test for each wire pair. This parameter is also to be measured from 1 through the highest applicable frequency in increments that do not exceed the maximum step size defined in the draft standard as shown in Table 2, column 2.

Minimum test result documentation (summary results): Identify the wire pair that exhibits the worst case margin and the wire pair that exhibits the worst value for Return Loss. These wire pairs must be identified for the tests performed from each end. Each reported case shall include the frequency at which it occurs as well as the test limit value at this frequency.

B.11.9 Propagation Delay

Propagation delay is the time required for the signal to travel from one end of the link to the other.

This measurement is to be performed for each of the four wire pairs.

Minimum test result documentation (summary results): Identify the wire pair with the worst case propagation delay. The report shall include the propagation delay value measured as well as the test limit value.

B.11.10 Delay Skew

As defined in TIA/EIA-568-B.1; Section 11.2.4.11, this parameter shows the difference in propagation delay between the four wire pairs. The pair with the shortest propagation delay is the reference pair with a delay skew value of zero.

Minimum test result documentation (summary results): Identify the wire pairs with the worst-case propagation Delay skew. The report shall include the Delay skew value measured as well as the test limit value.

B.11.11 ACR (Attenuation to crosstalk ratio)

This parameter is not required by TIA standards but may be expected in order to obtain the premise wiring manufacturer's warranty.

ACR provides an indication of bandwidth for the two wire-pair network applications. ACR is a computed parameter that is analogous to ELFEXT and expresses the signal to noise ratio for a two wire-pair system. This calculation yields 12 combinations – six from each end of the link. Minimum test result documentation (summary results): Identify the wire pair combination that exhibits the worst-case margin and the wire pair combination that exhibits the worst value for ACR. These wire pair combinations must be identified for the tests performed from each end. Each reported case shall include the frequency at which it occurs as well as the test limit value at this frequency.

B.11.12 PSACR

This parameter is not required by TIA standards but may be required in order to obtain the premise wiring vendor's warranty. The Power Sum version of ACR is based on PSNEXT and takes into account the combined NEXT disturbance of adjacent wire pairs on each individual pair. This calculation yields 8 combinations – one for each wire pair from both ends of the link.

Minimum test result documentation (summary results): Identify the wire pair that exhibits the worst case margin and the wire pair that exhibits the worst value for

Quality Assurance Guidelines

PSACR. These wire pairs must be identified for the tests performed from each end. Each reported case shall include the frequency at which it occurs as well as the test limit value at this frequency.

Quality Assurance Guidelines

APPENDIX C - FIBER OPTIC CABLE PERFORMANCE TESTS

C.1 Overview of Cable Tests

TIA/EIA-568-B.3 states, “The optical fiber cable construction shall consist of 50/125 mm or 62.5/125 mm multimode optical fibers or single mode optical fibers, or a combination of these media.” Multimode fiber shall have a graded-index optical fiber waveguide with nominal 50/125 μm for installations following specification 27 1514, or 62.5/125 μm core/ cladding diameter for installations following specification 27 1513. Primary and secondary backbone cable testing shall be equivalent to backbone cabling as defined in TIA/EIA-568-B.1 section 11.3.3, such as cabling interconnecting telecommunications closets, equipment cabinets, and entrance facilities. Therefore, the Owner’s Quality Assurance Team shall perform the following interrelated tests:

1. Verification of multi-mode fiber optic cable installations.
2. Verification of single-mode fiber optic cable installations.
3. Electronic measurement of the distance and equivalent attenuation per kilometer (km) to verify minimum data transmission capacity per specification.
4. Total link attenuation measurements.

C.2 Test Equipment

The following test equipment shall be used:

1. Fluke DSP 4300 Level III, or equal, tester with single mode and multi-mode power meter and light source heads
2. Fluke, or equal, OptiFiber Optical Time Domain Reflectometer (OTDR)

C.2.1 Cabling Distance

Section 27 1513 states that the maximum allowable multimode cable distance from MDF to IDF is 450 meters. The Multimode strands shall primarily be utilized by the network electronics up to 450 meters and testing shall conform to OFSTP-14A. The Singlemode strands shall be required where cabling the Backbone distance exceeds 450 meters and testing shall conform to OFSTP-7.

C.2.2 Cable Attenuation

The list below details the information presented in TIA/EIA – 568B.3 to illustrate the allowable attenuation per kilometer for 50/125, 62.5/125 and 9 μm fiber.

Table C.2.2-1. Maximum Cable Attenuation Coefficient for Backbone Fiber

MAXIMUM ATTENUATION RANGE	ALLOWABLE ATTENUATION
50/125 μm @ 850nm	3.5 dB/km
50/125 μm @ 1300nm	1.5 dB/km
62.5/125 μm @ 850nm	.5 dB/km
62.5/125 μm @ 1300nm	.5 dB/km
9 μm @ 1310 nm (indoor)	1 dB/km
9 μm @ 1550 nm (indoor)	1 dB/km
9 μm @ 1310 nm (indoor)	1 dB/km
9 μm @ 1550 nm (indoor)	1 dB/km

Quality Assurance Guidelines

C.2.3 Connector Attenuation

Per ANSI/EIA/TIA-455-59, the maximum optical attenuation per connector pair shall not exceed 0.75 dB.

C.3 Test Procedures

For multi-mode fiber the Owner's Quality Assurance Team shall use the Omni Scanner 2 to test the length and total attenuation at both the 850 nm and 1300 nm wavelengths in each direction (bi-directionally). If the test fails, the Owner's Quality Assurance Team shall complete a repeat test using the OTDR to assess the failure point and address corrective actions. (See Methods A and B attached.)

For single-mode fiber, the Owner's Quality Assurance Team shall use a power meter and light source. The specific nanometer wavelength(s) at which the single-mode fiber shall be tested (i.e., 1310 nm and/or 1550 nm) shall be determined based on the length of the fiber cable being tested.

C.3.1 Cable Distance

Using the Omni Scanner 2 or OTDR, the Owner's Quality Assurance Team shall determine the overall fiber optic cable length to ensure the cabling distance is within the maximum allowable length.

C.3.2 Attenuation

TIA/EIA-568-B.1 section 11.3.3, states, "When installing components compliant with this standard, the single performance parameter necessary for performance testing is link attenuation." Also "The backbone optical fiber cabling link segment should be tested in one direction at both operating wavelengths, to account for attenuation deltas associated with wavelength.

1. 50/125 μm backbone links shall be tested at 850 and 1300 nm in accordance with ANSI/EIA/TIA-526-14-A, Method B, with One "Reference Jumper."
2. 62.5/125 μm backbone links shall be tested at 850 and 1300 nm in accordance with ANSI/EIA/TIA-526-14-A, Method B, with One "Reference Jumper."
3. 9 μm backbone links shall be tested at 1310 and 1550 nm in accordance with ANSI/EIA/TIA-526-7, Method A.1."

The Owner's Quality Assurance Team shall use the Omni Scanner 2 or OTDR to measure the attenuation due to fiber optic cable and connectors. The Owner's Quality Assurance Team shall test and record attenuation at both 850nm/1300nm for each Multi-mode and 1310nm/1550nm for Single-mode fiber optic strand respectively terminated under this initiative. These tests shall be performed at each communications cabinet and from the MDF cabinet, as required.

C.3.3 Information Transmission Capacity

The fiber optic cable is assumed to be within the allowable attenuation per kilometer as specified in TIA/EIA-568-B.1 section 11.3.3.4. The Owner's Quality Assurance Team shall presume the transmission capacity of the cable is within specification.

C.4 Data Reporting and Accuracy

The Owner's Quality Assurance Team shall report loss measurement results, with locations and wavelength identifications, to the Owner in accordance with EIA/TIA OFSTP-14 and OFSTP-

Figure C - Testing Methods A, B and Adaptive B

Quality Assurance Guidelines

1. Diagrams and Explanations for testing

C.5 Fiber Optic Cable Installation Test Forms

The following pages provide the two fiber optic cable installation test forms:

1. Fiber Optic Cable Installation Test Form—OTDR
2. Fiber Optic Cable Installation Test Form—Power Meter and Light Source

Figure C - Method A, Method B and Adapted Method B Explained Solution

The testing of premises fiber optic cabling links requires precise methods for referencing to obtain accurate and valid test results. Loss testing for multimode fiber cabling is specified in ANSI/TIA/EIA-526-14A. This standard contains two test procedures: Method A and Method B. This article describes Methods A and B, and explains why Method B is the proper method for testing fiber links contained in premises networks.

This article also proposes a new test procedure as an adaptation to Method B to overcome some disadvantages associated with Method B. This new test procedure is the preferred method because it provides results conforming to Method B while offering installers more flexibility for testing fiber links with types of connectors, including Small Form Factor (SFF) connectors. This article also details other advantages of the Method B adaptation for simplifying the testing process and reducing the opportunity for errors.

Method A

Method A is used for testing links in which the total attenuation is dominated by the loss in the fiber cable, rather than the loss of the connectors, as is often the case for telecom networks. The referencing procedure for Method A uses two patch cords and an adapter connector per fiber link to be tested (See Figure 1).

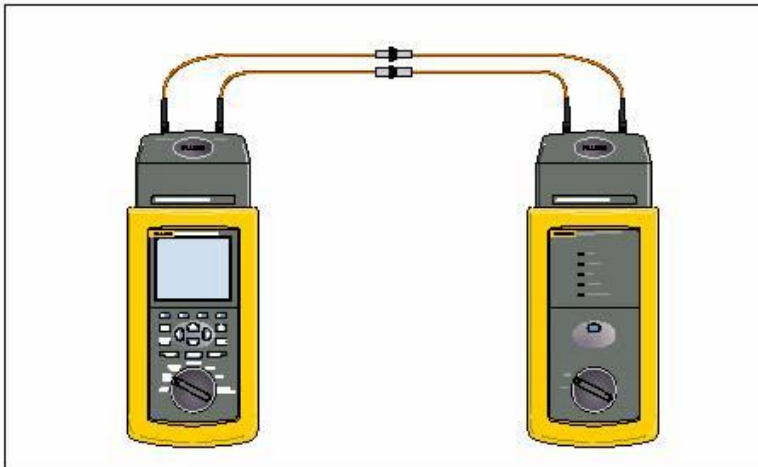


Figure 1 - Reference Configuration with a Dual Fiber Tester Simultaneously Testing Two Fiber Links

The two patch cords and one adapter connection are referenced out when the test is performed. Therefore, the test results include the loss of the fiber link under test plus only one connection (Note the blue section in Figure 2).

Quality Assurance Guidelines

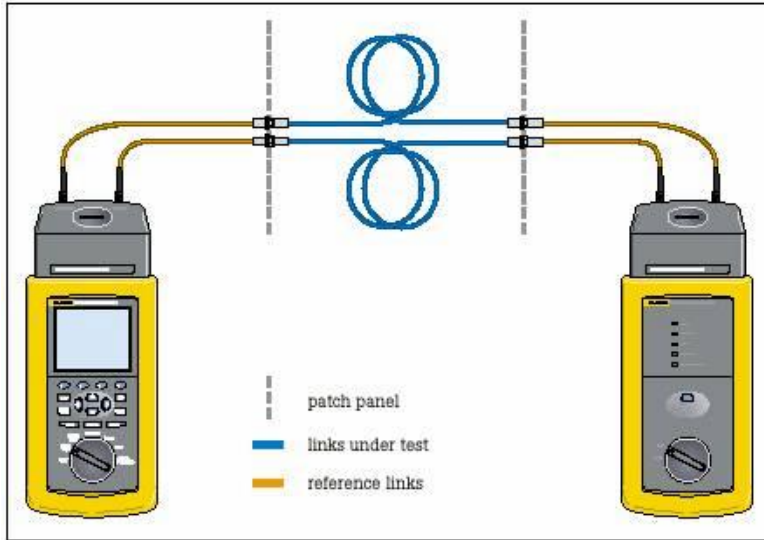


Figure 2 - Test Configuration with Dual Fiber Tester

While this method has been used effectively in the testing of long haul telecom fiber links, it is less precise than what is necessary for the premises market today. Because the network operation actually sees the loss of the fiber link plus the connections at both ends, Method A understates the power loss in the link since it includes only one connection. For long-haul telecom links, this is not an issue since the majority of the loss is in the long lengths of fiber with minimal loss in the precision connectors.

However, in premises applications, fiber lengths are very short and the amount of loss in the fiber cable itself is minimal. The majority of power loss is found in the connections at either end. The increasingly stringent power loss budgets of applications like Gigabit Ethernet require that the entire link loss be measured. That is where Method B becomes applicable.

Method B

Method B is used for testing links for which the connector loss is a significant portion of the total attenuation. This is the case for premises links. The referencing procedure for Method B uses one patch cord per fiber link to be tested (See Figure 3). (Note: This figure depicts a dual fiber tester that tests two fiber links at a time.)



Figure 3 - Method B Reference Configuration

Since only one patch cord (per link) is part of the reference, the test results shall include loss from the fiber cable under test plus the connections at BOTH ends (see blue section in Figure 4).

Quality Assurance Guidelines

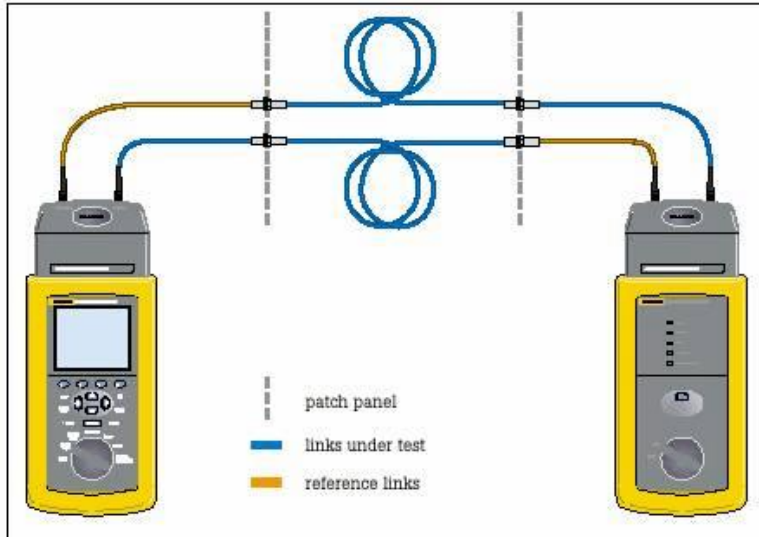


Figure 4 - Method B Test Configuration

Technically, it shall also include any loss in the additional patch cord but this is negligible because the length is so short.

For premises fiber networks, this method provides an accurate measure of the loss in the fiber link because it includes the fiber cable plus the connections at BOTH ends. However, when using Method B, be aware of the following shortcomings:

1. When going from the reference setup to the test setup, it is necessary to disconnect one end of the patch cords from the tester. It is very important never to disturb the connection at the OUTPUT or source end. If this connection is disrupted, the reference is lost, and proceeding without re-referencing shall seriously compromise the test results. Unfortunately, one could easily disconnect the patch cord from the source (OUTPUT) end instead of from the detector (INPUT) end.
2. Although you must disconnect the patch cords from the detector (INPUT) end of the tester, extreme care is required as dirt and other elements can cause damage to the detector.
3. To test Small Form Factor (SFF) connectors that have the transmit and receive fibers in the same connector, you are forced to disconnect from the source (OUTPUT) end in violation of proper referencing and test procedures.
4. Using Method B requires that you have the same type of connector on the tester as you shall be testing in the fiber link.

Presented in the next section is a new test procedure that is an adaptation to Method B, but provides the same test results and preserves integrity to testing Standards while overcoming the short-comings listed above.

Adaptation to Method B

A simple adaptation to Method B allows us to retain the accuracy (every measurement includes the cable and both connections) but avoid the major disadvantages.

The referencing procedure for this adaptation is performed using 2 patch cords and an adapter connector per fiber link to be tested (See Figure 5).

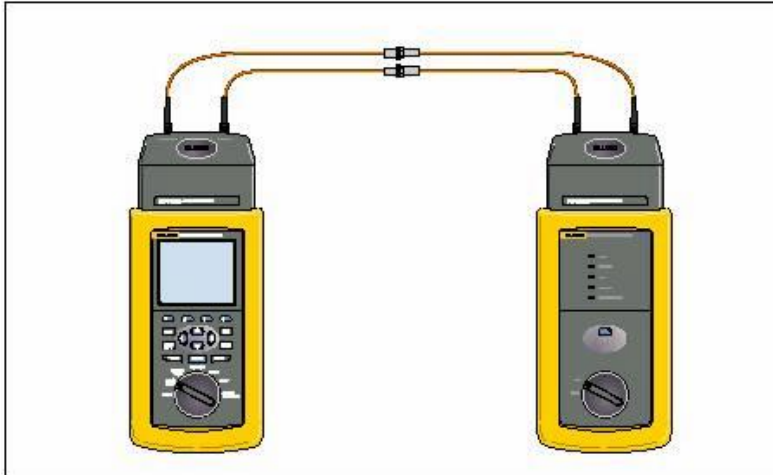


Figure 5 - Adaptation to Method B Reference Configuration

However, the test procedure is new, and is depicted in Figure 6.

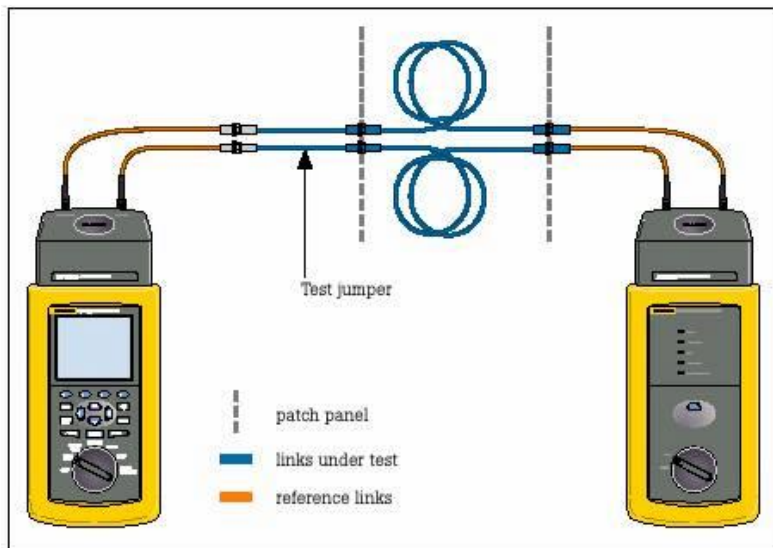


Figure 6 - Adaptation to Method B Testing Configuration

The test procedure includes the addition of a short test jumper with a connector so that the test results shall now be the same as the test results obtained with Method B. Just like Method B, the results contain the loss for the fiber cable plus the connections on BOTH ends (note the blue section in Figure 6). The two patch cords and one connection per link from the reference setup have been referenced out.

Make the Correct Loss Measurements

The Method B adaptation gives us several key advantages over the original Method B while preserving its accuracy:

The Method B adaptation gives loss results that conform to ANSI/TIA/EIA-526-4A, Method B. According to Method B, to measure the link loss correctly, the test path must have two more adapters in each fiber link than in the Set Reference path. The test procedure described in this article adheres precisely to this requirement. In this way, the measured loss shall be the loss of the fiber in a link plus the loss of a connection at each end of the link. This value of loss is the real value encountered by network application hardware.

Quality Assurance Guidelines

The Method B adaptation allows the use of hybrid patch cables to connect test equipment to the links under test. This allows consistent testing of links with all types of connectors, including those that use small form-factor (SFF) connectors.

Preserve the Integrity of your Test

The adaptation to Method B makes it unnecessary to disconnect the patch cords from the test equipment, thereby reducing the possibility of errors caused by reinsertion of patch cords or by contamination or damage of test equipment fiber interfaces.

Quality Assurance Guidelines

C.5.1 Fiber Optic Cable Installation Test Form—Omni Scanner 2 and OTDR

Site _____ Q/A Rep(s) _____ Date _____ Q/A Review Form: Pass / Fail

Omni Scanner2 Serial #: _____ Omni Scanner2 Location _____ Distant End Location _____

OTDR Serial #: _____ Near End TFBM Serial #: _____ Distant End TFBM Serial #: _____

Wave-length (nm)	Strand	Length (m)	Total Attn (dB)		Disk	Comments	Wave-length (nm)	Strand	Length (m)	Total Attn (dB)	
			↑	↓						↑	↓
850	1-blue						850	13-blue			
1300							1300				
850	2-orange						850	14-orange			
1300							1300				
850	3-green						850	15-green			
1300							1300				
850	4-brown						850	16-brown			
1300							1300				
850	5-slate						850	17-slate			
1300							1300				
850	6-white						850	18-white			
1300							1300				
850	7-red						850	19-red			
1300							1300				
850	8-black						850	20-black			
1300							1300				
850	9-yellow						850	21-yellow			
1300							1300				
850	10-violet						850	22-violet			
1300							1300				
850	11-rose						850	23-rose			
1300							1300				
850	12-aqua						850	24-aqua			
1300							1300				

Quality Assurance Guidelines

C.5.2 Fiber Optic Cable Installation Test Form—Power Meter and Light Source

Site _____ Q/A Rep(s) _____ Date _____ Q/A Review Form: Pass / Fail

Power Meter _____ Power Meter Location _____
 Serial #: _____

Light Source _____ Light Source Location _____
 Serial #: _____

Wave-length (nm)	Strand	Length (m)	Total Attn (dB)		Disk	Comments	Wave-length (nm)	Strand	Length (m)	Total Attn (dB)		Disk	Comments
			↑	↓						↑	↓		
1310	1-blue						1310	13-blue					
1550							1550						
1310	2-orange						1310	14-orange					
1550							1550						
1310	3-green						1310	15-green					
1550							1550						
1310	4-brown						1310	16-brown					
1550							1550						
1310	5-slate						1310	17-slate					
1550							1550						
1310	6-white						1310	18-white					
1550							1550						
1310	7-red						1310	19-red					
1550							1550						
1310	8-black						1310	20-black					
1550							1550						
1310	9-yellow						1310	21-yellow					
1550							1550						
1310	10-violet						1310	22-violet					
1550							1550						

Quality Assurance Guidelines

Wave-length (nm)	Strand	Length (m)	Total Attn (dB)		Disk	Comments	Wave-length (nm)	Strand	Length (m)	Total Attn (dB)		Disk	Comments
			↑	↓						↑	↓		
1310	11-rose						1310	23-rose					
1550							1550						
1310	12-aqua						1310	24-aqua					
1550							1550						

Quality Assurance Guidelines

APPENDIX D - NETWORK EQUIPMENT PERFORMANCE TESTS

D.1 Overview of Equipment Tests

These equipment tests verify the operation of the network components (e.g., switches, and routers) either purchased or provided for use as part of the particular project. This plan addresses industry-standard TCP/IP tests that collectively address Network layer connectivity and IP packet path routing; it does not address network performance (i.e., total throughput capabilities) tests.

The Owner's Quality Assurance Team shall perform the following interrelated tests:

1. Spanning Tree Root Bridge identification test. Spanning tree protocol is one of the most important layer 2 protocols at work in switches. Spanning Tree ensures that no loops occur in a network by a designated root bridge. The root bridge is a central point of a spanning-tree configuration and it controls how the protocol operates. It is best practice to configure the core switch to be the root bridge. Run the following command on the core switch to identify it is set as the root bridge: Show spanning-tree summary.
2. Internet Control and Message Protocol (ICMP) Ping Test. This test verifies the Network layer for connectivity by using Ether-type frame pings to reach IP target addresses and obtain or verify four results—the target IP address, the local media access control (MAC), the number of responses, and the response time. The target IP addresses are the upstream and/or downstream gateway IP addresses based on the device's connectivity in the network. The source is the management console on the device. Each test includes two steps, if necessary, as follows:
 - a. Obtain the four results by performing an address resolution protocol (ARP) for the target IP address and verifying the ping.
 - b. If test 1 is unsuccessful, obtain the four results by executing an ARP for the default router, then use the acquired MAC address to determine the IP address, send an ICMP echo request and monitor for the ICMP reply.
3. Trace Route/Path Discover. This test determines the path IP packets follow, and reports each router encountered in the path. Testing elicits an ICMP TIME-EXCEEDED response from each router encountered. Each hop is tested three times to help identify changing routes.
4. Configuration Test. This test verifies that each new network port is operational. Perform an ICMP ping from each port not previously tested, ensuring each port has a link light indicating port operability.
5. VLAN configuration verification. Inspect VLAN configuration and port assignments to be matching the provided documentation. Inspect VLAN trunking, and verify forwarding state of required VLANs on VLAN trunks.

D.2 Test Equipment

The following test equipment shall be used:

1. Fluke 682 Enterprise LAN Meter or equivalent.
2. Computer with TCP/IP protocol stack, TELNET application and data capture software (optional).

D.3 Test Methodology

Quality Assurance Guidelines

The basic test methodology is to verify connectivity from user access ports through and within the installed intra-network to the WAN Router. Overall connectivity is verified by testing to and from points in the network. Site testing reflects the specific switch(s) and router(s) implemented at the site.

D.4 Test Hierarchy for Connectivity (Pings, Trace Routes and Telnets)

Table D.4-1 contains the network equipment performance tests and corresponding descriptions.

Table D.4-1. Network Equipment Performance Tests

TEST	TEST DESCRIPTION
Ping from Wall outlet WAN or Internet location	Connect the computer into the network via the wall plate, obtain DHCP IP address and perform a ping to a known IP address or URL outside the campus network.

D.5 Network Equipment Configuration Verification and Performance Tests

The Owner's Quality Assurance Team shall follow the test sequence shown. The following sample form lists tests to be performed at this site. For the set of Network Equipment Performance Test forms tailored to the individual communications cabinets, please see enclosed file Network Checklists.doc.

D.5.1 Network Equipment Configuration Verification Form

Site _____ Date _____ Tester(s) _____

Building and Communications Cabinet Numbers _____

Device Name/IP	Type of device	Type of Configuration verified	PASS	FAIL
	Ethernet Switch	VLAN / STP/ port activation/ Trunking		
	Ethernet Switch	VLAN / STP/ port activation/ Trunking		
	Router/ L3 switch	IP Routing/ SNMP/ Access-lists		
	Router/ L3 switch	IP Routing/ SNMP/ Access-lists		

D.5.2 Network Equipment Performance Test Form

Site _____ Date _____ Tester(s) _____

Building and Communications Cabinet Numbers _____

(a packet loss in excess of 1% during ping test is not acceptable and is considered a FAIL)

TEST	SOURCE ADDRESS/LOCATION	DESTINATION ADDRESS/LOCATION	PASS	FAIL
Ping from Wall outlet				

Quality Assurance Guidelines

to WAN Router location				
Trace route from Wall outlet to WAN Router location				

Quality Assurance Guidelines

APPENDIX E - PHYSICAL CONFIGURATION AUDIT

E.1 Overview of Physical Connectivity Audit

A Physical Connectivity Audit is completed comparing the vendor supplied Equipment Inventory List (EIL) against the Cabinet Equipment Survey generated by the test team at Quality Assurance. This appendix provides the detailed audit of the physical equipment and materials installed under this expansion effort.

E.2 Physical Connectivity Audit Quality Assurance Review lists

The following sample form shows the general information to be documented for a standard Cabinet Equipment Survey.

Site _____ Date _____ Tester(s) _____
 Building and Communications Cabinet Numbers _____

Location	Location Annotation	Number of Switches	Number / Type of UPS	Number of Fibers (MM/SM)	Number of Horiz. Copper drops	Number of Horiz. Fibers
MDF						
IDF1						
IDF2						
IDF3						
IDF4						
IDF5						
IDF6						
IDF7						
LDF1						
LDF2						
LDF3						
LDF4						
Notes:						

Quality Assurance Guidelines

APPENDIX F - CABLE DOCUMENTATION SPECIFICATION

F.1 Documentation.

- F.1.1** The test result information for each link shall be recorded in the memory of the field tester upon completion of the test.
- F.1.2** Individual test reports shall be submitted in hardcopy and electronic format. Hand-written test reports are not acceptable.
- F.1.3** The test results records saved by the tester shall be transferred into a Windows™-based database utility, such as MS Access, or SQL, or MS Excel spreadsheet, that allows for the maintenance, review and archiving of these test records. A guarantee must be made that the measurement results are transferred to the PC unaltered, i.e., “as saved in the tester” at the end of each test and that these results cannot be modified at a later time.
- F.1.4** Hardcopy reports may be submitted in labeled 3 ring binders with an attached affidavit verifying passing execution of tests. For large installations electronic reports with hardcopy summaries are preferred. Hardcopy summary reports shall contain the following information on each row of the report: circuit ID, test specification used, length, and date of test and pass/fail result.
- F.1.5** Electronic reports are to be submitted in CD format. If proprietary software is used, disk or CD shall contain any necessary software required to view test results. If the results are delivered in a standard format like Excel, Access, CSV files, etc., then software to read these files is not needed. Electronic reports must be accompanied by a Certificate signed by an authorized representative of the Contractor warranting the truth and accuracy of the electronic report. Certificate must reference traceable circuit numbers that match the electronic record.
- F.1.6** Test reports shall include the test measurement information specified in Section 5 for each cabling element tested, in addition to:
- F.1.7** Cable manufacturer, cable model number/type and NVP.
- F.1.8** Tester manufacturer, model, serial number, hardware version and software Ver. 6.
- F.1.9** Circuit ID number.
- F.1.10** Auto test specification used.
- F.1.11** Identification of the tester interface.
- F.1.12** Overall pass/fail indication.
- F.1.13** Date and time of test.

Table F.2 Cable Test Parameter Preferences

When reading the printed test result output, the following parameters must be shown with the associated cable test.

Cable Testing Parameter Preferences								
Cable Test	NVP	Cable	Auto test	Fiber Type	GRI	Reference	Test Direction	Pulse Width
Level (IIE) Category 5 E Tester	69 – 72	Cat 5E	Cat 5E Perm link	n/a	n/a	n/a	n/a	n/a

Quality Assurance Guidelines

Level (III) Category 6 Tester	69 – 72	Cat 6	Cat 6 Perm link	n/a	n/a	n/a	n/a	n/a
Power Meter Horizontal MM F/O @ 850nm/1300nm	n/a	62.5/125 Mnfr	568B Horizontal	Multimod e 50 or 62.5	1.4920 @ 1300nm	1 jumper method	Bi- Directiona l	n/a
Power Meter Backbone MM F/O @ 850nm/1300nm	n/a	62.5/125 Mnfr	568B Backbone	Multimod e 50 or 62.5	1.4920 @ 1300nm	1 jumper method	Bi- Directiona l	n/a
Power Meter Backbone SM F/O @ 1310nm/1550n m	n/a	SM Mnfr	1000 Base –LX	Single Mode	1.4640 @1300n m	1 jumper method	Bi- Directiona l	n/a
OTDR Horizontal MM F/O @ 850nm/1300nm	n/a	n/a	n/a	Single Mode	n/a	n/a	Uni- Directiona l	<50ns
OTDR Backbone MM F/O @ 850nm/1300nm	n/a	n/a	n/a	Single Mode	n/a	n/a	Uni- Directiona l	<50ns
OTDR Backbone SM F/O @ 1310nm/1550n m	n/a	n/a	n/a	Single Mode	n/a	n/a	Uni- Directiona l	<50ns

NOTE: The length of the cable is the variable of which the Power Meter and light source determines the expected dB loss for Backbone cable tests.

Table F.3 Allowable Distance per Fiber Length

Use this table as a guideline to compare references for dB loss in the installed Backbone Fiber. Total loss includes .75 dB loss per mated connector pair.

Fiber Cable Distance	Multimode dB Loss	Singlemode DB Loss	Fiber Cable Distance	Multimode dB Loss	Singlemode DB Loss
100'	1.6	1.53	1200'	2.7	1.86
200'	1.7	1.56	1300'	2.8	1.89
300'	1.8	1.59	1400'	2.9	1.92
400'	1.9	1.62	1500'	3.0	1.95
500'	2.0	1.65	1600'	3.1	1.98

Quality Assurance Guidelines

600'	2.1	1.68		1700'	3.2	2.01
700'	2.2	1.71		1800'	3.3	2.04
800'	2.3	1.74		1900'	3.4	2.07
900'	2.4	1.77		2000'	3.5	2.10
1000'	2.5	1.80		2100'	3.6	2.13
1100'	2.6	1.83		2200'	3.7	2.16

SECTION 26 0500

COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

1.01 SUMMARY

- A. This Section specifies the basic requirements for electrical installations and includes requirements common to more than one section of Division 26. It expands and supplements the requirements specified in sections of Division 01.
- B. Related Requirements:
 - 1. Division 01 - General Requirements.
 - 2. Section 03 3000 - Cast-in-Place Concrete.
 - 3. Section 09 9000 - Painting and Coating.
 - 4. Division 14 - Conveying Equipment.
 - 5. Division 23 - HVAC.
 - 6. Division 27 – Communications.
 - 7. Division 28 - Electronic Safety and Security.
 - 8. Section 31 2323 - Excavation and Fill for Utilities.
- C. Applicable Standards
 - 1. ASTM D 709 (2007) – Laminated Thermosetting materials.
 - 2. ANSI/NEMA FB-1 (2010) – Standard for Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable.
 - 3. ANSI/NEMA 250 (2008) – Enclosure for Electrical Equipment (1000 Volts Maximum).
 - 4. California Electrical Code (CEC).
 - 5. IEEE C57.12.28 (2005) – Standard for Pad-Mounted equipment (Enclosure Integrity).
 - 6. UL 1 (2005) – Standard for Flexible Metal Conduit.
 - 7. UL 1242 (2007) – Standard for Electrical Intermediate Metal Conduit.
 - 8. UL 506 (2008) – Specialty Transformers.
 - 9. UL 6 (2010) – Electrical Rigid Metal Conduit-Steel.
 - 10. UL 797 (2007) – Electrical Metallic Tubing-Steel.
 - 11. UL 870 (2008) – Standard for Wireways, Auxiliary Gutters, and Associated Fittings

1.02 BASIC ELECTRICAL REQUIREMENTS

- A. Quality Assurance:
 - 1. Workers possessing the skills and experience obtained in performing work of similar scope and complexity shall perform the Work of this Division.
 - 2. Refer to other sections of the Specifications for other qualification requirements.
- B. Drawings and Specifications Coordination:
 - 1. For purposes of clearness and legibility, Drawings are essentially diagrammatic and the size and location of equipment is indicated to scale whenever possible. Verify conditions, dimensions, indicated equipment sizes, and manufacturer’s data and information as necessary to install the Work of this Division. Coordinate location and layout with other Work.

2. Verify final locations for rough-ins with field measurements and with the requirements of the equipment to be connected.
 3. Drawings indicate required size and points of termination of conduits, number and size of conductors, and diagrammatic routing of conduit. Install conduits with minimum number of bends to conform to structure, avoid obstructions, preserve headroom, keep openings and passageways clear, and comply with applicable code requirements.
 4. Routing of conduits may be changed provided that the length of any conduit run is not increased more than 10 percent of length indicated on the Drawings.
 5. Outlet locations shall be coordinated with architectural elements prior to start of construction. Locations indicated on the Drawings may be distorted for clarity.
 6. Coordinate electrical equipment and materials installation with building components and the Work of other trades
 7. As much as practical, connect equipment for ease of disconnecting, with minimum of interference with other installations.
 8. Coordinate connection of electrical systems with existing underground utilities and services.
- C. Terminology:
1. Signal Systems: Applies to clock, bell, fire alarm, annunciator, sound, public address, buzzer, telephone, television, inter-communication, elevator access controls, lighting control systems and security systems.
 2. Low Voltage: Applies to signal systems operating at 120 volts and less, and power systems operating at less than 600 volts. Medium voltage: Applies to power systems operating at more than 600 volts.
 3. UL: Underwriter's Laboratories Inc, Nationally Recognized Testing Laboratory (NRTL), or equal.
- D. Regulations: Work shall comply with the requirements of authorities having jurisdiction and the California Electrical and Building Codes. Material shall conform to regulations of the National Board of Fire Underwriters for electrical wiring and apparatus. Materials shall be new and listed by UL, or another NRTL.
- E. Structural Considerations for Conduit Routing:
1. Where conduits pass through or interfere with any structural member, or where notching, boring or cutting of the structure is necessary, or where special openings are required through walls, floors, footings, or other buildings elements, conform to CBC, Part 2, Title 24, Section 1906.3 for conduits and pipes embedded in concrete and Sections 2308.9.10 and 2308.9.11 for notches and bored holes in wood; for steel, as detailed on the structural steel Shop Drawings.
 2. Where a concrete encasement for underground conduit abuts a foundation wall or underground structure which the conduits enter, encasement shall rest on a haunch integral with wall or structure, or shall extend down to footing projection, if any, or shall be doveled into structure unless otherwise indicated. Underground structures shall include maintenance holes; pull boxes, vaults, and buildings.
 3. Holes required for conduit entrances into speaker poles, floodlight poles or other poles, shall be drilled with the conduit nipple or coupling welded to poles. Welds shall be provided by the electric arc process and shall be continuous around nipple or coupling.

- F. Electrically Operated Equipment and Appliances:
1. Furnished Equipment and Appliances:
 - a. Work shall include furnishing and installing wiring enclosures for, and the complete connection of electrically operated equipment and appliances and electrical control devices which are specified to be furnished and installed in this or other sections of the Specifications, wiring enclosures shall be concealed except where exposed Work is indicated on the Drawings.
 - b. Connections shall be provided as necessary to install equipment ready for use. Equipment shall be tested for proper operation and, if motorized, for proper rotation. If outlets are of incorrect electrical characteristics or any specified equipment fails to operate properly, repair and/or replace the outlet and/or equipment.
 2. Equipment and Appliances Furnished by Others:
 - a. Equipment and appliances indicated on Drawings as "not in contract" (NIC), "furnished by others," or "furnished by the Owner," will be delivered to the Project site. Required electrical connections shall be performed for such equipment and appliances. Motorized equipment will be furnished factory-wired to a control panel or junction box unless otherwise indicated. Appliances will be furnished equipped with portable cord and cap. Provide disconnect switches where required.
 - b. Connections to equipment furnished under this Division shall be part of the Work of this section. Work shall include internal wiring, installation, connection and adjustment of bolted drive motors in which the motor is supplied as a separate unit, and connections only for equipment furnished with factory installed internal wiring, except as further limited by Drawings and this Specification. Work shall include furnishing and installing suitable outlets, disconnecting devices, starters, push-button stations, selector switches, conduit, junction boxes, and wiring necessary for a complete electrical installation. Work shall also include furnishing and installing conduit and boxes for HVAC control systems, furnished under Division 23. Devices and equipment furnished shall be of same type used elsewhere on the Work or as specified.
 - c. Electrical equipment furnished under other sections, for installation and connection under Work of this section, will be delivered to the Project site ready for installation.
 - d. Mechanical equipment furnished under other sections, and requiring electrical connection under this section, will be set in place as part of the Work of the section furnishing such equipment unless noted otherwise.
 - e. Suitability and condition of equipment furnished under other sections shall be determined in advance of installation. Immediate notice of damage, unsuitability, or lack of parts shall be given to the entity providing such equipment.
- G. Protection of Materials:
1. Protect materials and equipment from damage and provide adequate and proper storage facilities during progress of the Work. Damaged materials and/or equipment shall be replaced.

- H. Cleaning:
 - 1. Exposed parts of Work shall be left in a neat, clean, usable condition. Finished painted surfaces shall be unblemished and metal surfaces shall be polished.
 - 2. Thoroughly clean parts of apparatus and equipment. Exposed parts to be painted shall be thoroughly cleaned of cement, plaster, and other materials. Remove grease and oil spots with solvent. Such surfaces shall be wiped and corners and cracks scraped out. Exposed rough metal shall be smooth, free of sharp edges, carefully steel brushed to remove rust and other spots, and left in proper condition to receive finish painting.
 - 3. Remove rubbish, debris, and waste materials and legally dispose of off the Project site.
- I. WARRANTIES
 - 1. Provide one year warranty on all material and labor performed, unless noted otherwise in specific sections.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION

3.01 GENERAL REQUIREMENTS

- A. Advise the Inspector before starting the Work of this Division.
- B. Exposed conduits shall be painted to match the surfaces adjacent to installation.
- C. Salvaged materials removed from buildings shall be removed from the Project site as required by the OAR.
- D. Trenches outside of barricade limits shall be backfilled and paved within 24 hours after being inspected by the Inspector. Provide traffic plates during the time that trenches are open in traffic areas and in areas accessible to students and staff.
- E. Where existing structural walls are cored for new conduit runs, separation between cored holes shall be three inches edge to edge from new or existing holes, unless otherwise required by the Architect. All coring to be laid out and reviewed by Architect prior to drilling. Contractor to verify location of structural steel, rebar, stress cabling or similar prior to lay out.
- F. Electrical equipment shall be braced and anchored for CBC Seismic Design requirements, or as otherwise indicated on the Drawings.

3.02 DELIVERY STORAGE AND HANDLING

- A. Deliver products to project site with proper identification, which shall include names, model numbers, types, grades, compliance labels, and similar information needed for City identification; all products and materials shall be adequately packaged and protected to prevent damage during shipment, storage, and handling.
- B. Coordinate deliveries of electrical materials and equipment to minimize construction site congestion.

3.03 CUTTING AND PATCHING

- A. Cutting and patching of electrical equipment, components, and materials shall include the removal and legal disposal of selected materials, components, and equipment.
- B. Do not endanger or damage installed Work through procedures and processes of cutting and patching.
- C. Repair or restore other work, or surfaces damaged as a result of the work performed under this contract.

3.04 CLEANUP

- A. Remove rubbish, debris and waste materials and legally dispose off the Project site.
- B. Remove equipment and implements of service, and leave entire work area neat and clean, to the satisfaction of the Owner Authorized Representative.

3.05

PROTECTION

- A. Protect the Work of this section until Substantial Completion.

END OF SECTION

SECTION 26 0513

BASIC ELECTRICAL MATERIALS AND METHODS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Boxes, enclosures, keys and locks.
 - 2. Receptacles and switches.
 - 3. Identifications and signs.
- B. Related Requirements:
 - 1. Division 01 - General Requirements.
 - 2. Division 26 – Electrical.
 - 3. Division 27 – Communications.
 - 4. Division 28 - Electronic Safety and Security.

PART 2 - PRODUCTS

2.01 BOXES, ENCLOSURES, KEYS AND LOCKS

- A. Outlet Boxes and Fittings:
 - 1. Outlet boxes installed in concealed Work shall be galvanized steel, pressed, or welded type, with knockouts.
 - 2. In exposed Work, where conduit runs change direction or size, outlet boxes and conduit fittings shall be cast metal with threaded hubs cast integral with box or fitting.
 - 3. Fittings shall be cast metal and non-corrosive. Ferrous metal fittings shall be cadmium-plated or zinc galvanized. Castings shall be true to pattern, smooth, straight, with even edges and corners, of uniform thickness of metal, and shall be free of cracks, gas holes, flaws, excessive shrinkage, and burnt-out sand.
 - 4. Covers for fittings shall be galvanized steel or non-corrosive aluminum and shall be designed for particular fitting installed.
 - 5. Light fixture outlets shall be 4-inch octagon, 4-inch square, 2 1/8-inch deep or larger, depending upon number of conductors or conduits therein. Plaster rings shall be furnished with round opening with two ears drilled 2 23/32 inches center to center.
 - 6. For local device outlets provide 4-inch square 2 1/8-inch deep, boxes for single gang, 5-inch square boxes for two-gang, and special solid gang boxes with gang plaster ring for more than two switches.
 - 7. For TV outlets, and horns and strobes provide manufacturer's supplied back box as needed. For television outlets, provide 4-gang deep boxes and 4-gang plaster rings.
 - 8. Plaster rings shall be provided on flush-mounted outlet boxes except where otherwise indicated or specified. Plaster rings shall be same depth as finished surface. Install approved ring extension to obtain depth to finish surface.
 - 9. In existing plywood wall or drywall construction, and where flexible steel conduit is fished into walls, single-gang and 2-gang outlets for wiring devices may be sectional steel boxes with plaster ears. Boxes shall be fastened to plywood with flat-head screws in each plaster ear screw hole. Boxes fastened to gypsum board shall be Raco, Appleton, Cooper, Bowers, or equal.
 - 10. Factory made knockout seals shall be installed to seal box knockouts, which are not intact.
 - 11. Where flexible conduit is extended from flush outlet boxes, provide and install weatherproof universal box extension adapters.
- B. Junction and Pull boxes:

1. Junction and pull boxes, in addition to those indicated, shall only be used in compliance with codes, recognized standards, and Contract Documents.
2. Interior and non-weatherproof boxes shall be constructed of blue or galvanized steel with ample laps, spot welded, and shall be rigid under torsion and deflecting forces. Boxes shall be furnished with auxiliary angle iron framing where necessary to ensure rigidity.
3. Covers shall be fastened to box with a sufficient number of machine screws to ensure continuous contact all around. Flush type boxes shall be drilled and tapped for cover screws if boxes are not installed plumb. Surfaces of pull and junction boxes and covers shall be labeled in black marker ink designating system, panelboard and circuit designation contained in box. In exposed Work, designation shall be installed on inside of pullbox or junction box cover.
4. Weatherproof NEMA 3R pull and junction boxes shall conform to foregoing for interior boxes with following modifications:
 - a. Cover of flush mounting boxes shall be furnished with a weather-tight gasket cemented to, and trimmed even with, cover all around.
 - b. Surface or semi-flush mounting pull and junction boxes shall be UL, or another Nationally Recognized Testing Laboratory (NRTL) listed as rain-tight and shall be furnished complete with threaded conduit hubs.
 - c. Exposed portions of boxes shall be galvanized and finished with one prime coat and one coat of baked-on gray enamel, unless already furnished with factory baked-on finish.
5. Junction and pull boxes shall be rigidly fastened to structure and shall not depend on conduits for support.
6. Underground Concrete Pull Boxes:
 - a. Pre-cast concrete pull boxes. Concrete pull boxes shall be traffic type, reinforced for H-20 wheel loading, pre-cast concrete. Pull boxes with inside dimensions of 2 feet by 3 feet by 3 feet deep shall consist of a base section, top ring, and cover. Base section shall be furnished with 2 knockouts measuring 10 inch by 10 inch in each 3 feet side, and one 20 inch by 20 inch knockout in each 2-foot side. Pull boxes with inside dimension 4 feet by 4 feet by 4 feet deep shall consist of a base section, midsection, topping, and cover. Base section shall be furnished with 2 knockouts measuring 8-inch by 16-inch on each of two opposite sides, and one 20-inch by 20-inch knockout on each of other two opposite sides. Pull boxes shall be furnished with a minimum of 6-inch diameter sump knockout and one inch diameter ground rod knockout. In pull boxes, furnish and install cable racks on walls. Racks shall be furnished with 3 porcelain cable holders on vertical steel mounting bars. Pull boxes shall be furnished with 3/4 inch diameter pull irons. Covers shall be traffic-type consisting of steel safety plate bolted to frame. Covers shall be marked as electrical, power, or signal as required. Pull boxes shall be as manufactured by Oldcastle Precast, Jensen Precast, Kistner, Western Precast, or equal.
 - b. Provide end bells in duct entrances. Terminate each metal conduit with insulated bushing provided with a grounding terminal.
 - c. Install pulling irons on opposite walls and below horizontal centerlines of ducts and bricked-up openings, and in bottom. Install pulling irons with each end hooked around a reinforcing bar.
 - d. Remove floor drain knockout and provide a depth of 24 inches of crushed rock below box extending a minimum of 12 inches beyond on all sides.

- e. Permanently and effectively ground metal equipment cases, cable racks, and similar items in pull boxes to site grounding electrode system. Provide grounding conductor in compliance with CEC Article 250.
 - f. Provide 6-inch deep sand base under pull boxes.
 - g. Identify power and signal cables by tagging in manholes and pull boxes. Tie securely to cables with nylon cord.
 - h. Top of steel plate shall provide a minimum coefficient of static friction of 0.5 for either wet or dry locations, when tested for any shoe sole material. Test shall comply with ASTM D 1047 or F 489 or F 609 standards. Submit manufacturer's test results for Architect's review as part of materials and equipment submittals.
 - i. The use of underground extension boxes shall be limited to not more than 1 times the original depth of pull box.
7. Underground utility boxes shall be reinforced concrete with non-setting shoulders to prevent settlement following installation. Boxes shall be furnished with cast iron cover with finger hole, size as indicated on Drawings. Utility boxes shall be as manufactured by Oldcastle, Jensen, Kistner, Western Precast, or equal.
8. Manholes, vaults, and pull boxes required by a utility company, and installed as part of this Contract, shall meet requirements of servicing utility company.
1. Three-Gang: Furnished three-gang floor lighting pockets shall be flush floor type, with cast iron floor plate and hinged cast iron door notched for cables. Three-gang floor pockets shall be owner approved Legrand or Hubbell Recessed Floor Boxes, C.W. Cole TLS-353-6, or equal, for wood floors and C.W. Cole TLS-353-6-C, or equal, for concrete slabs. Each floor pocket shall be provided with three 20 amp, 3 wire, 125 volt receptacles with matching caps.
- E. Keys and Locks:
- 1. Provide two keys with furnished door locks, including cabinet door locks and switchboard locks, two keys for lock switches on switchboards or control panels, and two keys with interlocks or other furnished lock switches. Deliver keys to OAR.
 - 2. Locks shall be keyed to Corbin No. 60 keys for access to operate equipment and Corbin 70 keys for service access. Special keys and locks shall only be provided where specified.

2.02 RECEPTACLES AND SWITCHES

- A. Receptacles:
- 1. Duplex receptacles shall be heavy-duty specification grade, grounding type. Terminal screws shall be back and side wired with internal screw pressure plates. Mounting strap shall feature heavy-duty brass construction. Receptacle back body shall be PVC. Receptacle face shall be ivory, impact resistant nylon. Receptacles shall have triple wipe brass power contacts.
- | <u>NEMA #</u> | <u>Pass & Seymour</u> | <u>Hubbell</u> | <u>Leviton</u> |
|---------------------|---------------------------|----------------|----------------|
| (20 amps) NEMA 5-20 | PS5362-I | HBL5362-I | 5362-I |
| (15 amps) NEMA 5-15 | PS5262-I | HBL5262-I | 5262-I |
- 2. Duplex receptacles on circuits supplied by panel boards with integral surge suppression shall be Pass & Seymour model number PS5262BL (blue), Hubbell DRUBTVSS15, Leviton 5262-SBU, 15 amps, 120 volts, or equal.
 - 3. Single receptacles shall be heavy-duty specification grade, grounding type. Terminal screws shall be back and side wire with internal screw pressure plates. Mounting strap shall feature heavy-duty brass construction. Receptacle back body shall be thermoplastic. Receptacle face shall be ivory, impact resistant nylon. Receptacles shall

have triple wipe brass power contacts. For circuits consisting of one single receptacle only, ampere rating of receptacle shall be same as circuit breaker or fuse.

<u>NEMA #</u>	<u>Pass & Seymour</u>	<u>Hubbell</u>	<u>Leviton</u>
(20 amps) NEMA 5-20R	5361-I	HBL5361-I	5361-I
(15 amps) NEMA 5-15R	5261-I	HBL5261-I	5261-I

4. 15 and 20 amps single receptacles on circuits supplied by panel boards with integral surge suppression shall be Pass & Seymour NEMA 5-20R model number 5361-BL (blue), and NEMA 5-15R model number 5261-BL (blue) respectively. Equal receptacles by other Owner approved manufactures are acceptable.

5. For kiln receptacles and range receptacles, provide 3-pole, 4-wire, grounding type, rated 50 amps at 125/250 volts NEMA 14-50R. Provide with 2-gang, stainless steel plates, SS 703, or equal.

<u>NEMA #</u>	<u>Pass & Seymour</u>	<u>Hubbell</u>	<u>Leviton</u>
NEMA 14-50R	3894	HBL9450A	279
WALL PLATE	SS703	S703	84026

6. For dryer receptacles, provide 3-wire, non-grounding type, rated 30 amps at 125/250 volts, NEMA 10-30R, with 2-gang stainless steel plates. Coordinate location of junction box with the work of Section 10 2815, Hand and Hair Dryers.

<u>NEMA #</u>	<u>Pass & Seymour</u>	<u>Hubbell</u>	<u>Leviton</u>
NEMA 10-30R	3860	HBL9350	5207
WALL PLATE	SS703	S703	84026

7. Provide specification grade ground-fault circuit interrupter (GFCI) type receptacles in accordance with 2010 UL standards. GFCI receptacles shall have a trip indication light. Receptacle terminal screws shall be back and side wire with internal screw pressure plates. Test and reset buttons shall match device body and shall be ivory. GFCI receptacles shall be manufactured in standard configuration for installation with stainless steel smooth plates. Exterior mounted receptacles shall be mounted inside weatherproof enclosure.

<u>NEMA #</u>	<u>Pass & Seymour</u>	<u>Hubbell</u>	<u>Leviton</u>
NEMA 5-20R	2095-I	GFR5352-IA	7899-I
NEMA 5-15R	1595-I	GFR5252-IA	8598-I

8. Provide weatherproof receptacles, except where otherwise indicated or specified, consisting of GFCI receptacles, as specified herein, and metal plates with die-cast lockable hinged lids and weatherproof mats;

9. In Kindergarten and Early Education Center rooms provide tamper-resistant receptacles with thermoplastic dual mechanism shutter system to help prevent insertion of foreign objects. Receptacles shall have extra heavy-duty brass, one-piece mounting strap with integral ground. Receptacles shall be ivory color, impact resistant nylon face and back body. For tamper-resistant receptacles rated 20 amps/125 volts, provide NEMA 5-20R, ivory in color,. For tamper-resistant receptacles rated 15 amps/125 volts, provide NEMA 5-15R, ivory in color.

<u>NEMA #</u>	<u>Pass & Seymour</u>	<u>Arrow Hart</u>	<u>Leviton</u>
(20 amps) NEMA 5-20R	TR63-I	TR8300V	8300SGI
(15 amps) NEMA 5-15R	TR62-I	TR8200V	8200SGI

B. Switches:

1. Local Switches:

- a. Provide local switches, high strength thermoplastic toggle, specification industrial grade, rated 20 amps at 120-277 volts AC only, with plaster ears, external screw pressure plate back and side wired, and standard size composition cups which fully enclose mechanism. Switches shall be approved for installation at currents up to full rating on resistive, inductive, tungsten filament lamp and fluorescent lamp loads, and for up to 80 percent of rating for motor loads. Switches shall have oversized silver alloy contacts for long life and better heat dissipation. Provide switches as single pole, double pole, 3-way, 4-way, non-lock type. Provide non-lock type switches with ivory handles;

	<u>Pass & Seymour</u>	<u>Hubbell</u>	<u>Leviton</u>
Single pole	PS20AC1I	HBL1221I	1221-2I
Double pole	PS20AC2I	HBL1222I	1222-2I
Three way	PS20AC3I	HBL1223I	1223-2I
Four way	PS20AC4I	HBL1224I	1224-2I

- b. Provide lock type switches, specification industrial grade, 20 amp, 120-277 volts with metal or nylon key guides with on/off indication, and operable by same key. Key shall be standardized vertically oriented, tamper resistant, forked key with two each 5/16-inch long forks, 5/32-inch spacing between forks and 5/16-inch width overall.

	<u>Pass & Seymour</u>	<u>Arrow Hart</u>
Single pole	PS20AC1L w/#500 Key-2L	1221L w/1201LK Key
Double pole	PS20AC2Lw/#500 Key	1222L w/1201LK Key
Three way	PS20AC3L w/#500 Key	1223L w/1201LK Key
Four Way	PS20AC4L w/#500 Key	1224L w/1201LK Key
Single pole	AH1191N	
Double pole	AH1192N	
Three way	AH1193N	

- d. Pilot light switches shall be rated 20 amps and shall conform to specifications for local switches. Switches shall be furnished with red, Lexan handles that are lighted by long-lasting neon lamps. Pilot light shall light when load is on. Pilot light 120 volt switches

	<u>Pass& Seymour</u>	<u>Hubbell</u>	<u>Leviton</u>
Single pole	PS20AC1-RPL	HBL1221-PL	1221-PLR
Double pole	PS20AC2-RPL	HBL1222-PL	1222-PLR
Three way	PS20AC3-RPL	HBL1223-PL	1223-PLR

Same as above except rated at 20 amps at 277 volts.

	<u>Pass & Seymour</u>	<u>Leviton</u>	<u>Hubbell</u>
Single pole	PS20AC1-RPL	1221-7PR	HBL1221-PL7

- e. Provide remote control switches for mechanically held contactors arranged for 3-wire control, toggle type, momentary contact, single pole, 3-position with center off position, rated 20 amps at 120-277 volts AC only, with plaster ears, binding screws for side wiring, standard size composition cups which fully enclose mechanism, and ivory handles

	<u>Pass & Seymour</u>	<u>Hubbell</u>	<u>Leviton</u>

- | | | | |
|--|--------|-----------|--------|
| | 1251-I | HBL1557-I | 1285-I |
|--|--------|-----------|--------|
- f. Provide remote control switches for magnetically held contactors arranged for 3-wire control, toggle type, maintained contact, single pole, 3-position with center off position, rated 20 amps at 120-277 volts AC only, with plaster ears, binding screws for side wiring, standard size composition cups which fully enclosed mechanism, and ivory handles.
- | | | |
|-------------------------|----------------|----------------|
| <u>Pass and Seymour</u> | <u>Hubbell</u> | <u>Leviton</u> |
| 1225-I | HBL 1385 | 1285-I |
- g. Momentary Contact locking key type switch. 20A 120/277V center off. Key shall be standardized vertically oriented, tamper resistant, forked key with two each 5/16" long forks, 5/32" spacing between forks and 5/16" width overall.
- Arrow Hart
AH1995L w/ AH2000 key
- h. Momentary Contact switch low voltage 1 pole 3A 24VAC 3 position center off. Key for locking switch shall be standardized vertically oriented, tamper resistant, forked key with two each 5/16" long forks, 5/31" spacing between forks and 5/16" width overall.
- Pass and Seymour
Toggle 108II
Locking 1081KGRY w/#500 Key
2. Time Switches and Photoelectric Controls for existing construction;
- a. Provide time switches with a 7-day, solid-state, electronic type capable of fully automatic or manual operation and housed in a sheet steel enclosure unless built into a panel or switchboard. Contacts rated for 25 amps resistive or inductive, each pole 240 VAC; 5 amps tungsten or 277 VAC pilot duty, each pole 240 VAC. Time switches to contain a non-volatile clock and non-volatile memory with a built-in rechargeable super capacitor power carry-over system. Battery carryover is not acceptable. Provide a minimum of 15 on/off set points per week. Timing to be in one minute increments with a minimum on or off time of one minute. Time switch digital displays to indicate days of week, hours, and minutes. Display to contain a load status light to indicate when equipment is in operation. Time switches; Paragon Model EC7000 Series, Tork Model EW 101B series, Intermatic ET7000 series, or equal. Features required for application:
- 1) Liquid crystal display panel.
 - 2) Holiday scheduling: Up to 40 dates may be assigned special holiday schedules, up to one year in advance.
 - 3) Automatically adjusts to and from daylight savings time and for leap year.
 - 4) Contact ratings: 10 amp at 240 VAC.
 - 5) Safety override switch for each circuit to either provide shut down of circuit or to override on.
 - 6) Selective review: All or part of schedule shall be displayed at touch of a key.
 - 7) Super Capacitor for power carry over system.
 - 8) Supply voltage: 120 V.
 - 9) 365-day advance scheduling.
- b. Photoelectric control: Shall be rated 2,000 watts, 120V with single pole, single throw, normally closed contact, enclosed in a die-cast aluminum gasketed enclosure with 1/2 inch conduit fitting, Tork series 2100, or equal.

3. Emergency Lighting Control Unit
 - a. The Emergency Lighting control Unit shall provide all required functionality to allow an standard lighting control device to control emergency lighting in conjunction with normal lighting in any area within a building.
 - b. The emergency lighting control unit shall allow control of emergency lighting fixture in tandem with normal lighting in an area while ensuring that emergency lighting will turn on immediately to full brightness upon loss of normal power supplying the control device. Emergency lighting operation shall be independent for each controlled area and shall not require a generalized power failure for proper operation.
 - c. The device shall have normally closed dry contacts capable of switching 10 amp emergency ballast loads at 120-277 VAC, 60 Hz, or 2 amp tungsten loads at 120 VAC, 60Hz.
 - d. The device shall have universal rated voltage inputs provided for normal power sense and normal switched power at 120-277 VAC, 60 Hz.
 - e. The device shall provide separate LEDs to indicate the presence of normal and emergency power sources. The LEDs shall indicate the unit's current operational mode (normal or emergency)
 - f. The device's normal power input terminal shall be connected to the line side of the control device such that any upstream fault causing a loss of power, including the tripping of the branch circuit breaker, will force the unit into the emergency mode and turn on the emergency lighting.
 - g. The unit shall automatically switch emergency lighting on and off as normal lighting is switched. When normal power is not available, the unit shall force and hold emergency lighting on regardless of the state of any external control device until normal power is restored.
 - h. Device shall be WattStopper ELCU-100 Emergency Lighting Control Unit, LVS #EPC-PM Series, Lighting Control Design #GR 2001 series or Equal.
4. Main Entrance Intercom Station: See other Division 26 sections
 - a. Hands free single button telephone auto dialer with major applications access control. Dialer shall dial a primary telephone number. If the number is busy or does not answer, the unit shall hang up and dial up to nine backup numbers. When call is answered and the visitor is identified, the called individual depresses telephone button to gain access. Unit shall be provided with a black and white camera, lighted hood, and an interface for Proximity option. Unit shall be a stand alone entry host for various types of access cards, through a 26-bit Wiegand protocol interface card.
 - b. Trigon Electronics HF-2 or equal.
 - c. Trigon Electronics HF-2 Weather mounts or equal.

2.03

IDENTIFICATION AND SIGNS

- A. Identification Plates:
 1. Provide identification plates for the following unless otherwise specified, for switchboards, unit substations, motor control centers, control panels, push-button stations, time switches, contactors, motor starters, motor switches, panelboards, and terminal cabinets.
 2. Identification plates shall be of plastic stock and shall adequately describe function, voltage and phase of identified equipment. Where identification plates are detailed or described on Drawings, inscription and size of letters shall be as indicated. For lighting and power panels, identification plates shall indicate panel designation, voltage, and

- phase of panel. For terminal cabinets, identification plates shall indicate system contained in terminal cabinet.
3. Identification plates shall be black-and-white nameplate stock of bakelite with characters cut through black exposing white. Plates shall be furnished with beveled edges and shall be securely fastened in place with No. 4 Phillips-head, cadmium-plated steel, self-tapping screws. Characters shall be 3/16 inch high, unless otherwise indicated.
- B. Markings:
1. Install identification markings to surface-mounted starters, switches, disconnect switches, contactors, and other devices controlling motors and appliances. Provide abbreviations required along with an identifying number. Markings to be provided with locking type stencils using paint of a contrasting color. Figures shall be 3/8 inch high unless otherwise indicated. Dymo Industries Inc., self-sticking plastic labels, with embossed characters made with a typewriter may be installed instead of stencils and paint; p-touch self adhesive plastic, or Brother P-Touch self sticking laminated plastic labels may be installed.
 2. High Voltage: High voltage switchboards, cabinets, boxes, and conduits exposed in accessible locations, including under buildings and in attics, are required to be marked "WARNING-HIGH VOLTAGE- ABOVE 600 VOLTS". Markings for switchboards shall consist of 18 gage steel, porcelain enamel sign of standard manufacture. Markings for boxes, cabinets, and conduits shall be by means of stenciling or printed self-adhesive markers, Westline Tel-A-Pipe, or equal. Provide letters of black on orange background and not less than 1-7/8 inches high. On conduit runs, install markings at intervals not exceeding 10 feet in any individual area. Markings shall be installed after other painting Work is complete.
- C. Warning Signs:
1. Provide a warning sign on outside of each door or gate to rooms or enclosures containing high voltage equipment. Signs required reading, "WARNING - HIGH VOLTAGE - KEEP OUT". Provide 2-inch high lettering.
 2. Provide a warning sign on each high-voltage non-load break disconnect and fused cutout (not oil filled). Signs required reading, "DO NOT OPEN UNDER LOAD". Provide 2 inch high lettering.
 3. Provide signs of standard manufacture, 18 gage steel, with porcelain enamel finish. Provide red lettering on a white background.

PART 3 - EXECUTION

3.01 INSTALLATION AND SUPPORT OF BOXES

- A. Install outlet boxes flush with finished surface of wall or ceiling. Install plumb and securely fastened to structure, independent of conduit. Except where otherwise indicated, provide factory-fabricated adjustable attachment bar hangers between studs to support outlet boxes. When installation is performed in fire rated walls, maintain the wall's rating integrity by means of approved fire stop methods.
- B. Outlet boxes installed in suspended or furred ceilings with steel runner or furring channels shall be supported, except where otherwise indicated, by a Unistrut P-4000 Tessco A1200HS-10, Cooper B-Line B22s-HG, or equal channel spanning main ceiling runner channels. Each box shall be supported from its channel by a 3/8 inch 16 threaded steel rod with a Unistrut P-4008, Fastenal #48604, Copper B-Line 78101140346 or equal nut and a Tomic No. 711-B Adapta-Stud, or equal. Rod shall be tightened to a jamb fit with channel and its nut. Box shall be locked to rod by means of a 1/2 inch locknut on stud and a 3/8 inch 16 hex nut locking stud to rod.

- C. Heights of outlets and equipment indicated on Drawings shall govern. In absence of such indications, following heights shall be maintained with heights measured to centerline unless otherwise noted:
1. Install wall-mounted telephones, light switches, and other switches, 48 inches above finished floor. Refer to other Division 26, 27 and 28 Sections.
 2. Outlet boxes for fire alarm pull stations shall be mounted at 45 inches above finished floor to insure that the operating handle of the initiating device is no higher than 48 inches at finished floor. Under no circumstances shall operating handle of the device exceed 48 inches above finished floor regardless of indicated height on drawing.
 3. Wall mounted fire alarm strobe or horn/strobe devices shall be mounted such that the entire lens is not less than 80 inches above finished floor. If ceiling heights allow, wall mounted appliances shall have bottom of lens a minimum of 80 inches but not more than 96 inches to the top of lens.
 4. Install outdoor fire alarm audible devices or fire alarm sprinkler flow bells at least 10 feet but not more than 12 feet above finished floor to center. Provide STI or equal protective covers for devices when required.
 5. Voice evacuation speakers mounted indoors shall be mounted in ceiling space or if mounted on wall shall not be less than 10 feet to center above finished floor.
 6. Install clocks and speakers, in rooms and offices, 8 feet above finished floor. Unless otherwise indicated.
 7. In rooms other than places of assembly such as, but not limited to, multipurpose rooms, auditoriums, and libraries, clock outlets and speakers in rooms and offices shall be mounted 8 feet above finished floors. Other assembly areas such as gymnasiums shall be mounted 10 to 12 feet above finished floor. Provide STI, or equal protective covers for clocks when required.
 8. Install fire alarm strobe lights 80 inches to bottom of light above finished floor.
 9. Install outside bells and yard light outlets 4 feet above second floor level for 2 or more story buildings, 12 inches below top plate level for one story buildings without covered porch or arcade, and 12 inches below covered porch and arcade ceilings.
 10. Install desk telephones, power receptacle outlets, and data outlets 15 inches above finished floor.
 11. Install panelboards and terminal cabinets 6 feet 6 inches from finish floor to top of cabinet.
 12. Install television outlets at a height corresponding to location of television monitor, or a minimum of 15 inches above finished floor.
 13. The use of extension boxes shall be limited to not more than 1 times the original depth of junction box.

3.02

COVER PLATES

- A. Provide a plate on each switch, plug, pilot light, data, interphone, public telephone, and television outlet, and on existing and reset outlets where so indicated or required. Plates shall be of stainless steel unless otherwise specified.
- B. Flush wiring device and signal system outlets indicated to be blank covered, shall be covered with blank stainless steel plates. Flush lighting outlets to be blanked shall be covered with Wiremold 5736 steel covers, or equal, painted to match surrounding finish. Provide stainless steel covers to blank indicated or required surface-mounted outlets.
- C. In the following cases, and at required locations. Switch and receptacle plates shall be engraved with the device(s), or fixtures being controlled, or as indicated:.
1. Three-gang and larger gang switches in locations other than rooms.
 2. Lock switches.
 3. Pilot switches.

4. Switches so located that operator cannot see fixtures, or items of equipment controlled while his hand is on the switch.
 5. Switches not in same room with fixtures or items of unit heaters, air curtains, fly fans, etcetera.
 6. Receptacles operating at other than 120 V shall be identified with the operating voltage.
 7. Switches operating on 277 V shall be identified with the operating voltage.
 8. Where indicated on Drawings.
- D. Designations shall be as indicated on Drawings or as specified by Architect.
- E. Standard GFI cover plates shall be Pass & Seymour 4600, Raco 5028-0, or equal. GFI cover plates shall be provided with a CAM lock mechanism with two keys or a padlock hasp that does not protrude through the face of the cover and will allow the shank of locks keyed Corbin No. 60 keys.

3.03

IDENTIFICATION OF CIRCUITS AND EQUIPMENT

- A. Provide descriptive nameplates or tags permanently attached to switchboards, motor control centers, transformers, panelboards, circuit breakers, disconnect switches, starters, pushbutton control stations and other apparatus installed for operation or control of circuits, appliances, fire alarm control panel(s), fire alarm annunciator(s), power supplies, terminal cabinets, energy management control units, and Information technology system backbone and distribution equipment points.
- B. Provide nameplates of engraved laminated plastic, or etched metal. Submit Shop Drawings denoting dimensions and format to Architect before installation. Fasten to equipment with escutcheon pins, rivets, self-tapping screws, or machine screws. Self-adhering or adhesive backed nameplates are not permitted.
- C. Fasten tags to feeder wiring in conduits at every point where runs are broken or terminated, including pull wires in empty conduits. Indicate circuit, phase, and function. Tag branch circuits in panel boards and motor control centers. Tags may be manufactured of pressure-sensitive plastic or embossed self-attached stainless steel or brass ribbon.
- D. Provide circuit identification cards and cardholders in all panel boards. Cardholders shall consist of metal frame retaining a clear plastic cover permanently attached to inside of panel door. List of circuits shall be typewritten on a card. Circuit description shall include name or number of circuit, area and connected load.
- E. Junction and pull boxes shall have covers stenciled with box number when indicated on Drawings, or circuit numbers according to panel schedules. Data shall be lettered in a conspicuous manner with a color contrasting with finish.
- F. Name shall be correctly engraved, with a legend indicating function or areas, when required by codes or indicated on Drawings.

3.04

PROTECTION

- A. Protect Work of this section until Substantial Completion.

3.05

CLEANUP

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

END OF SECTION

SECTION 26 0519
LOW-VOLTAGE WIRES (600 VOLT AC)

PART 1 - GENERAL

1.01 SUMMARY

- A. Provisions of Division 01 apply to this section.
- B. Section Includes: Low-voltage wire, splices, terminations and installation.

1.02 SUBMITTALS

- A. Provide in accordance with Division 01.

PART 2 - PRODUCTS

2.01 WIRES

- A. Wires shall be single conductor type THHN or THWN insulated with polyvinyl chloride and covered with a protective sheath of nylon, rated at 600 volts. Wires may be operated at 90 degrees C. maximum continuous conductor temperature in dry locations, and 75 degrees C. in wet locations and shall be listed by UL Standard 83 for thermoplastic insulated wires, listed by Underwriter's Laboratories (UL) for installation in accordance with Article 310 of the California Electrical Code (CEC). Conductors shall be solid copper for 12 AWG and smaller conductors, and stranded copper for 10 AWG and larger conductors. Conductors shall be insulated with PVC and sheathed with nylon. Wires shall be identified by surface markings indicating manufacturer's identification, conductor size and metal, voltage rating, UL symbol, type designations and optional rating. Indentations for lettering are not permitted. Wires shall be tested in accordance with the requirements of UL standard for types THWN, or THHN.
- B. Conductors shall be solid Class B or stranded Class C, annealed uncoated copper in accordance with UL standards, or another Nationally Recognized Testing Laboratory (NRTL).

2.02 STANDARDS

- A. THWN/THHN wires shall comply with the following standards:
 - 1. UL 83 for thermoplastic insulated wires.
 - 2. UL 1063 for machine tool wires and cables.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Wires shall not be installed until debris and moisture is removed from conduits, boxes, and cabinets. Wires stored at site shall be protected from physical damage until they are installed and walls are completed.
- B. Wire-pulling compounds furnished as lubricants for installation of conductors in raceways shall be compounds approved and listed by UL, NRTL, or equal. Oil, grease, graphite, or similar substances are not permitted. Pulling of 2 AWG or larger conductors shall be performed with a cable pull machine. Any runs shorter than 50 feet are exempt. When pulling conductors, do not exceed manufacturer's recommended values
- C. The Project Inspector will observe installation of feeder cables. Notify the Project Inspector not less than two working days in advance of the proposed time of feeder installation.
- D. At outlets for light, power, and signal equipment, pigtail splices with 8-inch circuit conductor leads for connection to fixtures, equipment, and devices.

- E. Pressure cable connectors, pre-insulated 3M Scotchklok, Hubbell Power, O-Z/Gedney or equal, Y, R or B spring-loaded twist-on type, may be furnished in splicing number 8 AWG or smaller wires for wiring systems; except public address and telephone systems.
- F. Joints, splices, taps, and connections to switchboard neutral, bonding or grounding conductors, conductors to ground busses, and transformer connections for wires 6 gage and larger shall be performed with high-pressure cable connectors approved for installation with copper conductors. Connectors shall be insulated with heavy wall heat shrink WCSM, or cold-applied roll-on sleeve RVS. Insulation level shall be a minimum of 600V and joints, splices, and taps shall be qualified to ANSI C 119.1, UL, NRTL, or equal listed mechanical pressure connections.
- G. Connections to any bussing and high-press cable connectors shall be securely bolted together with corrosion-resistant plated carbon steel, minimum grade five machine screws secured with constant pressure-type locking devices.
- H. Connection of any bonding or grounding conductors shall be securely bolted together with corrosion-resistant plated carbon steel, minimum grade five machine screws secured with constant pressure-type locking devices.
- I. Wire switchboards, panel cabinets, pull boxes, and other cabinets except public address, shall be neatly grouped and tied in bundles with nylon ties at 10-inch intervals. In switchboards, panels and terminal blocks, wires shall be fanned out to terminals. If bundles are longer than 24 inches, a maximum of nine current carrying conductors may be bundled together.
- J. Install conductor lengths with a minimum length within the wiring space. Conductors must be long enough to reach the terminal location in a manner that avoids strain on the connecting lug.
- K. Maintain the conductor required bending radius.
- L. Neutral conductors larger than 6 gage, which are not color identified throughout their entire length, shall be taped, painted white or natural gray, or taped white where they appear in switchboards, cabinet, gutters or pull boxes. Neutral conductors 6 gage and smaller shall be white color identified throughout their entire length.
- M. Fire alarm and clock wiring shall be continuous from terminal cabinets or from equipment to each device. Splices are not permitted between devices and/or terminal cabinets at junction and pull boxes. Wiring shall be terminated at terminal blocks or devices only.
- N. Wiring systems shall be free from short circuits and grounds, other than required grounds. The contractor shall be responsible for the testing of feeder and branch circuit conductor's insulation resistance. The insulation of the conductors shall be tested prior to connections to any panelboards, switchboards, variable frequency drives, lighting control systems, ballasts, and wiring devices such as but not limited to GFI receptacles, TVSS receptacles, or equipment. Insulation testing of panelboards and switchboards shall be independently performed from the insulation testing of any conductors as specified in other sections of this specification.
 - 1. Utilize the services of an approved independent testing laboratory to perform megger time-resistance insulation testing of feeder conductors. Tests must be conducted with wires disconnected at both ends.
 - a. Provide calibration program records to assure the testing instrument to be within rated accuracy. The test equipment accuracy shall be in accord with the requirements stated by the National Institute of Standards and Technology (NIST).

- b. Test equipment shall be provided with a label stating the date of last calibration. As a minimum the equipment shall have been calibrated within the past 12 months.
- c. Test reports shall include the following:
 - 1) Identification of the testing organization.
 - 2) Equipment identification.
 - 3) Ambient conditions.
 - 4) Identification of the testing technician.
 - 5) Summary of project.
 - 6) Description of equipment being tested.
 - 7) Description of tests.
 - 8) Test results.
 - 9) Analysis, interpretation and recommendations.
- 2. Utilize the services of an approved independent testing laboratory or a qualified contractor's employee (Technician certified in accordance with ANSI/NETA ETT-2000 Standard for Certification of Electrical Testing Personnel) to perform megger time-resistance insulation testing of branch circuit conductors. Tests must be conducted with wires disconnected at both ends.
 - a. Test equipment and report requirements stipulated under paragraph 3.01.N.1 apply to branch circuit testing.
- 3. Tests shall be performed in the presence of the Project Inspector.
- 4. Insulation resistance shall not be less than 100 mega-ohms.

3.02

COLOR CODES

A. General Wiring:

- 1. Color code conductor insulation as follows:

SYSTEM VOLTAGE		
Conductor	208Y/120	480Y/277
Phase A	Black	Brown
Phase B	Red	Orange
Phase C	Blue	Yellow
Neutral	White	Natural Gray

Neutrals shall be colored-distinguished if circuits of two voltage systems are used in the same raceway.

- 2. For phase and neutral conductors 6 gage or larger, permanent plastic-colored tape may be furnished to mark conductor end instead of coded insulation. Tape shall cover not less than 2 inches of conductor insulation within enclosure.
- B. Signal Systems:** Wires for signal systems shall be color-coded and installed under observation of the Project Inspector. Except where otherwise specified, color-coding shall be as follows:

<u>SYSTEM</u>	<u>COLOR CODE</u>
Clocks	Pink, Gray and Orange

Program Bells	White (Common)Black
Initiating Devices (Non-Addressable)	Red (+) and Black (-)
Program Bells	White (120 volt, common) Black (C.R. program) Blue (Shop program) Brown (Gym program) Yellow (Auditorium fire alarm)
Fire Alarm Horns	Pink (+) and Gray (-)
Fire Alarm Strobes	Orange (+) and Blue (-)
Un-Interruptible 24 Volt Power (Annunciator, Water Flow, and Audible Device)	Yellow (+) and White (-) Note: A single white wire may be common to both
Interruptible 24 Volt Power (4 wire smoke detectors, duct detectors)	Brown (+) and White (-) Note: A single white wire may be common to both
Switch-Leg Sprinkler Bell (Between water flow and audible device)	Violet (+) and White (-)
Door Holding Magnets (Non Power Limited)	Black (+) and White (-)

3.03 FEEDER IDENTIFICATION

- A. Feeder wires and cables shall be identified at each point the conduit run is broken by a cabinet, box, gutter, etc. Where terminal ends are available, identification shall be by means of heat shrink wire markers, which provide terminal strain relief. Markers shall be by Tyco Electronics, Panduit, Brady Perma-Sleeve, or equal. Identification in other areas shall be by means of wrap-around tape markers from Tyco Electronics, Panduit, Brady Perma-Code or equal. Markers shall include feeder designation, size, and description.

3.04 TAPE AND SPLICE KITS

- A. Splices, joints, and connectors joining conductors in dry and wet locations shall be covered with insulation equivalent to that provided on conductors. Free ends of conductors connected to energized sources shall be taped. Voids in irregular connectors shall be filled with insulating compound before taping. Thermoplastic insulating tape approved by UL, NRTL, or equal for installation as sole insulation of splices shall be furnished and shall be installed according to manufacturer's printed specifications.

3.05 PROTECTION

- A. Protect the Work of this section until Substantial Completion.

3.06 CLEANUP

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

END OF SECTION

SECTION 26 0526
GROUNDING AND BONDING

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes: Provide and install grounding system as indicated or required.
- B. Related Requirements:
 - 1. Refer to related sections for their system grounding requirements.
 - 2. Section 26 0500: Common Work Results for Electrical.
 - 3. Division 27: Communications.

1.02 QUALITY ASSURANCE

- A. Reference Standards:
 - 1. IEEE 142 Green Book.
 - 2. Underwriter's Laboratories (UL).
 - 3. California Electrical Code.
 - 4. Building Industry Consultant Services International (BICSI) (Signal).
 - 5. EIA/TIA (Signal and power).
 - 6. Nationally Recognized Testing Laboratory (NRTL) or equal.

1.03 SYSTEM DESCRIPTION

- A. Metallic objects on the Project site that enclose electrical conductors, or that are likely to be energized by electrical currents, shall be effectively grounded.
- B. Metal equipment parts, such as enclosures, raceways, and equipment grounding conductors, and earth grounding electrodes shall be solidly joined together into a continuous electrically conductive system.
- C. Metallic systems shall be effectively bonded to the main grounding electrode system.
- D. A separately derived AC source shall be grounded to the equipment grounding conductor, and to separate "made" electrode of building grounding electrode system.
- E. Electrical continuity to ground metal raceways and enclosures, isolated from equipment ground by installation of non-metallic conduit or fittings, shall be provided by a green insulated grounding conductor of required size within each raceway connected to isolated metallic raceways, or enclosures at each end. Each flexible conduit over six feet in length shall be provided with a green insulated grounding conductor of required size.
- F. Cold water, or other utility piping systems, shall not be utilized as grounding electrodes due to the installation of insulating couplings and non-metallic pipe in such installations. In addition to bonding to cold water pipe provide at least one of the following made grounding electrodes:
 - 1. A dedicated "made" electrode, fabricated of at least 20 feet of galvanized 1/2 inch diameter rebar encased by at least two inches of concrete, and placed next to the bottom of a concrete foundation, or footing in direct contact with earth A welded extended portion shall surface at the location of the common grounding electrode bus bar and be extended by a 3/0 CAD welded bare copper cable, or be CAD welded directly to the bus. The CAD weld shall be at least four inches above finished floor

- in a dry location. The main grounding electrode and associated grounding conductors shall be in an enclosure and in conduit.
2. Grounding electrodes as specified hereafter in this section.
 3. Concrete enclosed electrode, fabricated of at least 20 feet of No. 2 AWG, minimum size, bare copper conductor, encased by at least two inches of concrete, located within or near bottom of a concrete foundation, or footing, which is in direct contact with earth. Footing rebar shall be connected to copper wire with approved connectors. An external electrode, as specified hereafter or as required by the CEC, shall be installed and connected to foundation or footing rebar.
- G. Non-current carrying metal parts of high-voltage equipment enclosures, signal and power conduits, switchboard and panelboard enclosures, motor frames, equipment cabinets, and metal frames of buildings shall be permanently and effectively grounded. Provide a CEC sized grounding conductor in every raceway.
- H. Metallic or semi-conducting shields and lead sheaths of cables operating at high voltage, shall be permanently and effectively grounded at each splice and termination.
- I. Neutral of service conductors shall be grounded as follows:
1. Neutral shall be grounded at only one point within the Project site for that particular service. Preferable location of grounding point shall be at the service switchboard, or main switch.
 2. Equipment and conduit grounding conductors shall be bonded to that grounding point.
 3. If other buildings or structures on the Project site are served from a switchboard or panelboard in another building, power supply is classified as a feeder and not as a service.
 4. Equipment grounding conductor is installed from switchboard to each individual building. At building, grounding conductor is bonded with power equipment enclosures, metal frames of building, etc., to “made” electrode for that building.
 5. Feeder neutrals shall be bonded at service entrance point only, neutrals of separately derived systems shall be bonded at the source only.
- J. If there is a distribution transformer at a building the secondary neutral conductor shall be grounded to “made” electrode serving the building.
- K. Within every building, the main switchboard or panelboard, shall be bonded to the cold water line. Metallic piping systems such as gas, fire sprinkler, or other systems shall be bonded to the cold water line.

1.04 SUBMITTALS

- A. Provide in accordance with Division 01.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Furnished yard boxes shall be precast concrete and shall be approximately 14 inches wide by 19 inches long by 12 inches deep or larger, if necessary to obtain required clearances. Boxes shall be furnished with bolt-down, checkered, cast iron covers and cast iron frames cast into boxes. Yard boxes shall be Jensen Precast, Oldcastle Precast, Western Precast, Kistner , or equal.

- B. "Made" electrodes shall be copper-clad steel ground rods, minimum 3/4 inch diameter by ten feet long.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Grounding electrodes shall be installed in the nearest suitable planting area, where not otherwise indicated on Drawings, and each electrode shall terminate within a concrete yard box installed flush with finish grade. In planting areas, finish elevation of concrete yard boxes shall be two inches above planting surfaces.
- B. If concrete enclosed electrode is provided, grounding wire shall be terminated to a suitable copper plate with grounding lugs and must be enclosed in a raceway or box..
- C. Grounding rods shall be driven to a depth of not less than eight feet. Permanent ground enhancement material, (GEM) as manufactured by Erico Electrical Products, Loresco Powerset, Tessco Ultrafil or equal, shall be installed at each ground rod to improve grounding effectiveness. Install in accordance with manufacture's installation instructions.
- D. Grounding electrodes shall provide a resistance to ground of not more than 25 ohms.
- E. When installing grounding rods, if resistance to ground exceeds 25 ohms, two or more rods connected in parallel, or coupled together shall be provided to meet grounding resistance requirements.
- F. Ground rods shall be separated from one another by not less than ten feet.
- G. Parallel grounding rods shall be connected together with recognized fittings and grounding conductors in galvanized rigid steel conduit, buried not less than 12 inches below finish grade.

3.02 TESTING

- A. Provide the services of an approved independent testing laboratory to test grounding resistance of "made" electrodes, ground rods, bonding of building steel, water pipes, gas pipes and other utility piping. Tests shall be performed as follows:
 - 1. Visually and mechanically examine ground system connections for completeness and adequacy.
 - 2. Perform fall of potential tests on each ground rod or ground electrode where suitable locations are available per IEEE Standard No. 81, Section 8.2.1.2. Where suitable locations are not available, measurements will be referenced to a known dead earth or reference ground.
 - 3. Perform the two point method test per IEEE No. 81, Section 8.2.1.1 to determine ground resistance between ground rod and building steel, and utility piping - such as water, gas and panelboard grounds. Metal railings at building entrances and at handicapped ramps shall also be tested.
 - 4. Test shall be performed in the presence of the Inspector.
- B. Submit 3 copies of test results to the Architect. Test results shall be submitted on an official form from the independent testing laboratory recording Project location, test engineer, test conditions, test equipment data, ground system layout or diagram, and final test results.

3.03 PROTECTION

- A. Protect the Work of this section until Substantial Completion.

3.04 CLEANUP

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

END OF SECTION

SECTION 26 0533

RACEWAYS, BOXES, FITTINGS, AND SUPPORTS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Raceways and wire ways.
 - 2. Conduit installation.
 - 3. Underground requirements.
- B. Related Requirements:
 - 1. Section26 0500: Common Work Results for Electrical.
 - 2. Section26 0513: Basic Electrical Materials and Methods.
 - 3. Division27: Communications.
 - 4. Division 28 - Electronic Safety and Security.
- C. Applicable Standards and Codes.
 - 1. EIA/TIA 569 Standards.
 - 2. National American Standards Institute (ANSI).
 - 3. National Electrical Manufacturer's Association (NEMA).
 - 4. Nationally Recognized Testing Laboratory (NRTL).
 - 5. California Electrical Code (CEC).
 - 6. Uniform Building Code (UBC).
 - 7. Underwriters Laboratory (UL).

1.02 SUBMITTALS

- A. Materials List: Provide in accordance with Division 01.

PART 2 - PRODUCTS

2.01 RACEWAYS

- A. Conduit Materials:
 - 1. Metallic conduit, and tubing shall be manufactured under the supervision of an UL, or another NRTL factory inspection and label service program. Each ten-foot length of conduit and tubing shall bear the UL or another NRTL label and manufacturer's name.
 - 2. Rigid metallic conduit shall be rigid steel, heavy wall, mild steel, zinc-coated, with an inside and outside protective coating manufactured in accordance with ANSI C 80.1. Couplings, elbows, bends, conduits, bushings and other fittings shall be the same materials and finish as the rigid metallic conduit. Fittings, connectors, and couplings shall be threaded type, manufactured in accordance with ANSI C 80.1 and UL 6.
 - 3. Electrical metallic tubing shall be steel tubing, zinc-coated with a protective enamel coating inside, manufactured in accordance with NEMA C 80.3. Fittings, couplings, and connectors shall be gland compression type, set screw couplings and connectors not permitted. All parts shall be manufactured in accordance with NEMA C80.3 and UL 6A Electrical metallic tubing is designated hereinafter as EMT. Steel and rain tight fittings shall be approved and listed for the intended application.

4. Flexible steel conduit shall be of flexible interlocking strip construction with continuous zinc coating on strips, manufactured in accordance with UL 1.
 - a. Connectors and couplings shall be required fittings of the type, which threads into convolutions of flexible conduit.
5. Liquid-tight flexible metal conduit shall be galvanized heavy wall, flexible locked steel strip construction, UV rated, with smooth moisture and oil-proof, abrasion-resistant, extruded plastic jacket. Connectors shall be as required for installation with liquid-tight flexible conduit and shall be installed to provide a liquid-tight connection.
6. Non-metallic conduit shall be rigid PVC electrical conduit extruded to schedule 40 dimensions of Type II. Grade 1 high impact, polyvinyl chloride, sweeps, couplings, reducers and terminating fittings shall be listed under the UL, or another NRTL, and shall bear the manufacturer's listed marking.
7. Multi-cell raceway shall be four inch PVC, Type 40, UL or another NRTL listed for underground use with optical fiber and signal system cables. Raceway shall be furnished with 3-1/2 inch factory installed inner ducts with required internal spacers, and required couplers, sweeps, and end bells. Multicell raceway shall be Carlon Multigard, or City approved equal.
8. Metal Clad (MC) cable system is not allowed.
- B. Sleeves for Conduits: Sleeves shall be adjustable type by Carlon, U.S. Plastic, PEP Plastic or equal.
- C. Where conduit enters a building through a concrete foundation below grade, or ground water level, or where it is necessary to seal around a conduit where it passes through a concrete floor or wall, provide O-Z/Gedney Type FSK Thru Wall and Floor Seal, equivalent Cooper Crouse Hinds Thru-Wall, Legrand Thru-Wall, or equal.
- D. Expansion Joints-Seismic Separations between building(s) and other locations as indicated on drawings:
 1. Provide Thomas & Betts XJG-TB, O-Z/Gedney. type AX with bonding strap and clamps, Cooper XJGD or equal. At exterior locations, provide Thomas & Betts XJG-TB, O-Z/Gedney type EX, Cooper XJGD, or equal. Provide O-Z/Gedney type AXDX, or equal combination deflection/expansion fittings at all seismic separations. Provide manufacture's internal and external bonding jumpers at all locations. Liquid-tight metal conduit or flexible metal conduit shall not be approved at expansion joints, separations between buildings or seismic separations.
 2. Provide expansion fittings at intervals not exceeding 100 feet in conduits exposed to direct sunlight. Fittings may be installed in the conduit run or where conduit attaches to junction or pull boxes. OZ/Gedney type AX, TX or EXE series, or equivalent by Thomas and Betts, Crouse-Hinds or approved equal.
- E. Conduit Seal Fittings:
 1. Provide conduit seal fittings where indicated on the Drawings. Conduit seals shall be of rigid galvanized steel. Seals in horizontal conduit installations shall be Thomas & Betts EYS, Appleton Type ESU, Crouse Hinds Type EYS, or equal. Seals in vertical conduit installations shall be Thomas & Betts EYD, Appleton Type SF, Crouse Hinds Type EYD, or equal, with continuous drain. When installing conduit seals make provision for percent fill space reduction in accordance with CEC.
 2. Install sealing compound after wire has been installed. Ensure drain is not blocked in vertical seals when installing compound. Where conduit seals are installed in

hazardous area applications, there shall be no conduit coupling, fitting, etc., between seal and boundary of hazardous area.

F. Surface Steel Raceway:

1. The surface steel raceway system for branch circuit wiring, data network, voice, video, and other low voltage wiring shall be as manufactured by the Wiremold Company, Hubbell, or Mono-Systems, Inc. or equal. The raceway system may be supplied pre-wired in accordance with all sections of these specifications and requirements herein, and shall be UL or another NRTL listed. Computer data installation shall be as required by other sections of this Division.
 - a. If furnished pre-wired, the system must be listed in accordance with UL or another NRTL for "Multiple Outlet Assemblies" and so labeled on interior of the assembly. The pre-wired installation must contain no extra wire splices in the raceway as compared to a contractor assembled installation assembled from components. The pre-wired steel raceway shall be Hi-Pot tested at the factory to prevent any potential bare wire or shot circuit defects.
2. The raceway base, cover, and device bracket shall be manufactured of steel and finished in ivory, gray enamel or custom colors suitable for field painting to match adjacent finishes.
3. The raceway shall be a two-piece design with a metal base and snap-on metal cover, except for the Wiremold V700 system, Hubbell HBL750 series and Mono-Systems Inc. S145-700 series that shall be a one-piece design. The base and cover sections shall be a minimum of 0.040 inch wall thickness. The base section shall be available in ten-foot lengths. A hand-operated cutting tool shall be available for the base and cover to ensure clean, square cuts. Wiremold V500, Hubbell V500, and Mono Systems inc. SM500 series are not permitted.
4. A full complement of fittings shall be furnished, including but not limited to, flat internal and external elbows, tees, entrance fittings, wire clips, cover clips, couplings, support clips, C-hangers and end caps. The fitting color shall match the raceway color. Fittings shall be supplied with a base where indicated and/or required. A take-off fitting shall be furnished as required to adapt to existing flush wall boxes.
5. Device brackets shall be furnished for mounting single or two-gang devices within the raceway. Devices shall be provided with the ability of mounting flush or in conjunction with standard steel, stainless steel, or manufacturer's metal faceplates.
6. The raceway shall be furnished with a complete line of connectivity outlets and modular inserts for unshielded twisted pair including category 5, fiber-optic, coaxial, and other cabling types with face plates and bezels to facilitate installation. Computer data installation shall be as required by other sections of this Division, and Division 27.
7. Raceway shall be furnished with corner elbows and tee fittings to maintain a cable bend radius which meets the requirements of fiber-optic and copper cables under EIA/TIA 569 for communications pathways.

G. Factory Pre-Wired Surface Metal Raceway:

1. Furnish and install pre-wired surface metal raceways as indicated on Drawings and as specified.

2. Metal Raceway shall be galvanized steel Wiremold V4000, Hubbell 4000 series, or Mono-Systems Inc. SMS-4000 series complete with raceway base, cover, fittings, receptacles and mounting plates required for a complete assembly. Raceway shall have two wiring compartments with integral dividing barrier for isolating the wiring compartments.
 3. Pre-wired assembly shall be UL, or another NRTL listed as a multi-outlet assembly and surface raceway as labeled on interior of assembly.
 4. Wiring devices and other components shall be factory installed, electrically wired and covers labeled as indicated on drawings. Each receptacle shall be identified with panelboard and circuit number from which it was fed. Grounding shall be maintained by means of factory installed grounding conductors.
 5. Where shown on Drawings, Raceway covers shall have provisions for mounting computer data outlets.
 6. Complete assembly is to consist of required fittings such as elbows, slide couplings for joining raceway sections, blank end caps and flat tees.
 7. Prewired assembly must contain no wire splices.
 8. Receptacles and wiring shall be as indicated on drawings and as specified.
 9. Where raceway is used for power and computer data outlets, installation of data outlets shall be as required by other sections of this specification.
 10. Prior and during installation, verify and comply with manufacturer's installation instructions.
 11. Entire assembly shall be tested for shorts, opens, ground faults, and wire insulation at factory and certified. Raceways shall be electrically continuous and bonded in accordance with California Electrical Code.
 12. Submit shop drawings for approval showing the complete layout of all components of each raceway, raceway lengths, each component description, location and circuit identification.
 13. All wiring devices shall be removable without requiring disassembly of wireway.
 14. Standard non OEM wiring devices shall be used as specified in City's specifications.
- H. Wireways shall be 16 gage galvanized steel enclosed hinge/screw wiring troughs, surface metal raceway, wireway, and auxiliary gutter designed to enclose electrical wiring. Wireway fittings shall be furnished with removable covers and sides to permit complete installation of conductors throughout the entire wireway run. Cover shall be furnished with keyhole slots to accept captive screws locking the cover securely closed. Wireways shall be UL or another NRTL listed, and shall be Square D Type LDB NEMA-1 enclosure for interior applications, or Type RDB NEMA-3R enclosure for exterior applications, or equal by Cooper B-line, Hoffman, Wire Guard, or Circle AW.
- I. Penetration in Fire-Rated Structures: Provide 3M, or equal, sealant and fire barriers for installing fire-rated seals around penetrations through floors, walls, and elevator hoistways. Fire stop system must be UL, or another NRTL listed, and classified for through-penetration applications of metallic conduits and busways.
- J. Pull Wires: Install 1/8 inch polypropylene cords in empty or spare conduits.

PART 3 - EXECUTION

3.01 CONDUIT INSTALLATION

A. General Requirements:

1. Provide complete and continuous systems of rigid metallic conduit, outlet boxes, junction boxes, fittings and cabinets for systems of electrical wiring including lighting, power, and signal systems, except as otherwise specified.
2. EMT may be installed in interior concealed applications and in areas approved by owner. EMT shall not be installed in concrete, directly buried underground, outdoors, in boiler rooms, elevator pits, or where subject to damage.
3. Within buildings, flexible steel conduit may be installed instead of rigid steel conduit where permitted by code. Flexible steel conduit shall be installed:
 - a. For continuous lengths not exceeding more than 50 feet between pull points (pull boxes, outlet boxes, etcetera).
 - b. With no maximum total raceway length located within a building interior when the flex is located in concealed locations.
4. Flexible Steel conduit shall not exceed 1-1/2 inches in size.
5. Liquid-tight flexible steel conduit shall only be installed, except where otherwise specified, for final connection of motor terminal boxes, shop equipment, cafeteria equipment, HVAC equipment and other equipment, or for frequent interchange, and shall be of sufficient length, not exceeding 36 inches, to permit full travel or adjustment of motor on its base. Liquid-tight flexible conduit shall not be used for equipment not requiring adjustment or frequent interchange.
6. Connectors for flexible metal conduit shall be made of steel, and of the types which threads into convolutions of conduit. Connectors for watertight flexible metal conduit shall be as required for installation and shall be installed to provide a watertight connection.
7. Exposed conduit shall be installed vertically and horizontally following the general configuration of the equipment, using cast threaded hub conduit fittings where required and shall be clamped to equipment with suitable iron brackets and one hole pipe strap.
8. If connection is from a flush wall-mounted junction box, install an approved extension box.
9. Underground feeder distribution conduits for systems may be non-metallic conduit instead of rigid conduit except where otherwise specified or indicated.
10. Conduit shall be concealed unless otherwise indicated. Conduits exposed to view, except those in attic spaces and under buildings, shall be installed parallel or at right angles to structural members, walls, or lines of building. Conduits shall be installed to clear access openings.
11. Bends or offsets will not be permitted unless absolutely necessary. Radius of each conduit bend or offset shall be as required by ordinance. Bends and offsets shall be performed with standard industry tools and equipment or may be factory fabricated bends or elbows complying with requirements for radius of bend specified. Heating of metallic conduit to facilitate bending is not permitted. Public telephone conduit bends and offsets shall be provided with a radius which is not less than ten times trade size of conduit unless otherwise permitted. Refer to underground installation,

- specified in this section, for radius of bends and offsets required for underground installations.
12. Running threads are not permitted. Provide conduit unions where union joints are necessary. Conduit shall be maintained at least six inches from covering of hot water and steam pipes and 18 inches from flues and breechings. Open ends of conduits shall be sealed with permitted conduit seals during construction of buildings and during installation of underground systems.
 13. Expansion Joints/Seismic Separations/Separations between buildings/Locations Indicated: Provide Thomas & Betts XJG-TB, O-Z Electrical Mfg. Co. Inc. Type AX with bonding strap and clamps, Crouse Hinds XJGD, or equal. At exterior locations, provide Thomas & Betts XJG-TB, O-Z Electrical Mfg. Co. Inc. Type EX, Crouse Hinds XJGD, or equal. Provide Crouse Hinds, Thomas & Betts, or O-Z Electrical Mfg. Co. Type AXDX, or equal Combination Deflection/Expansion Fittings at all seismic separations. Provide manufactures internal and external Bonding Jumpers at all locations. Liquid-tight flexible conduit shall not be approved at expansion joints or seismic separations.
 14. Where conduits are terminated in groups at panelboards, switchboards, and signal cabinets, etc., provide templates or spacers to fasten conduits in proper position and to preserve alignment. Conduits terminating at signal cabinets shall only enter cabinets in the following locations:
 - a. Conduits entering top, side, and bottom of cabinets shall be aligned in a single row, centered two inches from rear of cabinet.
 - b. Conduits entering back of cabinet shall be aligned in a single row centered two inches from top of cabinet.
 - c. Conduits shall not be spaced closer than three inches on centers.
 15. Conduits above metal lath ceilings shall be rigidly suspended with pipe hangers or pipe racks or shall be secured to superstructure with factory fabricated pipe straps. Conduits in metal lath or steel stud partitions shall be tied to furring channels or studs. In ceiling spaces and in partitions, tie wires shall be spaced not more than 5 feet apart, shall fasten conduit tight against channels and studs at point of tie and shall not support any of conduit weight. Tie wire shall be 16 gage galvanized double annealed steel.
 16. Where auxiliary supports, saddles, brackets, etc., are required to meet special conditions, they shall be fastened rigid and secure before conduit is attached.
 17. Conduit in ceiling spaces, stud walls, and under floors, shall be supported with factory fabricated pipe straps or shall be suspended with pipe hangers or pipe racks. Pipe straps shall be attached to and shall fasten conduit tight at point of support against ceiling and floor joists, rafters, and wall studs, or two-inch x four-inch headers fitted between joists or wall studs.
 18. Conduits installed on exposed steel trusses and rafters shall be fastened with factory fabricated conduit straps or clamps, which shall fasten conduit tight against supporting member at point of support.
 19. Conduits installed under buildings shall be strapped with factory fabricated conduit straps to underside of concrete floor or joists, or wood floor joists, or shall be suspended with pipe hangers or pipe racks. Conduits under building are not permitted to be placed directly on grade; they shall be suspended from building or shall be

- buried below surface or ground. 1-1/4 inch and larger conduits under buildings shall be installed with conduit hangers or racks.
20. Pipe hangers for individual conduits shall be factory fabricated. Steel rods shall be 3/8 inch for two-inch conduit hangers and smaller and shall be 1/2 inch for 2 1/2-inch conduit hangers and larger.
 21. Pipe racks for groups of parallel conduits and for supporting total weights not exceeding 500 pounds shall be trapeze type and shall consist of a cross channel, Steel City Kindorf B-900, Unistrut P-1000, equivalent Cooper B-Line or equal, suspended with a 3/8 inch minimum diameter steel rod at each end. Rods shall be fastened with nuts, top and bottom to cross-channel and with square washers on top of channel. Conduits shall be clamped to top for cross-channel with conduit clamps, Steel City Kindorf C-105 or Unistrut P-1111 through P-1124, equivalent Cooper B-Line, or equal. Conduits shall not be stacked one on top of another, but a maximum of two tiers may be on same rack providing an additional cross-channel is installed. Where a pipe rack is to be longer than 24 inches, or if the supported weight exceeds 500 pounds, submit Shop Drawings of installation to the Architect for review.
 22. Conduits suspended on rods more than two feet long shall be rigidly braced to prevent horizontal motion or swaying. Installation shall meet zone 4 seismic requirements.
 23. Factory fabricated pipe straps shall be one or two-hole formed galvanized clamps, heavy-duty type, except where otherwise specified.
 24. Hangers, straps, rods, or pipe supports under concrete shall be attached to inserts set at time concrete is placed, or with approved concrete anchors. Under wood, install bolts, lag bolts, or lag screws; under steel joists or trusses, install beam clamps. Contractor shall submit size of anchors, bolts, screws, and installation method to Architect for approval prior to start of any work.
 25. Conduits shall be supported at intervals required by code, but not to exceed ten feet. One inch and smaller exposed conduits shall be fastened with one-hole malleable iron straps. Perforated straps and plumber's tape is not permitted for the support of conduits.
 26. Conduits stubbed up through a roof or an arcade shall be flashed with a waterproof flashing. Refer to Division 07 for additional requirements.
 27. Bushings and locknuts for rigid steel conduit shall be steel threaded insulating type. Setscrew bushings are not permitted.
 28. Flex conduits shall be cut square and not at an angle.
 29. Routing of conduits may be changed providing length of any conduit run is not increased more than ten percent of the length indicated on Drawings.
- B. Underground Requirements:
1. Conduits and multicell raceways installed underground shall be entirely encased in three inch thick concrete on all sides , except where otherwise specified. Provide required spacers to prevent any deflection when concrete is placed and to preserve position and alignment. Conduits and raceways shall be tied to spacers. Anchors shall be installed to prevent floating of conduits and raceways during placing of concrete. Provide red colored concrete to encase conduits of systems operating above 600 volts.
 2. Underground conduits and raceways shall be buried to a depth of not less than 24 inches below finished grade to top of the concrete envelope, unless otherwise specified.

3. Assemble sections of conduit with required fittings. Cut ends of conduit shall be reamed to remove rough edges. Joints in conduits shall be provided liquid-tight. Bends at risers shall be completely below surface where possible.
 4. Conduits and raceways in a common trench shall be separated by at least three inches of concrete. Electrical power and/or lighting conduit runs installed in a common trench with conduits containing signal system wiring such as public address, telephone, intrusion detection, fire alarm, television, computer networking, and clock systems shall maintain a separation of a minimum of six inches from these types of signal system conduits and raceways. Electrical power, lighting and signal conduits and raceways installed in a common trench with other utility lines such as gas, water, sewer and storm lines shall maintain 12 inches separation from these types of utility lines.
 5. The Inspector will observe underground installations before and during concrete placement. A mandrel shall be drawn through each run of conduit in presence of the Inspector before and after placing concrete. Mandrel shall be six inches in length minimum, and have a diameter that is within 1/4 inches of diameter of conduit to be tested.
 6. Non-metallic conduit installations shall comply with following additional requirements. Joints in PVC conduit shall be sealed by means of required solvent-weld cement supplied by conduit manufacturer. Non-metallic conduit bends and deflections shall comply with requirements of applicable electrical code, except that minimum radius of any bend or offset for conduits sized from 1/2 inch to 1 1/2-inch inclusive shall not be less than 24 inches. Bends at risers and risers shall be PVC-coated rigid steel conduit. Radius of curve of bends or offsets in non-metallic conduit for public telephone system shall be not less than ten times trade size of conduit, unless otherwise specifically permitted.
 7. Furnish and install a six-inch wide, polyethylene, red underground barrier type 12 inches above full length of concrete reading, "CAUTION ELECTRIC LINE BURIED BELOW".
 8. Underground conduit systems provided for utility companies shall be furnished to meet the requirements of the utility companies requiring service.
 9. Protect inside of conduit and raceway from dirt and rubbish during construction by capping openings.
 10. Add bell-end bushings for conduit stub-up including underground entries to pull boxes, and manholes. Under floor standing switchboards and motor control centers provide a four-inch galvanized nipple with ground bushing.
 11. Underground conduit and raceways shall be swabbed prior to wire pull.
- C. General Installation Requirements for Computer Network System Conduits:
1. Location of outlet boxes and equipment on Drawings is approximate, unless dimensions are indicated. Drawings shall not be scaled to determine position and routing of wireways, drops, and outlet boxes. Location of outlet boxes and equipment shall conform to architectural features of the building and other Work already in place and must be ascertained in the field before start of Work.
 2. The maximum pulling tensions of the specified cables shall not be exceeded and proper radius of cable bends shall be maintained.

3. For computer network wiring, conduit types shall be limited to rigid metal conduit, electrical metallic tubing, schedule 40 PVC, multi-cell raceways, and flexible metallic conduit for lengths less than six feet.
 4. Interior section of conduit run shall be not longer than 100 feet and shall not contain more than two bends of 90 degrees between pull points or pull boxes.
 5. The inside radius of a conduit bend shall be at least six times the internal diameter of the conduit. When the conduit size is greater than two inches, the inside radius shall be at least ten times the internal diameter of the conduit. For fiber-optic cable, the inside radius of a conduit bend shall be at least ten times the internal diameter of the conduit.
 6. Conduit shall be sized in accordance with Table 4.4-1 of EIA/ TIA 569 standard.
 7. Splicing or terminating cables in pull boxes is not permitted.
 8. For indoor application, a pull box shall be provided in conduit run where:
 - a. The length is over 100 feet.
 - b. There are more than two bends of 90 degrees.
 - c. There is a reverse bend in the run.
 9. Boxes shall be provided in a straight section of conduit and shall not be installed in lieu of a bend. The corresponding conduit ends are to be aligned with each other. Conduit fittings shall not be installed in place of pull boxes.
 10. Where a pull box is provided with raceways, pull box shall comply with the following:
 - a. For straight pull-through, provide a length of at least eight times the trade-size diameter of the largest raceway.
 - b. For angle and U-pulls:
 - 1) Provide a distance between each raceway entry inside the box and the opposite wall of the box of at least six times the trade-size diameter of the largest raceway, this distance being increased by the sum of the trade-size diameters of the other raceways on the same wall of the box.
 - 2) Provide a distance between the nearest edges of each raceway entry enclosing the same conductor of at least:
 - a) Six times the trade-size diameter of the raceway; or
 - b) Six times the trade-size diameter of the larger raceway if they are of different size.
 - c) For a raceway entering the wall of a pull box opposite to a removable cover, provide a distance from the wall to the cover of not less than the trade-size diameter of the largest raceway plus six times the diameter of the largest conductor.
 11. Drawings generally indicate Work to be installed, but do not indicate all bends, transitions of special fittings required to clear beams, girders or other Work already in place. Investigate conditions where conduits and wireways are to be installed, and furnish and install required fittings.
- D. Slabs on Grade:
1. Unless specifically reviewed by the Architect and DSA, conduits 1 ¼-inches and larger are not permitted to be installed in structural concrete slabs. Where conduits are

permitted, and are installed in concrete slabs on grade, slabs shall be thickened at bottom where conduits occur to provide three inches of concrete between conduit and earth. Required excavation shall be part of the Work of this section.

2. If concrete slab is five inches or more in thickness with a moisture barrier plastic sheet between earth and slab, one inch and smaller conduits shall be installed in the slab with a minimum of one inch concrete between earth and conduit.
- E. Concrete Walls, Beams, and Floors: Provide sleeves where conduits pierce concrete walls, beams, and floors, except floor slabs on grade. Sleeves shall provide 1/2 inch clearance around conduits. Sleeves shall not extend beyond exposed surfaces of concrete and shall be securely fastened to forms. Where conduits pass through walls below grade, seal with required sealant and backer materials between conduit and sleeve to provide a watertight joint. Sealant shall be as indicated in Section 07 9200: Joint Sealants.

3.02

STUBS

- A. Panelboard: Install two one inch conduits from each flush mounted panelboard to access under floor space and to access above ceiling space where these conditions occur. Cap conduits with standard galvanized pipe caps.
- B. Floor: At points where floor stubs are indicated in open floor areas, for connections to machines and equipment, conduits shall be terminated with couplings, tops flush with finished floor. Stubs shall extend above couplings the indicated distance. Where capped stubs are designated, couplings shall be closed with cast iron plugs with screw drive slots.
- C. Underground:
1. Underground conduit stubs shall be terminated at locations indicated, and shall extend five feet beyond building foundations, steps, arcades, concrete walks and paving. Rigid metallic conduit stubs and non-metallic conduit stubs shall be capped by installing a coupling flush in end wall of concrete encasement and plugging with a permitted plug. Project record drawings shall indicate location of ends of underground conduit stubs fully dimensioned and triangulated with reference to buildings or permanent landmarks. These dimensions, including depth below finished grade, shall be marked on project record drawings in presence of the Inspector before backfilling trench. Where extending existing concrete encased stubs, clean, chip and wire brush end of existing concrete and brush on a heavy coat of neat cement paste or epoxy bonding agent.
 2. Over ends of individual underground conduit stubs or groups of conduit stubs, install four-inch by 18-inch deep PVC filled with concrete, flush with finished grade in asphaltic concrete or lawns, and two inches above finished grade in planting areas. Cast a three-inch by three-inch brass plate engraved "ELECT" flush in top of concrete. Secure plate to concrete with brass dowels or as indicated on drawings.

3.03

PROTECTION

- A. Protect the Work of this section until Substantial Completion.

3.04

CLEANUP

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

END OF SECTION

SECTION 26 0800
ELECTRICAL SYSTEMS COMMISSIONING

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Section Includes:

1. General requirements for Commissioning (Cx) of lighting systems components, lighting controls and HVAC systems line voltage interconnection components, including installation, start-up, testing and documentation according to Construction Documents and Commissioning Plan (CxP).
2. Standard procedures for the execution of commissioning work shall be in conformance with Division 1, Section 01 9113 General Commissioning Requirements. Coordinate work with the Commissioning Agent (CxA).

1.02 RELATED REQUIREMENTS:

1. Division 01 - General Requirements.
2. Section 01 9113: General Commissioning Requirements.
3. Section 01 7900: Maintenance and Operations Staff Demonstration and Training.
4. Section 23 8000: Heating, Ventilation, and Air Conditioning Equipment.
5. Section 23 0800: HVAC Systems Commissioning.
6. Section 23 0923: Environmental Control and Energy Management Systems.
7. Section 23 0813: Environmental Controls and Energy Management System Commissioning.
8. Section 26 0500: Common Work Results for Electrical.
9. Section 26 0513: Basic Electrical Materials and Methods.
10. Section 26 0526: Grounding and Bonding.
11. Section 26 0519: Low Voltage Wires (600 Volt AC).
12. Section 26 0586: Motors and Drives.
13. Section 26 2419: Motor Control Center and Motor Control Devices.
14. Section 26 5000: Lighting.
15. Section 26 0923: Lighting Control Systems.
16. Section 26 5563: Theatrical Lighting and Stage Dimming Systems.
17. Section 26 5566: Theatrical Lighting and Stage Dimming Systems.
18. Project Commissioning Plan.
19. Basis of Design (BOD).

1.03 REFERENCES

- A. Applicable codes, standards, and references: inspections and tests shall be in accordance with the following applicable codes and standards:
1. National Electrical Testing Association – NETA.
 2. National Electrical manufacturer’s Association – NEMA.
 3. American Society for Testing and Materials – ASTM.

4. Institute of Electrical and Electronic Engineers – IEEE.
5. American National Standards Institute – ANSI.
6. National Electrical Safety Code – NESC.
7. California Building Code – CBC.
8. California Electrical Code – CEC.
9. California Green Building Standards Code (CalGreen).
10. United States Green Building Council, Leadership Energy and Environmental Design (USGBC) (LEED).
11. Conglomerate for High Performance Schools (CHPS).
12. Insulated Power Cables Engineers Association – IPCEA.
13. Occupational Safety and Health Administration – OSHA.
14. National Institute of Standards and Technology – NIST.
15. National Fire Protection Association – NFPA.
16. ANSI/NFPA 70 – National Electrical Code.
17. ANSI/NFPA 70B – Electrical Equipment Maintenance.
18. NFPA 70E – Electrical Safety Requirements for Employee Work Places.
19. ANSI/NFPA 101– Life Safety Code.

1.04 SUBMITTALS

- A. Submittals shall include the following:
1. Submit required Cx submittals in accordance with Division 1 Specification Sections.
 2. Copy of the Architect’s reviewed and accepted submittals to the CxA via the OAR.
 3. List of team members who will represent the Contractor in the Pre-functional Equipment Checks and Functional Performance Testing, at least two weeks prior to the start of Pre-functional Equipment Checks.
 4. Detailed manufacturer installation and start-up, operating, troubleshooting and maintenance procedures, checklist documentation and field checklist forms to be used by factory or field technicians, and a copy of full details of Owner-contracted tests, full factory testing reports, if any, and Warranty information, including responsibilities of Owner to keep Warranty in force, clearly defined.
 5. Detailed manufacturer’s recommended procedures and schedules for Pre-functional Equipment Checks, supplemented by Contractor’s specific procedures, and Pre-functional Tests, at least four weeks prior to the start of Pre-functional Performance Tests.
 6. After facility’s commission is complete, submit completed Pre-functional Equipment Checklists and Functional Performance Test checklists organized by system and by subsystem. Bind information in a single package. The results of failed tests shall be included along with a description of the corrective actions taken.
- A. Sequencing and Scheduling: The work described in this Section shall begin only after work required in related Division 26 Sections has been successfully completed, and tests, inspection reports and Operation and Maintenance manuals required in Division 26 Sections have been submitted and approved. The start-up and Pre-functional Equipment Checklists shall be completed and submitted to the Owner’s Authorized Representative (OAR) prior to the Functional Performance Tests. Refer to the project Cx Plan for more details.

1. Coordinate electrical work with the work of other trades prior to scheduling of any Cx procedures.
2. Coordinate the completion of electrical testing, inspection, and calibration prior to start of Cx activities.
3. Cx activities shall be scheduled in accordance with project's Cx plan.

1.05 QUALITY CONTROL

- A. Comply with Owner's Quality Control Specifications, Sections 01 4516 – 01 4519, as applicable.
- B. Incorporate manufacturer's recommended Cx procedures for the systems and equipment to be commissioned under this Section.

PART 2 - PRODUCTS

2.01 TEST EQUIPMENT

- A. Equipment to be utilized in the commissioning process shall meet the following requirements:
 1. Provide test equipment as necessary for the equipment and systems to be commissioned.
 2. Provide testing equipment and accessories that are free of defects and certified for use.
 3. Provide testing equipment with current calibration labels per NIST Standards.
 4. Testing equipment shall be UL Listed.

PART 3 – EXECUTION

3.01 COMMISSIONING PROCESS REQUIREMENTS

- A. Work to be performed prior to commissioning:
 1. Complete all phases of the work so the system(s) can be started, tested, adjusted, balanced, and otherwise commissioned.
 2. Start-up services required to bring each system into full operational state and ready for functional performance testing:
 - a. Completion of prefunctional checklists.
 - b. Manufacturer's Authorized Representative Start-up as required
 - c. Contractor start-up
 - d. Testing.
 - e. Motor rotation check.
 - f. Control sequences of operation.
 - g. Full and part load performance.
 3. If modifications or corrections to the installed systems are required to bring the system(s) to acceptance levels due to Contractor's incorrect installation or defective materials, such modifications or corrections shall be made at no additional cost to the Owner.
 4. Start-up services required to bring each system into full operational state and ready for functional performance testing:
 - a. Completion of prefunctional checklists.
 - b. Manufacturer's Authorized Representative Start-up as required
 - c. Contractor start-up
 - d. Testing.
 - e. Motor rotation check.
 - f. Control sequences of operation.

- g. Full and part load performance.
- 5. Commissioning shall not start until each system is complete and the above items are completed and approval has been received by the OAR
- B. Pre-commissioning Responsibilities: Inspection, calibration and testing of the equipment and apparatuses to commission the following systems:
 - 1. Electrical Lighting Systems.
 - 2. Lighting Controls.
 - 3. HVAC line voltage electrical components.
 - 4. Line voltage interface of Environmental Controls and Energy Management System with other systems.
 - 5. Photovoltaic Systems
- C. Commissioning Process Requirements:
 - 1. Refer to Section 01 9113 General Commissioning Requirements, related sections and Cx Plan for information on meetings, start-up plans, Pre-Functional and Functional Performance Testing (FPT), operations and maintenance data, and other Commissioning activities.

3.02 PREPARATION

- A. Provide certified electricians or other qualified personnel as required with tools and equipment necessary to perform Cx activities.
- B. Provide equipment manufacturer's factory representative(s) for commissioning of rooms lighting and its control system, Theatrical Lighting Controls, and Energy Management and Environmental Control Systems as required by the Cx Plan.
- C. Provide certified testing agency personnel or report(s) as required in the Cx Plan.

3.03 TESTING

- A. Testing documentation shall include the following minimum information:
 - 1. Test number.
 - 2. Equipment used for the test, with manufacturer and model number and date of last calibration.
 - 3. Date and time of the test.
 - 4. Indication of whether the record is the first commissioning test or a retest following correction of a previously identified problem or issue.
 - 5. Identification of the system, subsystem, assembly, or equipment.
 - 6. Conditions under which the test was conducted, including (as applicable) ambient conditions, set points, override conditions, and status and operating conditions that impact the results of the test.
 - 7. Systems and assemblies test results, performance and compliance with contract requirements.
 - 8. Issue number, if any, generated as the result of the test.
 - 9. Name and signature(s) of witnesses and the person(s) performing the test.
- B. Test lighting and controls systems performance to verify operation, functionality, light levels, energy usage, and compliance with construction documents.
 - 1. Start up, test and document results under the observation of the CxA.

2. Execute the Functional Performance Test (FPT) under the observation of the CxA who will record the results of the Functional Performance Test procedures.
3. Equipment and Components to be tested: Refer to Article 3.01, B.
4. Functions and Testing Conditions:
 - a. Occupancy sensors and timer controls for lighting:
 - 1) Verify that specified functions and features are set up, debugged and fully operable at time of test.
 - 2) Verify that occupant override feature functions properly and as intended in the contract documents.
 - 3) Verify that sensor durations are set properly.
 - 4) Test the sequence of operation for features and modes and confirm that adjustable timing matches the design specifications and contract documents.
 - b. Electric lighting dimming, photocells and controls:
 - 1) Test the dimming controls during daytime when conditions are such that controls should be dimming electric lighting. Verify that amperage changes in light fixtures are proportional to external light changes. Verify that dimmed light levels at the specified work plane remain within specified limits.
 - 2) Verify that delays and ramp times are set and functioning so that the speed of change of light fixture output is slow enough to not bother occupants and in compliance with the specifications.
 - 3) Verify that dimming does not cause lower than specified light levels in adjacent “non-dimmed” spaces.
 - 4) Verify that the controls and sensors cannot be easily overridden or disabled by occupants.
 - 5) Verify that dimming systems in places of assembly are interfaced with the Central Fire Alarm system. Dimmed lighting in these areas shall come back to full bright during a fire alarm condition.
 - c. Illumination Levels, Night Conditions:
 - 1) Verify that lighting throughout the building is operating automatically.
 - 2) Test with doors closed (to simulate actual occupancy) and after finishes are complete.
 - d. Illumination Levels, Day Conditions:
 - 1) Verify that lighting throughout the building is operating automatically.
 - 2) Test with doors closed (to simulate actual occupancy), after finishes are complete, and room is furnished.
 - 3) Test at different times during the day, or under Owner-approved simulated conditions, to ensure proper system response and to determine that lighting levels are within specified requirements.
 - 4) Test the system for the different pre-determined settings. Quiet time, AV mode, and normal standard class operation.
 - e. Lighting Power Density: Perform the test with interior lighting turned on and any manual or automatic controls temporarily overridden. The lighting power shall

- be measured at the building's electrical panels. Measurements shall be taken at least one minute after lighting in the building is on.
- f. Emergency Lighting System: Verify that the system operates automatically under any condition, without human intervention, and that it resets back to normal operations after the power failure is over or cleared.
5. Acceptance Criteria:
 - a. Lighting Controls: For the conditions, sequences and modes tested, the dimming, occupancy, photocell, and timing controls, integral components and related equipment respond to changing conditions and parameters appropriately as defined in the Contract Documents.
 - b. Illumination Levels: Average light levels in the tested space at the work plane elevation shall not be less than ten percent below nor greater than 20 percent above the specified light level range for the space.
 - c. Lighting Power Density: Average instantaneous lighting power density is plus or minus ten percent of that indicated in the Construction Documents. Power factors on lighting circuits shall be 0.95, or as required by lighting fixture specifications.
 6. Sampling Strategy for Identical Units:
 - a. Lighting Controls: Test automatic interior lighting controls.
 - b. Illumination Levels: At least 50 percent of space zones and rooms, chosen by the Owner, shall be verified as realizing proper light levels. If 25 percent of the spaces in the first sample fail the Functional Performance Tests, test another ten percent of the untested space zones and rooms (the second sample). If ten percent of the spaces in the second sample fail, test remaining spaces.
 - c. Power Density: Test lighting circuits.
- C. HVAC Electrical Component Testing
1. Document HVAC Division 23 electrical components using the startup procedure submitted by Contractor and accepted by the CxA.
 2. Complete requirements of the Prefunctional Checklists.
 3. Verify the following information prior to HVAC system equipment startup.
 - a. Voltage.
 - b. Phase.
 - c. Motor Size.
 - d. Lock Rotor Amperage.
 - e. Full Load Amperage.
 - g. Minimum and Maximum Circuit Ampacity.
 - h. Feeder protection or branch circuit protection, breaker or fuse size as applicable.
 4. Coordinate and check corresponding unit electrical protection size and code required clearances.
- D. Participate and perform Cx related testing requirements prescribed under Sections 01 9113 and the approved project Cx Plan.
- 3.04 ADJUSTING**
- A. Systems improperly adjusted, incorrectly installed equipment or deficient Contractor performance may result in additional work being required for Cx acceptance.

1. Perform work required to correct installations not meeting contract requirements at no additional cost to the Owner.
- B. Corrective work shall be completed in a timely manner to permit completion of the Cx process.
 1. Refer to the Cx Plan for retesting requirements necessary to achieve required system performance.
 2. If the systems' Cx deadline, as defined in the Cx Plan, goes beyond the scheduled completion of Commissioning without resolution of the problem, the Owner reserves the right to obtain supplementary services or equipment to resolve the problem.

3.05 TRAINING

- A. Provide training and documentation as required in applicable Division 26 specification sections, and other related sections.

END OF SECTION

SECTION 26 0923
LIGHTING CONTROL SYSTEMS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Low-voltage lighting control system.
- B. Related Requirements:
 - 1. Division 01 - General Requirements.
 - 2. Section 26 0500: Common Work Results for Electrical.
 - 3. Section 26 0513: Basic Electrical Materials and Methods.
 - 4. Section 26 0519: Low-Voltage Wires (600 Volt AC).
 - 5. Section 26 0533: Raceways, Boxes, Fittings, and Supports.
 - 6. Section 26 2416: Panelboards and Signal Terminal Cabinets.
 - 7. Section 26 5000: Lighting.

1.02 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 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.

1.03 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.
- C. Conduct a coordination meeting with the lighting control contractor, electrical contractor, EOR, Manufacturer Representative, and the OAR to validate the location of lighting control system components, including daylight sensors. Sensors shall be located based on manufacturer's recommendations.

1.04 WARRANTY

- A. Manufacturer shall provide a three year material warranty.
- B. Installer shall provide a two year installation warranty.

1.05 SYSTEM REQUIREMENTS

- A. Systems shall be furnished with networkable relay panels complete with relays, transformers, and control electronics. The system shall be furnished with hardware and resident software, occupancy sensors, constant light controllers, exterior light sensors, occupancy sensors, local wall switches and dimmer switches, conduit and wiring for a complete and functional installation.
- B. 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 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, seven 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 hardware and software; software shall be resident within the lighting control system. System shall provide local access to programming functions at the master Lighting Control Panel (LCP) and remote access to 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 a 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.
- C. System software shall provide real time status of each relay, each zone and each group.
- D. 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 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
- E. Devices shall be able to be pre-addressed at the factory. Systems requiring field addressing only are not acceptable.
- F. Programs, schedules, time of day, etcetera, 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.
- G. 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.
- H. 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.
- I. The lighting control system shall provide the ability to control each relay and each relay group. 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.

- J. 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. Remote relay panels, smart breaker panels, centralized relay panels and digital switches shall communicate as one network. Remote Relay Panels (RRP) shall control 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 specification line voltage type switches, and if area dimming is indicated on the plans, they shall be capable of outputting an independent 0v to 10v dimming signal for each remote relay provided. Remote relay panels, switches, photocells and occupancy sensors shall be wired per lighting control manufacturers instructions.

1.06

LIGHTING CONTROL OVERVIEW-BY AREA CONTROLLED

- A. Rooms:
1. Rooms are controlled by a combination of occupancy sensors, daylight controllers and dimmers switches, ON/OFF and quiet time switches.
 - a. The occupancy sensor is to automatically switch lights OFF when the room is not occupied.
 - b. Daylight controls shall automatically adjust light intensity according to the natural light level in the room. The daylight sensors shall be enabled and disabled by the occupancy sensors to ensure daylight controlled lights never automatically turn ON when room is unoccupied. The lighting control system shall allow an authorized person to disable the daylight sensors and dimming controls.
 - c. Wall switches are to manually switch lights ON and OFF. Switches shall comply with the operational requirements of the current T24, and include location of device, accessibility and override capability.
 - d. Quiet time switch is to temporarily bypass the occupancy sensors for a programmed time period, typically one hour.
- B. Corridors and Open Areas:
1. Corridors and other common areas are to be controlled by a combination of programmable low voltage keyed switches and time schedules supplied by the networked lighting control system.
 - a. Low voltage keyed switches are operable 24 hours a day and are to manually switch lights ON and OFF.
 - b. The central timer is to automatically sweep lights OFF after hours, and provide scheduling capability.
 - c. Interior corridors require occupancy sensors.
- C. Custodial and Equipment Rooms:
1. Custodial, Equipment rooms and unsupervised rooms shall be provided with occupancy sensors with automatic on-off capability in addition to manual switches. These sensors shall turn off the lights in the room via a pre-set but programmable interval after the room has been vacated.
- D. Exterior Security Lights:
1. Exterior wall packs and security lights are to be controlled via exterior light sensors.
 - a. When natural light level is insufficient, the lights are ON.

- b. When natural light level is sufficient, the lights are OFF.
- E. Exterior, Non-Security Lights:
 - 1. Exterior parking lot lights, pathway lights and decorative lights are controlled by an exterior light sensor in conjunction with time schedules provided by the networked lighting control system.
 - a. When natural light level is insufficient or the timer is ON, the lights are ON.
 - b. When natural light level is sufficient or the timer is OFF, the lights are OFF.
- F. Restrooms:
 - 1. Student Restroom Lighting and Exhaust Fans (Fans interlocked with lights):
 - a. Restroom lights shall be controlled from the lighting control panel via assigned relays. Provide by-pass lock type, vandal resistance key operated switch adjacent to the door, and ceiling mounted occupancy sensors for on/off controls. The sensor shall turn off the lights in the room via a pre-set but programmable interval after the room has been vacated.
 - 2. Staff Restrooms Lights and Exhaust Fans (Fans interlocked with lights):
 - a. Restrooms lights and fan shall be controlled from the lighting control panel via assigned relays. Provide ceiling mounted occupancy sensors, and by-pass toggle switches for system override adjacent to the door. The sensor shall turn off the lights in the room via a pre-set but programmable interval after the room has been vacated.
- G. Emergency Lighting:
 - 1. Emergency lighting controls shall be equipped with by pass circuitry that will bypass all manually operated switches, lighting control systems, dimmers and occupancy sensors during power failure situations. Design shall comply with applicable codes and regulations. Each area of luminaries or groups of luminaries shall be equipped with and controlled by a UL924 listed emergency lighting control unit to allow the detection of localized power failure.

PART 2 - PRODUCTS

2.01. CENTRAL LIGHTING CONTROL PANELS

- A. Central Lighting Control Panels (CLCP) shall be located in the electrical closets and shall be Douglas Dialog Series, LC & D #GR-2400 series, series or 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. Panels shall include the following components or features:
 - 1. Shall be preprogrammed and preassembled with 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 percent spare relays for 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 inch 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), Douglas Lighting Controls, or equal.

2.02. REMOTE LIGHTING CONTROL PANELS

- A. Remote lighting control panels shall be mounted in the ceiling space per plans and shall be LC&D GR-2404 Series or Douglas WRM-3414. , Each panel shall be connected to the network lighting control system using manufacturer's recommended wiring method and configured using central lighting control software. Add a printed label "RLCP" to the T-bar grid below the RLCP".
- B. Each remote relay panel shall contain the following hardware features:
 1. Programmable, matrix able switch inputs
 2. 12 VDC and 24 VDC inputs for occupancy sensors requiring DC voltage.
 3. DC power supply rated for 250 mA for supplying power to occupancy sensors.
 4. Digital light sensor inputs.
- C. Switch inputs are to be capable of switching individual relays, local groups of relays within the panel or global groups of relays system wide. Each switch input can be configured for connection to momentary 24 VAC switches or maintained contact 24 VAC switches. Each input can also be configured to be ON, OFF or Toggle.
- D. The remote panels shall accept 12 or 24 VDC or 24 VAC occupancy sensors. The inputs may be configured for OFF only or ON/OFF switching scenarios. It shall be possible to link the photo sensor control with occupancy sensing so that when light levels are high enough, the occupancy sensor will not switch the photo controlled relays ON.

2.03 RELAYS

- A. Relays shall be warranted for a minimum of three years.
- B. Relays shall be individually added or replaced. Lighting control systems incapable 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: Douglass WR-6161, LC&D SL-277-NC, or equal.
 2. Double Pole: Douglass WR-6172, LC&D SL-480-NC, or equal.

2.04 LOW VOLTAGE SWITCHES

- A. 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 Douglas WSW-3500 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. Provide stainless steel switch covers as specified.
- D. Local switches controlling lights in rooms shall be wired to programmable inputs in the remote lighting control panels. Each switch shall be programmable to control one, some or all relays in the entire network ON only, OFF only or ON and OFF. Use standard toggle switches as specified or digital low voltage switches by lighting control manufacturer as indicated on plans.
- E. Switches controlling the “quiet time” function in the remote lighting control panels shall connect directly to programmable inputs within the panel or connect to the lighting control system network. Use standard toggle switches or digital low voltage switches by lighting control manufacturer as indicated on plans.
- F. High abuse areas (common areas, gymnasiums, etcetera) shall be controlled using a vandal resistant, touch sensitive high abuse switch and available with up to three buttons in a single gang. Multi gang versions shall also be available. Touch pads shall be stainless steel and capable of handling both high abuse and wash down locations. High abuse switches shall be digital or analog. Each high abuse switch touch button shall be able to control any relay or any group in any panel or panels that is part of the lighting control system. Each touch button shall be able to be programmed for ON, OFF, Toggle or Maintain operation. Programming shall be done locally or remotely via dial up modem or web interface as described in other paragraphs of this section. High abuse switches shall be able to be enabled or disabled digitally. Each touch pad is to be identified as to function by an engraved label. Switches must be capable of handling electrostatic discharges of at least 30,000 volts (1cm spark) without any interruption or failure in operation.

2.05 INTERIOR DAYLIGHT SENSORS

- A. In rooms requiring day lighting control provide an interior daylight sensor. Refer to lighting plans to determine which switch legs are controlled by the daylight controller. Use LC&D iPC Series, Douglas WPH-3711, or equal.
- B. Interior daylight sensors shall cause light fixtures within the room to brighten or dim to maintain pre-determined and uniform light levels between 30 and 50 foot candles; in areas not provided with dimming ballasts the sensors shall permit any relay to switch at a unique light level and shall attempt to maintain a constant light level by switching individual relays ON or OFF as the ambient light level changes. Controllers offering single set point controls are not acceptable.
- C. Each interior daylight sensor shall continuously monitor the true light level and shall broadcast this level to lighting control network. Controllers requiring readings at the sensor head itself are not acceptable.
- D. Each interior daylight sensor shall be fully adjustable via the lighting control software. Controllers requiring adjustments at the sensor head are not acceptable.

2.06 EXTERIOR LIGHT SENSORS

- A. Provide one exterior rated light sensor for control of exterior lights. Use Douglas WPH-3751, LC&D PCO or equal.
- B. One exterior light sensor shall permit different relays to switch at different light levels. Sensors offering less than 14 remotely settable trip points are not acceptable.

- C. Exterior light sensor shall continuously monitor the true light level and shall broadcast this level over the lighting control network. Sensors requiring adjustments at the sensor head are not acceptable.
- D. Exterior light sensor shall be fully adjustable via the networked lighting control system. Controllers requiring adjustments at the sensor head are not acceptable.

2.07 DIMMING BALLAST CONTROLLER

- A. If plans indicate rooms and other areas to be dimmed, remote relay panels shall be capable of outputting one independent 0V – 10V dimming signal for each relay provided in the remote relay panel. Dimming ballasts shall be controlled by industry standard 0V-10V control input. Ballasts using proprietary control protocols shall not be acceptable. In order to maximize daylight harvesting and minimize disruption to occupants, each dimming output shall provide adjustment for baseline, start point, mid point, end point, trim fade up rate, fade down rate, time delay and enable/disable masking. Photocell settings must be remotely accessible. Systems that provide ON, OFF with Time Delay only and systems that do not provide remote access are not acceptable.
- B. Mount photocells in locations indicated on plans and according to manufacturer's recommendations for daylight system type, open or closed loop. Trip points shall be able to be changed remotely via internet or dial up modem. Photocells requiring manual trip point adjustment are not acceptable. Photocell used for interior lighting control shall have multiple settings such as start-point, mid-point, off-point, fade-up rate, fade-down etc. Settings shall be remotely accessible and adjustable. Systems that provide local adjustments only are not acceptable. Photocells are to be certified to be in compliance with California Energy Commission Title 24 requirements at time of submittal of plans for building permit. Use Douglass WPCH-3711, LC&D iPC series, or equal.

2.08 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 ten percent in temperature range of 0 degrees F. to 120 degrees F., and in humidity range of ten 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 two sensors.
 - g. Manufacturers: Watt Stopper No. DT-200, similar as manufactured by Leviton, Sensor Switch, Unenco, or equal.

2. Passive Infrared Wall Switch Sensors with Daylight Controls:
 - 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. Sensor shall be furnished with a daylight filter which ensures that sensor is insensitive to short-wavelength infrared waves, such as those emitted by the sun.
 - d. Sensors shall be furnished with convenient bypass provisions, which enable lighting to be turned on in case of failure.
 - e. Time delay range shall be adjustable from 15 seconds to 15 minutes.
 - f. Sensitivity adjustment shall range from 0 (off) to ten (maximum).
 - g. Adjustments and mounting hardware shall be concealed under a removable cover to prevent tampering with adjustments and hardware.
 - h. Each sensor shall cover up to 800 square feet, with a field-of-view of 150 degrees.
 - i. Sensor shall be two-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.
 - j. Sensor shall be capable of switching from 50 to 1000 watt, incandescent or fluorescent.
 - k. Sensor shall be furnished with a daylight feature, adjustable from ten to 400 foot-candles, that maintains lighting off when a desired foot-candle level is present.
 - l. Sensors shall be dual voltage, 120 volt and 277 volt.
 - m. Manufacturers: Watt Stopper No. WI 200, I 300, similar as manufactured by Leviton Sensor Switch, Unenco, or equal.

2.09

LIGHT LEVEL CONTROLLERS (EXISTING FACILITIES)

- A. Controller shall be capable of detecting changes in lighting levels; it shall utilize an internal photoconductive cell to measure light levels through 50 percent diffused lens.
- B. Controller shall be capable of controlling any type of lighting. It shall be a self-contained 24 VDC device that controls lighting through use of power switch packs.
- C. Controller shall be capable of turning lighting on and off between ten and 200 foot-candles.
- D. Controller shall be furnished with an adjustable dead-band feature of ten percent to 100 percent, to prevent lighting from cycling when lighting goes on and off and from minor changes due to cloud cover.
- E. Controller shall be furnished with an adjustable time delay range of three seconds to five minutes.
- F. Controller shall be furnished with a dual color LED-indicating status of sensor. LED shall have an on level with one color and an off level with another.

- G. Adjustments and mounting hardware shall be concealed under a removable cover, to prevent tampering with adjustments and hardware.
- H. Each controller shall be furnished with a convenient by-pass provision, which will enable lighting to be turned on in event of failure.
- I. Manufacturers: Watt Stopper No. LS-100 XA, similar as manufactured by Leviton, Sensor Switch, Unenco or equal.

2.10 UNIT INVERTERS

- A. Unit Inverters shall be rapid start type consisting of emergency fluorescent power packs designed to be installed in channels of new lighting fixtures.
- B. Power pack construction shall be of durable polycarbonate housing having same size as low profile rapid start ballast.
- C. Units shall be furnished with test switches and pilot lights.
- D. Units shall automatically power designated fluorescent lamp(s) in fixture to provide a minimum of 1100 lumens for 90 minutes of emergency service upon failure of utility power.
- E. Upon return of utility power, battery shall automatically recharge for future emergency use.
- F. Batteries shall be field-replaceable, sealed, rechargeable, spill-proof, maintenance-free nickel cadmium.
- G. High efficiency inverter/charger design shall include low-voltage disconnect to prevent deep discharge of battery and dual voltage designed for connection to either 120 or 277 volts. Chargers shall recharge fully discharged batteries to provide 90 minutes operation within 24 hours. An additional hot wire shall connect to unit in order to signal unit in event of a power failure. Power pack will not operate if shut off manually.
- H. An unconditional five year warranty is required.
- I. Units shall be Dual-Lite UFO-5 Series, Bodine, Iota I series, Beghelli Luce, or equal.

2.11 INTERFACE TO BUILDING MANAGEMENT SYSTEM

- A. When interface to the Building Management System is required, the lighting control system shall provide a BACnet/IP interface module that communicates with the BMS via a BACnet/IP network (a collection of one or more IP sub networks (IP domains) that are assigned a single BACnet network number). Verify if interface to BMS is required.
- B. BACnet/IP interface module shall provide the capability for the BMS to:
 - 1. Communicate directly with each relay in the lighting control system network and each group used within the lighting control system.
 - 2. Monitor the current status and status changes of each relay and each group.
- C. Install wiring and confirm operation of the lighting control BACnet/IP interface module per the lighting control manufacturer's instructions. Installing, wiring, and interfacing of BMS components to the lighting control system.

PART 3 – EXECUTION

3.01 GENERAL

- A. Lighting control system shall not be used for any other purpose other than its intended use and application.
- B. Provide 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 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.

3.02

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. Provide for room Digital type switches, and wire according to lighting control manufactures requirements.
- C. Digital switches and wire shall be according to lighting control manufactures requirements.
- D. Central lighting control panels and remote lighting control panels are connected via a data line (Douglas uses a non-polarized two No. 18 LC&D use Cat5 four twisted pair cable, with RJ45 end connectors). Connect entire lighting control system per manufacturer's requirements. Do not exceed manufacturer's total data line length requirement.
- E. Panels shall be located so that they are readily accessible and not exposed to physical damage.
- F. Panel locations shall be furnished with sufficient working space around panels to comply with the California Electrical Code.
- G. Panels shall be securely fastened to the mounting surface by at least four points.
- H. Unused openings in the cabinet shall be effectively closed.
- I. Cabinets shall be grounded in accordance with Article 250 of the California Electrical Code, and manufacturer's recommendations.
- J. Lugs shall be suitable and listed for installation with the conductor being connected.
- K. 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.
- L. Maintain the required bending radius of conductors inside cabinets.
- M. Clean cabinets of foreign material such as cement, plaster and paint.
- N. Distribute and arrange conductors neatly in the wiring gutters.
- O. Follow the manufacturer's torque values to tighten lugs.
- P. 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.
- Q. Follow manufacturers' instructions for installation.

3.03

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 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.

3.04 PROTECTION

- A. Protect the Work of this section until Substantial Completion.

3.05 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 Project Inspector 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.

3.06 INSTRUCTION PERIODS

- A. Before Substantial Completion, arrange and provide an eight hours Owner instruction period for designated personnel.

3.07 SPARE PARTS

- A. Provide a minimum of five percent spare parts of each type of relay, sensors, switches, and peripheral devices.

3.08 CLEANUP

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

END OF SECTION

SECTION 26 2416

PANELBOARDS AND SIGNAL TERMINAL CABINETS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes: Lighting and power distribution facilities, including panelboards.
- B. Related Requirements:
 - 1. Division 01 - General Requirements.
 - 2. Section 26 0500: Common Work Results for Electrical.
 - 3. Section 26 0513: Basic Electrical Materials and Methods.
 - 4. Section 26 2600: Power Distribution Units.
 - 5. Section 26 5000: Lighting.
 - 6. Division 27: Communications.
 - 7. Division 28: Electronic Safety and Security.

1.02 SUBMITTALS

- A. Provide in accordance with Division 01.
- B. Shop Drawings: Include a front elevation indicating cabinet dimensions, make, location and capacity of equipment, size of gutters, type of mounting, finish, and catalog number of locks. General layout of internal devices, wiring drawings with wire numbers and device connections, vendor cut sheets of devices in enclosure and bill of materials listing description, manufacturer, part number, and quantity of items shall be included.
- C. Installation Instructions: Submit manufacturer's written installation instructions.

1.03 DESIGN REQUIREMENTS

- A. Panelboards:
 - 1. Panelboards shall be wall-mounted, enclosed safety type with 120/240 volt, three-wire solid neutral 277/480 volt, four-wire or 120/208 volt, four-wire solid neutral mains as indicated on Drawings or specified. First panelboard of each building shall be provided with main or sub-feeder circuit breakers where so indicated.
 - 2. Single pole branches shall be molded case, thermal magnetic circuit breakers with inverse time delay, trip free, quick-make, quick-break mechanism and silver alloy contacts. Circuit breakers shall be fully rated, with ampere rating marked on handle and shall indicate on/off and tripped positions. Ground fault interrupters shall be incorporated into circuit breakers where indicated. They shall be listed by UL, or other NRTL as ground fault devices. Provide appropriate lug kit of sufficient size to accommodate the feeders.
 - 3. Two- and three-pole branches shall be enclosed, and shall be thermal magnetic circuit breakers with inverse time delay, tamper-proof, ambient compensated, single handle, internal common trip, and quick-make, quick-break mechanism with silver alloy contacts. Circuit breakers shall be fully rated or as otherwise indicated on the Drawings.
 - 4. Main and subfeeder circuit breakers shall be enclosed, thermal magnetic type with inverse time delay, single handle common trip, quick-make, quick-break mechanism, corrosion-resistant bearings and silver alloy contacts. Ampere frame size and trip rating shall be as indicated on Drawings. Breakers over 225 amperes shall be

- furnished with interchangeable trip units. Handles of main and subfeeder circuit breakers shall be provided cabinet door. Voltage rating shall be as indicated on Drawings.
5. Circuit breakers shall be fully rated and of one-piece, bolt-on type and shall meet short-circuit interrupting capacity requirements indicated on Drawings. Series rated circuit breaker combinations are not acceptable.
 6. Internal connections shall be fabricated with plated copper bus bars and the busses shall extend for full length of space available for branch circuit breakers. Feeder cable connectors shall be installed at point of feeder entrance. Terminals shall be furnished with copper conductors. Panelboards fed by conductors having over-current protection greater than 200 amperes shall be protected on supply side by over-current devices having a rating not greater than that of panelboards. Copper bussing shall be fully rated. Heat rated bussing is not acceptable.
 7. Except where otherwise indicated, circuit breakers shall be in two vertical rows connected to bus bars in a distributed phase arrangement. Two-pole branches shall be balanced on busses. Single pole branches shall be numbered adjacent to its circuit breaker, with odd numbers on left and even numbers on right.
 8. Specified circuit breaker spaces shall be furnished with hardware required for future installation of circuit breakers.
 9. Provide locking devices for individual circuit breakers. Padlocking devices shall be secured to circuit breakers and by panel dead front plates.
- B. Surge Suppressors: Where indicated on Drawings, provide transient voltage surge suppressors as an integral part of panelboards. Panelboards shall be complete with 200 percent rated copper neutral bus, ground bus and isolated ground bus in addition to requirements of this section. Surge suppressors shall be as follows:
1. Surge Capacity:
 - a. Line-to-neutral for wye systems: 80 KA.
 - b. Line-to-ground: 80 KA.
 - c. Neutral-to-ground: 80 KA, three-phase wye.
 - d. Line-to-neutral plus line-to-ground: 160 KA.
 2. UL 1449 2nd Edition Suppressed Voltage Rating for 208/120 Wye System:
 - a. Line-to-neutral: 400 volts.
 - b. Line-to-ground: 400 volts.
 - c. Neutral-to-ground: 400 volts.
 - d. Maximum continuous over-voltage: 150 volts.
 3. EMI/RFI High-Frequency Noise Power Filter (Characteristics):
 - a. 100 KHz at 44 dB.
 - b. 100 MHz at 44 dB.
 - c. 10 MHz at 44 dB.
 - d. 100 MHz at 44 dB.
 4. MOVs shall be thermally protected for low current faults and shall be fused with surge-rated fuses. The surge-rated surge current passes and clears the circuit safely if the surge capacity is exceeded. Enhanced diagnostics shall continuously monitor the

- unit's status and shall include LEDs to signal a reduction in surge capacity or the loss of a suppression circuit. An audible alarm, with test and silence features, shall be furnished in diagnostic package.
5. Each phase or the entire unit shall be replaceable and have bolted-on, tin-plated copper connections. Unit to have UL witnessed fault current rating of 65,000 symmetrical amperes.
 6. Surge suppression units shall comply with the following:
 - a. UL certified.
 - b. UL 1283.
 - c. UL 1449.
 - d. IEEE C 62.45.
 - e. IEEE C 62.41.
 - f. Nationally Recognized Testing Laboratory (NRTL) or equal.
- C. Panelboard Cabinets:
1. Panelboard cabinets shall be code gage galvanized steel or blue steel; fronts, doors, and trims shall be code gage furniture steel. Cabinets shall be furnished with at least six-inch high gutters at top and bottom where feeder cable size exceeds four gage or where feeder cable passes through cabinet vertically. Cabinets shall be furnished with top and bottom gutters sized as required by inspection department having jurisdiction, but never less than six inches where more than one feeder enters top or bottom of cabinets. Side gutters shall not be less than four inches wide. Width of cabinets shall be 20 inches, unless otherwise indicated on Drawings.
 2. Doors shall be cut true, shall accurately fit opening and finish smooth across joints. Rabbets shall be inside. Hinges shall be entirely concealed except for barrels and pins. Hinge flanges shall be welded to door and trim. Doors shall be equipped with flush type, spring-latching, Corbin locks for metal doors, keyed to Corbin No. 60 keys.
 3. Where contactors, time switches, and control devices are specified or indicated to be installed within panelboard cabinets, a separate compartment and door shall be provided at top of cabinet for such devices. Door shall be sized as required to permit removal of contactor and other devices intact. Gutters shall be provided at sides and top of compartment. Doors shall be equipped with flush type, spring-latching, Corbin locks for metal doors keyed to Corbin No. 60 keys.
 4. Provide and install panelboard manufacturer's permanent circuit number kit option.
 5. Panelboards with control devices in compartment shall arrive at the Project site completely assembled with control devices installed and wired.
 6. Outdoor cabinets shall be NEMA Type 3R. Construction shall be formed from code gage galvanized steel with ANSI No. 61 gray enamel finish. Provide heavy-duty, three point latching, vault type door handles with padlocking provisions. Provide stainless steel or galvanized butt hinges on doors. Padlocks shall be furnished, keyed to Corbin No. 60 keys.
 7. Self-tapping screws and bolts not permitted.
- D. Panelboard Schedule: Provide a neatly typewritten schedule with number or name of room or area, or load served by each panelboard circuit. Room numbers or names shall be determined at the Project site and shall not necessarily be those indicated on the Drawings. Schedule shall also indicate panel designation, voltage and phase, building and distribution panel or

- switchboard from which it is fed. Schedule shall be installed in a frame under transparent plastic 1/32 inch thick on inside of each panelboard cabinet door.
- E. Panelboard nameplate: Provide a nameplate identifying panelboard. Plates shall be black and white plastic nameplate stock, with character cut through black exposing white and shall bare designation of service. Name plate shall be mechanically fastened to switchboard.
 - F. Provide additional labeling on dead-front of panelboard. Label shall be a P-Touch or equal with a minimum width of 3/8 inch with black letters on white background. Label shall re-identify panelboard and also identify name and location of power source feeding this panel. Location information shall include building name if located in different building and name or room location. If power source is installed in same room, label should indicate source name and "In this Room"
 - G. Panelboard Standards: Panelboards shall be UL, or other NRTL listed and labeled. Panelboards shall meet latest revisions of following standards:
 - 1. California Electric Code, Article 384.
 - 2. UL 67, Panelboards.
 - 3. UL 50, Cabinets and Boxes.
 - 4. UL 943, GFCI.
 - 5. UL 489, Molded Case Circuit Breakers.
 - 6. NEMA PB1.
 - 7. Federal Specifications W-P- 115C and WC-375B.
 - H. Signal Terminal Cabinets:
 - 1. Signal terminal cabinets shall conform to the Specifications for panelboard cabinets, except as modified herein.
 - 2. Terminal cabinets shall be flush type, with two-inch trim or surface mounted type, as indicated on Drawings. Terminal cabinets shall be furnished with sections and barriers to separate each system. Sections over 24 inches in width shall be provided with double doors and locks. Terminal cabinets, or sections of terminals housing separate systems, shall measure 12 inches long by 18 inches high by 5 3/4-inch deep, unless otherwise indicated on Drawings. Trims for sectional cabinets shall be of one-piece construction.
 - 3. Terminal cabinets shall be furnished with 3/4 inch thick plywood. Plywood shall be fastened in place with machine screws or factory installed mounting screws.
 - 4. Flush-mounted terminal cabinets shall be finished as specified for flush-mounted panelboard cabinets. Surface and semi-flush mounted terminal cabinets shall be finished as specified for surface-mounted panelboard cabinets.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Panelboards shall be manufactured by Siemens, W.A. Benjamin, General Electric, Cutler Hammer, Square D or equal.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Panelboards shall be located so they are readily accessible and not exposed to physical damage.

- B. Panelboards installed outdoors shall be specifically listed for wet locations and shall be weatherproof in NEMA Type 3R cabinets.
- C. Panelboard locations shall provide sufficient working space around panels to comply with the California Electrical Code.
- D. Panelboards shall be securely fastened to structure and mounted on surface by at least four points.
- E. Unused openings in cabinets shall be effectively closed as required by the manufacturer.
- F. Cabinets shall be grounded as specified in Article 250 of the California Electrical Code.
- G. Conduits shall be installed so as to prevent moisture or water from entering and accumulating within the enclosure.
- H. Lugs shall be suitable and listed for installation with the conductor being connected.
- I. 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.
- J. Maintain the required bending radius of conductors inside the cabinet.
- K. Clean the cabinet of foreign material such as cement, plaster, and paint.
- L. Distribute and arrange conductors neatly in the wiring gutters.
- M. Use the manufacturer's torque values to tighten lugs.
- N. Before energizing panelboards, the following steps shall be taken:
 - 1. Retighten connections to the manufacturer's torque specifications. Verify that required connections have been provided.
 - 2. Remove shipping blocks from component devices and panelboard interiors.
 - 3. Manually exercise circuit breakers to verify they operate freely.
 - 4. Remove debris from panelboard interior.
- O. Follow manufacturer's instructions for installation.
- P. Do not install in highly corrosive environments, unless rated for the application.

3.02 PROTECTION

- A. Protect the Work of this section until Substantial Completion.

3.03 CLEANUP

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

END OF SECTION

SECTION 26 5010

SOLID STATE (LED) LIGHTING

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes: LED Luminaires, LED modules, drivers, wiring, and lighting controls.
- B. Related Requirements:
 - 1. Division 01 - General Requirements.
 - 2. Section 26 0500: Common Work Results for Electrical.
 - 3. Section 26 0513: Basic Electrical Materials and Methods.
 - 4. Section 26 0526: Grounding and Bonding.
 - 5. Section 26 0519: Low-Voltage Wires (<600 Volt AC).
 - 6. Section 26 0923: Lighting Controls Systems.
 - 7. Section 26 5200: - Emergency Power Systems.
 - 8. Section 32 1313 - Site Concrete Work.

1.02 REFERENCES

- A. American National Standards Institute/American National Standard Lighting Group ANSI/ANSLG – C78.377-2008 Specifications for the Chromaticity of Solid State Lighting Products.
- B. American National Standards Institute/American National Standard Lighting Group ANSI/ANSLG – C82.77-2002 Harmonics Emission Limits.
- C. Federal Communication Commission (FCC) 47 CFR Part 15 – Radio Frequency Devices.
- D. Illuminating Engineering Society of North America (IESNA) LM-79-, LM-80-15, and TM-21.
- E. National Electrical Manufacturers Association (NEMA) SSL-1-2010 Electronic Drivers for LED Devices, Arrays, or Systems.

181129

- F. SSL-3-2010 Solid State Lighting High Power LED Binning for General Illumination.
- G. SSL-4-2012 Solid State Lighting Retrofit Lamps.
- H. National Fire Protection Association (NFPA) NEC-70-2011
- I. Underwriters Laboratories (UL) 8750-Light Emitting Diode (LED) Equipment for Use in Lighting Products.
- J. Underwriters Laboratories (UL) 1598C- Light Emitting Diode (LED) Retrofit Luminaire Conversion Kits.

1.03 SUBMITTALS

- A. List of Materials: Submit a complete list of proposed materials.
- B. Shop Drawings: Provide detailed and dimensioned Shop Drawings indicating kind, weight and thickness of materials, method of fitting and fastening parts together, location and number of sockets, size of lamps, and complete details of method of fitting suspension and fastening luminaires in place. Provide wiring diagrams for lighting control equipment. Drawings shall contain sufficient information to assemble and install equipment at the Project site without further instructions.
- C. Prior to start of construction; provide photometric calculations with graphic of lighting foot-candle levels at work plane, ceiling and walls. Calculations shall comply with IESNA recommendations.
- D. Installation Instructions: Submit manufacturer's written installation instructions for luminaires and accessories.

1.04 SUBSTITUTIONS

- A. Luminaires that deviate from these requirements shall not be accepted without written approval from OWNER'S Design Standards Section and Maintenance and Operations Technical Unit. When deviating or substituting luminaires, the following information shall be submitted:
 - 1. Substitution request form substantiating reasons and benefits to OWNER.
 - 2. OWNER'S approval shall be obtained for any equipment or materials substitutions.
 - 3. Submit a completed OWNER's LED luminaires evaluation form with supporting documentation for any and all fixtures' performance claims. The form can be found at the following electronic address:
http://www.laschools.org/documents/file?file_id=310976408

181129

- B. Substitutions: Submittals must comply with contract general provisions.

1.05 QUALITY ASSURANCE

- A. Design of lighting luminaires, accessories, supports, and method of luminaire installation shall comply with requirements for earthquake-resistant construction of the State of California.
- B. Provide suspension points at no more than two feet from luminaire ends. Spacing between supports shall not exceed eight feet.
- C. Components and luminaires shall be listed and approved for the intended application by Underwriter's Laboratories (UL), or other Nationally Recognized Testing Laboratory (NRTL), and in compliance with applicable industry standards and codes, including those mentioned under article 1.02 – References.

1.06 WARRANTY

- A. Provide the following warranties:
 - 1. One year labor warranty.
 - 2. Material warranty:
 - a. LED modules: five years minimum.
 - b. Drivers: five years minimum.
 - c. Lighting Pole (Standards): five year minimum.
- B. Warranty period shall begin at substantial completion or at project acceptance for beneficial occupancy, whichever occurs first.
- C. CONTRACTOR shall warranty Luminaires, including drivers, LED modules and ancillary components via a single warranty source. Multiple warranty sources is not acceptable.

PART 2 - PRODUCTS

2.01 MATERIAL AND FABRICATION

- A. Luminaires of same type shall be of one manufacturer.
- B. Manufacturer and model number references are indicated as a standard of performance and quality; other manufacturers' models may be submitted for review, provided the product meets or exceeds the product's specified requirements and substantially complies with OWNER'S LED Luminaires Evaluation Requirements Form.

- C. Conductors that pass over edges or through metal opening(s) shall be secured from contacting the edges, and be protected from cutting and abrasion. This requirement shall be met through one of the following:
1. Rolling the edge of the metal not less than 120 degrees.
 2. A bushing or grommet of a material other than rubber at least 1.2 mm (0.047") thick.
 3. Glass sleeving at least 0.025 mm (0.010") thick.
- D. Lighting luminaires shall meet the following requirements:
1. Industry standards as indicated under Article 1.02.
 2. Luminaire shall be from a manufacturer who has been in the business of manufacturing LED lighting luminaires for interior and exterior applications for a minimum of 5 years.
 3. Luminaires shall comply with the California Health and Safety Code requirements for products containing substances identified in the California Lighting Efficiency and Toxics Reduction Act, or be in compliance with the European Restriction of Hazardous Substances (RoHS), whichever is more stringent.
 4. Luminaires shall be baked-on enamel or powder-coated, unless otherwise specified in this section.
 5. The luminaire(s) lens, including end caps shall be 0.187 nominal thickness.
 6. Drivers shall be easily accessible without the use of special tools.
 7. Wiring cavity shall be field accessible for service or repairs.
 8. Luminaires shall be capable of being operated by standard motion/ vacancy sensors, daylight sensors, and dimmers.
 9. Luminaires shall be provided with a manufacturer's stencil or permanent legible sticker that states manufacturer business information and date of delivery.
 10. Temperature rating; -20 degrees Celsius minimum starting temperature. Luminaire accessories including LEDs and drivers shall be able to withstand temperatures in excess of 110 Fahrenheit degrees.
 11. Color Rendering Index (CRI):
 - 1) Interior Applications: +82 CRI.

- 2) Exterior Applications: +70 CRI
12. Power factor: Greater than 0.9 at 120V and 277V.
13. Total Harmonic Distortion: Less than 20% at 120V and 277V.
14. Color Correlated Temperature: 4000K minimum \pm 275K degrees.
15. LEDs and drivers life expectancy: 50,000 minimum projected hours at 6,000 hours testing for both LEDs and drivers.
16. Luminaires in contact with insulation materials shall be IC rated.

2.02 DRIVERS and LED MODULES

A. Drivers:

1. Approved Drivers Manufacturers:
 - a. Osram – Optotronic.
 - b. Philips – Advance and Xitanium.
 - c. Universal Lighting Technologies – Everline.
 - d. General Electric – Ligttech.
 - e. Thomas Research Products
 - f. Kenall – Low Profile LED Driver
 - g. EldoLED
 - h. Equal. Only if approved by OWNER’s M&O Technical Services and Design Standards units through a deviation request.
2. Driver Type and Characteristics:
 - a. Comply with the state of California Health and Safety Code requirements for products containing substances identified in the California Lighting Efficiency and Toxics Reduction Act, or be RoHS compliant, whichever is more stringent.
 - b. Dimming for 0-10 volt DC control circuits. Drivers shall be specifically compatible with the lighting control system being provided.
 - c. Comply with applicable state, federal, and industry standards listed under References article.

SOLID STATE (LED) LIGHTING

- d. Wattage as stated in Luminaire’s LM-79 test report.
- e. Driver performance requirements:

DRIVERS PERFORMANCE CHARACTERISTICS		
No.	Characteristic	Minimum Requirements
1	Input Voltage range	120V, 277V
2	Input Overvoltage	320 VAC for 48 hours, 350 VAC for 2 hours.
3	Frequency	50/60 Hz Nominal
4	Power factor	+0.95 Minimum
5	Inrush Current	Less than 30 amps @ 120V Less than 70A @ 277V
6	Input Current Range	54A @ 120V, 23A @ 277V
7	Output Current	1670 mA Maximum
8	Maximum Power	65 Watts
9	Total Harmonic Distortion	Less than 20%
10	Leakage Current	Less than 500 mA
11	Output Protection	Short and Open Circuit Protection
12	Maximum Case Temperature	90 ⁰ C
13	Minimum Starting Temperature	-20 ⁰ C
14	Storage Temperature	No less than 70 ⁰ C
15	Humidity	Rated for dry and damp locations
16	Cooling	Convection
17	Sound Rating	Class A
18	Life Expectancy	>50,000 hours at +50 ⁰ C
19	Dimming, Motion Sensors and Daylight Sensors Controllability	0-10V

B. LEDs:

- 1. Approved Manufacturers:
 - a. General Electric.

SOLID STATE (LED) LIGHTING

- b. Philips.
- c. NICHIA
- d. Samsung LED Co.
- e. CREE
- f. Equal. With OWNER's approval.

2. LEDs Characteristics:

- a. Color Correlated Temperature (CCT):
 - 1) Chromaticity target Duv and tolerance 0.001 plus/minus 0.006.
 - 2) Nominal CCT for 4000K, target CCT 3985K \pm 275K.
 - 3) CCT measurements in compliance with ANSI C78.377-2008.
- b. Lumen Maintenance: Greater than 90% at 50⁰ C degrees.
- c. LEDs must be from same manufacturer and batch.
- d. TM-21 and LM-80 reported hours of no less than 50,000 with a minimum of 6000 hours testing.
- e. LM-79 reported CCT and CRI in compliance with articles 2.01.D.11 and 14.

2.03 LUMINAIRES

A. Refer to appendix A for list of approved luminaires.

B. Luminaires types and minimum requirements:

1. Type A, Ceiling Surface-Mounted with wraparound diffusers:

- a. Lens shall be extruded of clear acrylic plastic, 12 pattern prismatic with minimum 25 DR meeting the ASTM specifications for methacrylate molding compounds D-788-69A. The overall length of the lens, including end caps shall be 0.187 nominal thickness.
- b. Furnish luminaires with number of LED strips as indicated on drawings.
- c. Spring-loaded barrel latches shall consist of sliding steel pins or rods operating through spring-loaded steel cylinders tack-welded or pop-riveted to luminaire body. Pins shall be fabricated of solid steel with
SOLID STATE (LED) LIGHTING

round cross-sectional areas of sufficient size to prevent bending when operating latches. Latches shall engage when pins are fitted into corresponding catches on diffusers. Latches shall disengage by applying finger pressure to a portion of the pin, turned up at 90 degrees, at operating end. Alternative latches mechanisms are discouraged.

- d. Luminaire channels shall be formed as single pieces of 20 gage metal without joints or splices and shall be assembled by means of spot-welding. Metal surfaces of luminaires shall be powder-coat painted after fabrication. Provide two 8-32 screw knockouts for alignment on each end plate.
- e. Approved luminaires: Hubbell-Columbia LAW4-40ML-EDU, LA Lighting WBE200-4K-4L-DRP-3-1DRDM-UNV-2/840, or OWNER approved equal.

2. Type AB, Linear Suspended Direct/Indirect:

- a. Luminaire shall be minimum 20 gage CRS with die-cast end cap mechanically attached with no exposed fasteners.
- b. Housing shall come in three styles perforated, pierced or solid with a clear acrylic dust cover.
- c. Cable suspension canopy shall be a minimum of 3 ½-inch diameter with 1/16 inches diameter stainless steel aircraft cable adjustable up to 36 inches.
- d. Reflector shall be semi-specular aluminum.
- e. Furnish luminaires with LED strips as indicated on drawings.
- f. Approved luminaires: Hubbell-Alera Lighting LCV-440-HL-PERF-CM-48-EDU; Hubbell-Alera Lighting LP7-OA-4/8-40-HL-40-CM-48-EDU; Peerless 7CRM3L-HI-EZB-LP840, Corelite J3-WM-3L-40-1D-UNV-AC48-XX-4'-E34-L34, or OWNER approved equal.

3. Type AC, Linear Suspended Direct/Indirect:

- a. Luminaire shall be minimum 20 gage steel, cast aluminum end caps. No exposed fasteners or hardware.
- b. Cable suspension shall be minimum 3 ½-inch diameter canopy with 1/16 inch diameter stainless steel aircraft cable adjustable up to 36, inches unless otherwise specified.
- c. Housing shall be supplied with a clear acrylic dust cover.

- d. Reflector shall be highly reflective aluminum.
 - e. Furnish luminaires with LED strips as indicated on drawings.
 - f. Approved luminaires: Hubbell-Alera Lighting LP7-OA-4/8-40-HL-40-CM-48-EDU; Lidalite Boldplay, or OWNER approved equal.
4. Type AD, Ceiling Recessed Troffer Luminaires:
- a. Luminaire shall be 20 gage cold rolled steel housing with no exposed fasteners or hardware.
 - b. Approximately 4 ½-inch maximum depth housing with full length die-formed stiffeners, and contoured ballast wireway cover.
 - c. Positive cam action steel latches and safety lock T-hinges to allow hinging and latching on either side.
 - d. Baked white enamel finish.
 - e. Trim shall be painted to match ceiling color.
 - f. Reflector reflectance shall equal or exceed 89 percent.
 - g. Flat non-glare acrylic panel.
 - h. Minimum lens thickness 0.187 inch.
 - i. Furnish luminaires with LED strips as indicated on drawings. Mounting shall be compatible with standard or slot T-grid systems.
 - j. Furnish mounting frames on recessed luminaires in plaster and tile surfaces.
 - k. Approved luminaires: Hubbell-Columbia Lighting RLA24-40-HL-G-EDU, HE Williams HET Series, HE Williams VCL Series, HE Williams LPT Series, HE Williams 50GS, HE Williams DI Series, Daybrite Dualed 2DLG49-840-4D-UND-DIM, or OWNER approved equal.
5. Type ADR, Ceiling Recessed Troffer-Retrofit Luminaires:
- a. Retrofit kits shall comply with all requirements sets forth in parts 2.01 and 2.02
 - b. Provide proof of even distribution on lighting with max/min foot-candle ratios of 2.5.

- c. Approved luminaires: LED Living technology G2CLA-30-6-D-40-1K-24, Orion MKLDRTLX42551com-40, or OWNER approved equal.
6. Type AH Linear Suspended 100 percent Direct:
 - a. Luminaire shall be minimum 20 gage steel housing with steel ends.
 - b. Luminaire shall have a top reflector for 100 percent down light.
 - c. Lens shall be high impact vandal resistant acrylic hinging from either side of housing.
 - d. Approved luminaires: Hubbell Alera Lighting LP7-OA-4/8-40-HL-CM-48-EDU-UB, Lidalite Boldplay, or OWNER approved equal.
7. Type AR, Recessed Linear Wall Washer:
 - a. Luminaire shall be minimum 20 gage steel with integral adjustable hanger clamps.
 - b. High performance luminaire with low iridescent specular aluminum reflector.
 - c. One piece body with integral hangers.
 - d. Approved luminaires: Prudential Lighting P43-LED4-HO4-UNV-DM01, or OWNER approved equal.
8. Type AW, Linear Suspended or Wall Mounted Wall Washer:
 - a. Luminaire shall be 20 gage die formed steel.
 - b. Reflector shall be die-formed white and/or semi specular.
 - c. Luminaire shall be an asymmetric distribution.
 - d. Luminaire shall come with the option for prismatic lens or louver.
 - e. Luminaire shall have an option to be wall mounted or suspended.
 - f. Approved luminaires: Prudential Lighting P43-LED4-HO4-UNV-DM01, or OWNER approved equal.
9. Type B, Ceiling Surface-mounted or Recessed Troffer Luminaires:
 - a. 22 gage extruded aluminum doorframes, white baked enamel finish. Spring loaded and half recessed with flush latches and T-handle hinge,

accessible from bottom to drivers and wiring. Clear prismatic 100 percent pure virgin acrylic Pattern 12.

- b. Recessed Troffer Housing minimum depth shall be 4 ½-inch to eliminate lamp images in lens.
- c. Minimum lens thickness 0.187 inch.
- d. Furnish mounting frames on recessed luminaires in plaster and tile surfaces.
- e. Manufacturers and catalog numbers: Modify catalog numbers for mounting in gypsum drywall ceilings, as required.
- f. Approved luminaires: HE Williams DIS Series, HE Williams HES Series, Hubbell-Columbia Lighting LCAT24-40-HL-EDU, Hubbell-Columbia Lighting LIT24-40-ML-G-FS-187-EDU-G2, Hubbell-Columbia LJT24-40-ML-G-FS-187-EDU-G2, or OWNER approved equal.

10. Type BB, Recessed Indirect Luminaire:

- a. Housing shall be made of die-formed 20 gage steel with a minimum depth of 5 ½-inch.
- b. Lamp shield shall be made of 22 gage perforated mesh with white acrylic overlay.
- c. Approved luminaires: Hubbell-Columbia Lighting LTRE24-40-ML-RFA-EDU, Lithonia 2VTL4-48L-ADP-EZ1-LP840, or OWNER approved equal.
- d. Luminaire shall provide the option to be hinged from either side.

11. Type C, Wall-Mounted Luminaires:

- a. Fully enclosed, with high impact white acrylic diffuser.
- b. Die-formed, prime quality 20 gage steel body, 48 inches long.
- c. Approved luminaires: Prudential Lighting SNAP-X1LED4-WA-UNV, Luminaire LED TSL9-40K-2B-VOLT-CP, Luminaire LED Stair Lighter TSL-9 Series, Lithonia WL4-40L-EZ1-LP840, Hubbell-Columbia Lighting LBIL-4-40-ML-EDU, or OWNER approved equal.

12. Type D, Surface-Mounted Industrial Luminaires:

- a. Approximately 48-inch or 96-inch long by 16-inch wide by 7 ½-inch deep.
 - b. Provide couplings, clips and end caps for continuous row installation.
 - c. Furnish luminaires with screw-on wire guards. Design guards to accommodate luminaire, provided by same manufacturer as luminaire.
 - d. Exposed LED strips are not allowed.
 - e. Housing shall be made of die formed 20 gage cold rolled steel.
 - f. Approved luminaires: Philips Daybrite LF4FR3140UDTZ-FH360, Hubbell Columbia Lighting LCR-4-40-HL-EDU, Lithonia MSL-40LM-MVOLT-EXT1-40K-80CRI, or OWNER approved equal.
13. Type DD, Recessed two-foot by four-foot Static Troffer Luminaires with Parabolic Louvers:
- a. Approximately 5 ½-inch maximum depth housing fabricated of 22 gage, prime cold-rolled steel, with full length die-formed stiffeners. Contoured driver wireway cover.
 - b. Provide positive cam action steel latches and safety lock T-hinges to allow hinging and latching on either side.
 - c. Baked white enamel finish. Trim shall be painted white to match ceiling color.
 - d. Louvers shall be three inches deep, die-formed of semi-specular anodized aluminum with anodic oxide coating. Parabolic cells shall be fastened with interlocking feature. Provide 12-cell louvers for two-lamp luminaires and 18-cell louvers for three-lamp luminaires.
 - e. Voltage shall be as indicated on Drawings.
 - f. Approved luminaires: Hubbell Columbia Lighting LCAT24-40-HL-EDU, or OWNER approved equal.
 - g.
 - g. Furnish luminaires with LED strips as indicated on drawings. Luminaire shall have the option to have narrow or wider housing channels depending on the application.
 - h. Approved luminaires: Hubbell Columbia Lighting LCL-40-ML-ED-U, Lithonia ZL1N-L48-5000LM-FST-MVOLT-40K-80CRI, or OWNER approved equal.

14.

14. Type E, Enclosed and Vandal Resistant Luminaires:

- a. Luminaire shall be 20 gage extruded aluminum with die cast end caps.
- b. Luminaire shall have opal polycarbonate lens.
- c. Furnish luminaires with LED strips as indicated on drawings. Luminaire shall have tamper resistant hardware.
- d. Luminaire shall have the ability to be in continuous rows with seamless appearance.
- e. Luminaire shall be listed for wet location.
- f. Approved luminaires: Luminaire LED Vision 8-VPF84-4000K, Lithonia VAP-6000LM-FSTMD-MVOLT-GZ10-40K-80CRI, A Light Elements D34LH40US, or OWNER approved equal.

15. Type E1 – Enclosed, Gasketed Luminaire:

- a. Luminaire shall be 20 gage steel.
- b. Lens enclosure shall be heavy duty vapor tight enclosed gasketed with closed-cell foam gasketing permanently attached to luminaire housing.
- c. Luminaire shall have tamperproof latches.
- d. Luminaire shall be furnished with minimum one watertight hub kit for top or end conduit entry.
- e. Luminaire shall have option for cable mount and safety strap
- f. Wet Location listed.
- g. Approved luminaires: Hubbell Columbia Lighting LXEP-4-40-HL-DFA-ED-U, Luminaire LED Vision 8-VPF84-4000K, Lithonia PGX-LED-P2-40K-T5M-MVOLT, or OWNER approved equal.

16. Type E2: Surface, Wall or Recess Mounted fixtures

- a. Luminaire shall be 20 gage extruded aluminum with die cast end caps.
- b. Opal polycarbonate lens.

- c. Furnish luminaires with LED strips as indicated on drawings.
- d. Luminaire mounting as indicated on drawings.
- e. Luminaire shall be listed for damp and wet location.
- f. Approved luminaires: Luminaire LED Vision 8-VPF84-4000K, Luminaire LED Vision 4-VPF4-4000K, Hubbell-Columbia Lighting CLO 24NB-XX-4K-X-UNC-X, Hubbell-Columbia Lighting LXEP-4-40-HL-DFA-ED-U, Lightolier C6L-DL-VB, or OWNER approved equal.

17. Type F1, Down Lights:

- a. 4 to 6 inch round LED downlight.
- b. Color trim as specified in construction drawings.
- c. Trim attachment to frame-in kit via push-in connector on frame.
- d. Removable cover for access.
- e. Complete luminaire including all peripheral devices including frame-in kit, light engine, trim kit, etc. shall be provided.
- f. Approved luminaires: Philips Calculite C4LDL40K, Lightolier Calculite C6LDL40K, or OWNER approved equal.

18. Type HA, High Abuse Surface Luminaires:

- a. Lens shall be extruded polycarbonate, clear prismatic refractor, nominal thickness 0.125 inch, UV stabilized.
- b. Base-plate shall be 18 gage prime cold-rolled steel with corrosion-resistant, 92 percent reflective, white polymer finish.
- c. End caps shall be 16 gage prime cold roll steel with corrosion-resistant, white polymer finish and shall be spot welded to the base-plate.
- d. Lens/housing shall be furnished with a minimum of two large or four small stainless steel fasteners to secure lens/housing to base plate.
- e. Listed for wet and damp locations.
- f. Approved luminaires: Kenall SH8-48-67L40K-DCC-DV, Kurtzon WL Series, Luminaire LED LVP, or OWNER approved equal.

19. Type HB, Wall Mounted Vaportite Luminaire:

SOLID STATE (LED) LIGHTING

- a. Luminaire housing shall be die cast aluminum with corrosion resistant polyester powder coated finish.
- b. Luminaire shall be heat and shock resistant, with prismatic glass optical chamber with neoprene gasketing.
- c. Luminaire shall be 15 or 20 watt LED; LEDs and drivers as indicated on drawings.
- d. Luminaire shall be equipped with lens guard.
- e. Approved luminaires: Rig-a-lite AVP, Hubbell VWGL, or OWNER approved equal.

20. Type J1, Ceiling-Mounted Luminaires:

- a. Separate ceiling and reflector pans with foil-backed fiberglass between pans and 1/8 inch thick neoprene gasketing between ceiling pan and ceiling.
- b. White polyester finished 18 gage cold-rolled steel back-plate with clear prismatic injection molded polycarbonate lens, UV stabilized heavy gage aluminum back-plate and four tamper-proof screws.
- c. Provide luminaire wattage as indicated on drawings.
- d. Luminaire shall be listed for damp locations.
- e. Approved luminaires: Luminaire LED FFW1212-X-4000K, Kenall S1414L series, or OWNER approved equal.

21. Type J2, Ceiling Mounted Luminaires:

- a. Luminaire shall be die-cast aluminum.
- b. Luminaire shall have reinforced four-point mounting system construction to resist breakage from impact and prying.
- c. Luminaire finish shall be as indicated on drawings.
- d. Lens shall be Injection molded UV stabilized, high impact resistant opal polycarbonate.
- e. Luminaire shall have option trim ring to fit between housing and inside lip of trim ring for a smooth transitional look.
- f. Provide luminaire with input watts as indicated on drawings.

- g. Ceiling luminaires shall be supplied without eye lid option, wall mounted luminaires shall be supplied with eye lid option.
 - h. Approved luminaires: LA Lighting BCL100 Series, Luminaire LED ARV1325-4000K-OP, Kenall MR13FD-PP-MW-50L-40K, or OWNER approved equal.
22. Type K1, Recessed Interior/Exterior Vandal Resistant Luminaires (Square):
- a. Housing/door shall be fabricated from 16 gage cold-rolled steel, and polyester powder coated after fabrication.
 - b. Fully gasketed for exterior installation.
 - c. 0.187 inch clear polycarbonate UV stabilized safety lens.
 - d. Provide luminaire wattage as indicated on drawings.
 - e. Approved luminaires: Hubbell Beacon Lighting CLO-24NB-4K-UNV, or OWNER approved equal.
23. Type K2 – Recessed Interior/ Exterior Vandal Resistant Downlight Luminaire :
- a. Luminaire shall have a die cast aluminum mounting frame suitable for dry or wet plaster ceilings of a minimum thickness of 1 1/8 inches.
 - b. Luminaire shall be UL listed for damp locations.
 - c. Lens shall be vandal resistant acrylic with flat or drop diffuser. (Refer to luminaire schedule in drawings for type of diffuser).
 - d. Die formed aluminum reflector.
 - e. Luminaire shall be provided with input wattage as indicated on drawings.
 - f. Approve luminaires: Kenall HADL6FF, Prescolite LC6LED8X-6LCLED940K8WX, or OWNER approved equal.
24. Type L1, Outdoor Wall-Mounted Luminaires (Vandal Resistant):
- a. Seamless, one-piece, injection molded polycarbonate lens/housing, 0.187 inch, UV stabilized polycarbonate lens. The wraparound lens design encloses and protects the interior of unit.
 - b. Die cast aluminum mounting plate.
 - c. One-piece, full size, closed cell neoprene rubber gasket.

- d. One stainless steel tamper-proof screw.
- e. Luminaire shall be UL listed for wet locations.
- f. Luminaires shall be provided with input watts as indicated on drawings.
- g. Approved luminaires: Hubbell LNC2 Series, Kenall MR13FD-PP-MW-50L-40K, or OWNER approved equal.

25. Type M – Wall Mounted Full Cutoff Exterior Wall.

Luminaire shall be mounted at no less than nine feet above finished grade, or as indicated in drawings.

- a. Housing shall be made of 20 gage die cast aluminum, and be equipped with hinged doors.
- b. Luminaire shall have Stainless steel tamperproof hardware.
- c. Luminaire shall be provided with input watts as indicated on drawings. Luminaire Optics shall be full 90 degree horizontal cutoff on all distributions. Reflector shall be specular aluminum. Luminaire shall have tempered glass lens with optional wire guard.
- d. Approved luminaires: Philips Gardco 121-4-35-LA-350-NW-R-XPG, Lithonia WST LED-2-10A-700/40K-MVOLT, or OWNER approved equal.

26. Type P – Recessed Low Level Light:

- a. Housing shall be die cast aluminum with captive stainless steel hardware.
- b. Luminaire shall be gasketed with a single piece of molded silicone.
- c. Lens shall be Louver and completely sealed to prevent water, dust and insect infiltration.
- d. Luminaire shall be equipped with drivers and LED strips wattage as indicated in drawings.
- e. Approved luminaires: Vista Professional Outdoor Lighting 1505, or OWNER approved equal.

27. Type Q, Explosion-Proof Luminaires:

- a. Designed for Class I, group CD location, ceiling-mounted.

- b. Holophane HRL-8L-AS-GG-CE, or OWNER approved equal.
- 28.
28. Type S, Step Lighting:
- a. Recessed aisle die cast aluminum lights 1/8 inch minimum wall thickness. Luminaire shall be provided with tamper-proof screws.
 - b. Silicon gasket to exclude moisture, insects and contaminants.
 - c. Ribbed guard face plate design as specified in construction drawings.
 - d. Manufacturer: Approved manufacturers: Philips Gardco 943L, or OWNER approved equal.
29. Type N1, Wall-Mounted Luminaires (Vandal Resistant):
- a. One-piece prismatic refractor held by cast metal door, hinged to die-cast anodized aluminum weatherproof housing with visor to limit light pollution.
 - b. Die-cast aluminum housing of 1/8 inch minimum wall thickness. Luminaire shall be provided with tamper-proof screws.
 - c. High impact resistant, UV stabilized injection molded polycarbonate lens.
 - d. High power LEDs.
 - e. Approved manufacturers: Philip Gardco 161-X-220W-NW-R-UNIV, Hubbell PVL3-180L-4K-U-X-X, Kenall MR13FD-PP-MW-50L-40K, or OWNER approved equal.
30. Type N2 – Wall Mounted Full Cutoff – Luminaires:
- a. Luminaire shall be injection molded, impact resistant polycarbonate lens, with optional wire guard.
 - a. Luminaire shall have Tamperproof hardware.
 - b. Reflector shall be hydro-formed anodized aluminum.
 - c. Lens shall be injection molded UV stabilized high impact acrylic.
 - d. Drivers and LED strips as indicated on drawings.
 - e. Housing shall be 20 gage die cast aluminum with hinged doors.

- f. Luminaire Optics shall be full 90 degree horizontal cutoff on all distributions.
- g. Approved Luminaires: Philip Gardco 161 or OWNER approved equal.

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EXIT ILLUMINATION

A. Lighting Luminaire Type G-1:

- 1. Ceiling or wall-mounted, vandal-resistant type, LED EXIT, consisting of:
 - a. LED board, green exit lettering and directional arrows as indicated on drawings.
 - b. Face plate and polycarbonate shield.
 - c. Number of faces, voltage, and emergency power source shall conform to design requirements indicated on drawings.
 - d. Area of refuge listing is required when luminaires are used in such locations.
 - e. Utilize a flag mount luminary with additional support from the ceiling or wall for canopy or pendant mounted exit signs. This option shall be exercised only if a wall is not available.
 - f. Approved Products: Evenlite CCDS Series, Lithonia LEP-1-G, Lithonia LV EL N Series, Lightolier LWL Series, Cooper-Surelite CX Series, Dual Lite Freedom LED Series, Astralite TP Series, Kenall MET Series, or OWNER approved equal.

B. Light Luminaire Type G-2:

- 1. Low Level Exit Signs:
 - a. Approved products: Evenlite DCG Series, Lightolier LWL Series, Lithonia LV EL N, and LEP-1-G Series, Cooper-Surelite CX Series, Dual Lite Freedom LED Series, Astralite TP Series, Kenall MET Series or OWNER approved equal.
 - b. Luminaires shall be:
 - 1) L.E.D. boards, green lettering, or as indicated on drawings.
 - 2) Die cast aluminum body and face plate with white finish.
 - 3) Polycarbonate shields.
 - 4) Area of refuge listing is required when luminaires are used in such locations.
 - c. Emergency battery pack operation shall be as indicated on Drawings.

SOLID STATE (LED) LIGHTING

2.05 LIGHT POLES (STANDARDS)

- A. Standards shall be 25 feet high, tapered galvanized steel.
 - a. Starting at the base, a minimum of 12 inches of the light standards interior and exterior surfaces shall be treated with water repellent or barrier coatings to prevent moisture contact with galvanized surface.
- B. Aluminum poles are not acceptable.
- C. Pole shaft shall conform to ASTM A595 Grade A and be 11 gage thickness, unless otherwise indicated on Drawings. Shaft shall be one piece construction with a full length longitudinal high frequency resistance weld.
- D. The anchor base shall be constructed from structural quality hot rolled carbon steel plate conforming to ASTM A36.
- E. Anchor bolts shall be fabricated from commercial quality hot rolled carbon steel bar with minimum yield strength of 55,000 PSI. Bolts shall have an L bend on one end and threaded on the opposite end. Anchor bolts shall be hot dipped galvanized with a minimum length of 12 inches on the threaded end. Four properly sized bolts furnished with two hex nuts, and flat washers, shall be provided for each pole. Contractor to obtain manufacturer required base bolt pattern prior to concrete installation.
- F. A two piece base cover shall completely seal the entire base plate and be securely fastened.
- G. Each pole shall have a three-inch by five-inch handle. A nut holder shall be provided near the hand-hole and shall include a ½ inch – 13 UNC HE by Head bolt and nut for grounding. The hand-hole shall be welded in the pole shaft and shall include a steel cover with attachment screws. The hand-hole shall be located 18 inches above the base of the pole.
- H. Finish of pole and accessories shall be electrostatically applied, and thermally cured polyester powder coat. Color shall be selected by Architect.
- I. All structural fasteners shall be galvanized high strength carbon steel.
- J. Poles shall be designed to withstand wind velocity of 80 MPH and 100 MPH gusts. Concrete base shall be a monolithic concrete pour when installed.
- K. Standards shall be installed plumb and straight on concrete footings. Grout and dry-pack after leveling. Concrete, grout and drypack requirements and procedures are as specified in Division 02.
 - a. Standards footings shall be provided with a moisture release channel to keep the interior of the standards dry and free from rain, dew or condensation. Refer

to District's Standards Footing Detail. Engage a California Registered structural engineer to design the base.

- L. Provide in line fuse assembly in hand-hole of each light standard with breakaway receptacle Bussmann HEY series, or OWNER approved equal. Fuse assembly shall easily disconnect power to light standard. Fuse type and rating shall be as required by each application.
- M. Provide all required fixture mounting accessories.
- N. Standards shall be as manufactured by Gardco, Alcastco, Lytepole, or OWNER approved equal.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install a lighting luminaire for each lighting outlet indicated and label with day of installation.
- B. Luminaire voltage shall be as indicated on Drawings.
- C. Install recessed and surface-mounted luminaires, with plaster frames compatible with ceiling and wall systems employed; secure luminaires mechanically to frames.
- D. Align rows of suspended and surface-mounted luminaires to form straight lines at uniform elevations.
- E. Recessed luminaires shall fit snugly against ceilings to prevent light leakage.
- F. Luminaire installations shall comply with CBC Seismic requirements
- G. Support suspended recessed luminaires in T-bar ceilings as follows: Luminaires shall be attached to ceiling grid to resist a horizontal force equal to weight of luminaires. For heavy-duty grid systems, luminaires weighing less than 56 pounds must also have two 12 gage slack safety wires from diagonal corners to the structure above; luminaires weighing more than 56 pounds shall be independently supported by not less than four taut 12 gage wires capable of supporting four times the load. For intermediate duty grid systems, luminaires shall be independently supported by not less than four taut 12 gage wires capable of supporting four times the load. Luminaire hanger wire ends shall be twisted three tight turns within a 1 ½ -inch distance. Provide positive point of attachment to T-bar ceiling with four, #8 wafer head tek screws (one at each corner), avoiding conflict with operation of the lens. Luminaire installation shall be coordinated with acoustical ceiling installation.
- H. Emergency light luminaires shall be labeled "Emergency Luminaire" with one inch high letters produced with a P-touch or similar labeling system.

- I. Continuous suspended luminaires:
 - 1. Luminaire suspension device shall allow vertical adjustment of luminaire without the use of tools. Cable shall be minimum seven strand twisted stainless steel capable of supporting minimum four times the luminaire weight. For continuous linear suspended luminaires longer than eight feet, provide not less than three suspension points.
 - 2. Top of luminaire shall be suspended as shown on the Drawings, typically 24 inches below the ceiling and a minimum of 18 inches from the ceiling.
 - 3. Luminaire shall utilize factory furnished or approved hardware and canopy for either hard or T-bar ceilings.
 - 4. White Board Lights shall be suspended 24 inches from the wall unless specifically shown otherwise.
- J. Surface mount luminaires shall be attached to structure. Toggle bolts are NOT permitted. Provide backing where required.
- K. Low level exit signs shall be installed with the bottom of the sign not less than six inches, or more than eight inches above the floor level and shall indicate the path of exit travel. For exit and exit-access doors, the sign shall be on the door or adjacent to the door with the closest edge of the sign within four inches of the door frame.

3.02 TESTING

- A. Check and adjust luminaires for required illumination.
- B. Replace defective LED strips and drivers.
- C. Test and adjust lighting control equipment for proper operation.

3.03 SPARE PARTS

- A. Furnish ten percent spare LED strips with a minimum of one spare strip of each type.
- B. Furnish ten percent spare motion detectors of each type with a minimum of one spare detector of each type.
- C. Furnish ten percent spare drivers of each type with a minimum one spare driver of each type.

3.04 HAZARDOUS WASTE DISPOSAL

- A. Hazardous waste disposals shall be handled and disposed of by an approved, licensed contractor.

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- B. Products with PCBs are not acceptable. Hazardous waste shall be placed in appropriate containers provided by hazardous waste contractor labeled clearly with:
 - 1. Project Name
 - 2. Quantity of materials
 - 3. Date materials became waste
- C. Store, remove, transport and dispose of hazardous materials in accordance with state and federal regulations.
- D. Provide Owner with copy of manifest and certificate of destruction.

3.05 PROTECTION

- A. Protect the Work of this section until Substantial Completion.

3.06 CLEANUP

- A. Remove rubbish, debris, and waste materials from all areas of work each day.
- B. Clean luminaire surfaces of dirt, cement, plaster and debris. Furnish cleansers compatible with material surfaces being cleaned.

END OF SECTION

SECTION 26 5617
PARKING LOT LED LIGHTING

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes: Lighting fixtures, including LED lamps arrangements, drivers, wiring, and lighting controls.
- B. Related Requirements:
 - 1. Division 01 - General Requirements.
 - 2. Section 26 0500: Common Work Results for Electrical.
 - 3. Section 26 0513: Basic Electrical Materials and Methods.
 - 4. Section 26 0526: Grounding and Bonding.
 - 5. Section 26 0519: Low-Voltage Wires.
 - 6. Section 26 0533: Raceways, Boxes, Fittings and Supports.
 - 7. Section 26 0923: Lighting Controls Systems.
 - 8. Section 26 2416: Panel boards and Signal Terminal Cabinets.
 - 9. Section 26 5000: Lighting.
 - 10. Section 26 5200: Emergency Power Systems.
 - 11. Section 31 2323: Excavating and Fill for Utilities
 - 12. Section 32 1313: Site Concrete Work.

1.02 REFERENCES

- A. Publications are referenced within the text by their basic designation only. The most current version shall apply.
- B. American National Standards Institute (ANSI):
 - 1. ANSI C82.SSL1 – SSL Drivers.
 - 2. ANSI C136.2 - American National Standard for Roadway and Area Lighting Equipment – Luminaire Voltage Classification.
 - 3. ANSI C136.3 – American National Standard for Roadway and Area Lighting Equipment – Luminaire Attachments.
 - 4. ANSI C136.10 – American National Standard for Roadway Lighting Equipment – Locking-Type Photocontrol Devices and Mating Receptacle Physical and Electrical Interchangeability and Testing.
 - 5. ANSI C136.15 – American National Standard for Roadway and Area Lighting Equipment – Luminaire Field Identification.
 - 6. ANSI C136.25 – American National Standard for Roadway and Area Lighting Equipment – Ingress Protection (Resistance to Dust, Solid Objects and Moisture) for Luminaire Enclosures.
 - 7. ANSI C136.31 – American National Standard for Roadway Lighting Equipment – Luminaire Vibration.
- C. American Society for Testing and Materials International (ASTM):
 - 1. ASTM A36 – Standard Specification for Carbon Structural Steel.

2. ASTM A595 - Standard Specification for Steel Tubes, Low-Carbon or High-Strength Low-Alloy, Tapered for Structural Use.
 3. ASTM D1654 – Standard Test Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments.
 4. ASTM G35 – Standard Practice for Determining the Susceptibility of Stainless Steels and Related Nickel-Chromium-Iron Alloys to Stress-Corrosion Cracking in Polythionic Acids.
- D. Federal Trade Commission (FTC):
1. Green Guides, 16 CFR Part 260, Guides for the Use of Environmental Marketing Claims.
- E. Illuminating Engineering Society of North America (IESNA):
1. IESNA DG-13 – Guide for the Selection of Photo controls for Outdoor Lighting Applications.
 2. IESNA LM-64 – Photometric Measurements of Parking Areas.
 3. IESNA LM-79 – IESNA Approved Method for the Electrical and Photometric Measurements of Solid-State Lighting Products.
 4. IESNA LM-80 – IESNA Approved Method for Measuring Lumen Maintenance of LED Light Sources.
 5. IESNA TM-15 – Luminaire Classification System for Outdoor Luminaires
 6. IESNA TM-21 – Projecting Long Term Lumen Maintenance of LED Light Sources.
 7. IESNA RP-13 – Nomenclature and Definitions for Illuminating Engineering.
- F. National Electrical Manufacturers Association (NEMA):
1. ANSI/NEMA/ANSI C78.377 – American National Standard for the Chromaticity of Solid-State Lighting Products.
 2. NEMA WD 7 – NEMA Guide Publication: Occupancy Motion Sensors.
- G. California Building Code (CBC):
1. California Electrical Code (CEC).
- H. Next Generation Lighting Industry Alliance/Department of Energy:
1. LED Luminaire Lifetime: Recommendations for Testing and Reporting – 1st Edition.
- I. Underwriters Laboratories (UL):
1. UL – 1449 – Surge Protective Devices.

1.03

DEFINITIONS

- A. Lighting terminology used herein as defined in IESNA RP-16. See referenced documents for additional definitions.
- B. Exception: The term “driver” is used herein to broadly cover both drivers and power supplies, where applicable.
- C. Clarification: The term “LED light source(s)” is used herein in accordance with IES LM-80 to broadly cover LED package(s), module(s), and array(s).
- D. Support Assembly: Means a pole or other support structures, brackets, cross-arms, appurtenances, base, anchorage, and foundation.

1.04

SUBMITTALS

- A. List of Materials: Submit a complete list of materials proposed for this section.
- B. Shop Drawings: Provide detailed and dimensioned Shop Drawings indicating kind, weight and thickness of materials, method of fitting and fastening parts together, location and number of sockets, size of LED boards and drivers, and complete details of method of fitting suspension and fastening fixtures in place. Provide wiring diagrams for lighting control equipment. Drawings shall contain sufficient information to assemble and install equipment at the Project site without further instructions.

EDIT NOTE: Include paragraph C for projects to be designed by Contractor.

- C. Photometric calculations: Submit calculations with graphic of luminance levels of work and floor planes. Calculations shall comply with IESNA LM-64 recommendations.
- D. Performance Reports:
 - 1. Luminaire photometric reports per IESNA LM-79 including: laboratory name, report number, date, luminaire catalog number, luminaire and light source specifications. Report shall contain lumen values in Backlight, Uplight, and Glare (BUG) zones per IESNA TM-15 and roadway type classifications luminous intensity, zonal lumen summary, and iso-footcandle diagrams, as well as documentation that specified standards and tests methods were followed.
- E. Certifications:
 - 1. LM 79 report at T=0 and T=6000 hours with a summary table showing the percent lumen output change and percent input power change.
 - 2. Provide LM80 test results to demonstrate L70 life after 6000 hours of test.
 - 3. LM-80 test data for the LEDs at the three temperatures per LM-80. Provide extrapolation data using and exponential decay function to show the output at 50,000 hours. Provide the Ts value from the IESNA LM-79 and where the point fall in relation to the IESNA LM-80 extrapolated data. Interpolate between the LM 80 data for the Ts temperature.
 - 4. Provide safety certification and file number as required for the luminaire family that must be listed, labeled or identified per the California Electrical Code (CEC), Applicable testing bodies are determined by the US Occupational Safety Health administration (OSHA), and include ETL, UL, or another Nationally Recognized Testing Laboratory (NRTL).
 - 5. Report substantiating compliance with IESNA TM-21.
- F. Certified Statements:
 - 1. Submit manufacturer's certified statement indicating that the manufacturer has been in the business of fabricating lighting fixtures for outdoor and general area illumination for a minimum of 10 years.
 - 2. Establish compliance with the California Lighting Efficiency and Toxics Reduction Act requirements for the manufacturer to have in place a collection and recycling system of any end-of life general purpose light fixtures generated in the State of California.
 - 3. Submit manufacturer's certified statement indicating that the manufacturer has local service with offices no more than 50 miles from Owner's central offices.
 - 4. Certification of compliance that California Health and Safety Code requirements for products containing substances identified in the California Lighting Efficiency and Toxics Reduction Act shall not exceed the following allowed content in parts per million (ppm):

- a. Lead content > 0.1% or 1000 ppm.
 - b. Mercury Content > 0.1% or 1000 ppm.
 - c. Cadmium Content > 0.01% or 100 ppm.
 - d. Hexavalent Chromium > 0.1% or 1000 ppm.
 - e. Polybrominated Biphenyls > 0.1% or 1000 ppm.
 - f. Polybrominated Biphenyls Ether > 0.1% or 1000 ppm.
- G. Installation Instructions: Submit manufacturer's written installation instructions for fixtures and accessories.

1.05 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: 10 years in the fabrication of lighting fixtures.
- B. Listing and Labels: Light fixtures shall be Underwriters Laboratory (UL) or Nationally Recognized Testing Laboratory (NRTL) listed, and in compliance with applicable industry standards and codes. NRTL test laboratories shall be qualified by the DOE and listed in the DOE SSL website.
- C. Design of lighting fixtures, accessories, supports, and method of fixture installation shall comply with requirements for earthquake-resistant construction of the State of California.

1.06 WARRANTY

- A. Five years on-site replacement material, fixture finish and workmanship. On-site replacement includes transportation, removal, and installation of new products. Finish warranty shall include warranty against failure or substantial deterioration such as blistering, cracking, peeling, chalking or fading.
- B. Five years material replacement warranty for defective or non-starting LED source assemblies, drivers, and power supply units (PSU).
- C. LED source assemblies, drivers and power supplies that fail to maintain illuminance levels per Article 2.03.E shall be provided with an additional 10 years warranty.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

EDIT NOTE: Select paragraph 1 or 2 as applicable to project. Delete unused paragraph.

- A. Lighting Fixtures.
 - 1. The following fixtures are approved for installation in modernization projects:
 - a. General Electric – Evolve EAMM-EASM Series
 - b. Cree/Betalux – STR-LWY or ARE-EDG Series.
 - c. McGraw Edison/Cooper Lighting – Galleon Series.
 - d. Philips-Gardco – Pureform Series.
 - e. Equal with mast arm adapter will be acceptable.
 - 2. The following fixtures are approved for installation in new construction projects:
 - a. General Electric – Evolve EAMM-EASM Series
 - b. Cree/Betalux – STR-LWY or ARE-EDG Series.
 - c. McGraw Edison/Cooper Lighting Galleon Series.
 - d. Philips/Gardco Pureform Series.
 - e. XGB3 Series by LSI

f. Equal.

B. Light Standards

EDIT NOTE: Revise paragraph A below if different height standards are required for complete replacements or new construction projects.

In retrofit projects where existing poles will remain, specify round tubular arm bracket mounting fittings.

1. Standards shall be 25 feet high, tapered galvanized steel, unless otherwise indicated on Drawings.
2. Aluminum poles are not acceptable.
3. Pole shaft shall conform to ASTM A595 Grade A and be 11 gage thickness, unless otherwise indicated on Drawings. Shaft shall be one piece construction with a full length longitudinal high frequency resistance weld.
4. The anchor base shall be constructed from structural quality hot rolled carbon steel plate conforming to ASTM A36.
5. Anchor bolts shall be fabricated from commercial quality hot rolled carbon steel bar with minimum yield strength of 55,000 PSI. Bolts shall have an L bend on one end and threaded on the opposite end. Anchor bolts shall be hot dipped galvanized with a minimum length of 12 inches on the threaded end. Four properly sized bolts furnished with two hex nuts, and flat washers, shall be provided for each pole. Contractor to obtain manufacturer required base bolt pattern prior to concrete installation.
6. A two piece base cover shall completely seal the entire base plate and anchorage and it shall be securely fastened.
7. Each pole shall have a three-inch by five-inch handle. A nut holder shall be provided near the handhole and shall include a ½ inch – 13 UNC HE by Head bolt and nut for grounding. The handhole shall be welded in the pole shaft and shall include a steel cover with attachment screws. The handhole shall be located 18 inches above the base of the pole.
8. Finish of pole and accessories shall be galvanized. Color shall be selected by Architect.
9. All structural fasteners shall be galvanized high strength carbon steel.
10. Poles shall be designed to withstand wind velocity of 80 MPH and 100 MPH gusts. Concrete base shall be a monolithic concrete pour when installed.
11. Standards shall be installed plumb and straight on concrete footings. Grout and dry-pack after leveling. Concrete, grout and drypack requirements and procedures are as specified in Division 2.
12. Provide in line fuse assembly in hand hole of each light standard with breakaway receptacle Bussmann HEY series, or equal. Fuse assembly shall easily disconnect power to light standard. Fuse type and rating shall be as required by each application.
13. Provide all required fixture mounting accessories, including round tubular arm brackets supplied with pole.
14. Standards shall be as manufactured by Gardco, Alcastco, Lytepole, or equal.

2.02

EQUIPMENT

- A. Fixtures shall meet the minimum performance requirements of efficiency and quality specified on Article 2.03.

- B. Fixtures of same type shall be of one manufacturer and shall meet the following requirements:
1. Finish: Baked-on enamel or powder-coated.
 2. Luminaire Attachments in compliance to ANSI C136.3.
 3. Lens: Injection molded UV stabilized high impact acrylic in compliance to ANSI C136.31 requirements for luminaire vibration.
 4. Fixture Optics: Capable of full 90 degree horizontal cutoff on all distributions, and in compliance with the chromaticity of solid-state lighting products per ANSI/NEMA/ANDLG C78.377.
 5. Luminaire housing: Constructed of metal of sufficient thickness to meet or exceed the rated life of the luminaire LED's. Finish color as indicated in drawings. Powder-coated and rust resistant for the life of the luminaire in compliance with ASTM D1654 requirements.
 6. Driver shall be replaceable and mounted within luminaire housing.
 - a. Screws shall be stainless steel. Captive screws shall be provided for any components that require maintenance after installation.
 - b. Driver surge protection in compliance to UL 1449.
 - c. Approved drivers: Philips, General Electric, Cree, Osram, Nichia, or approved equal.
 7. No parts of the luminaire shall be constructed of polycarbonate, unless it is ultraviolet (UV) stabilized (lens discoloration shall be considered a failure under warranty).
 8. Luminaire shall be "Dark Sky" compliant.
 9. Luminaire shall have an option for individual LED's optical shield for house-side light control.
 - a. LEDs shall be Philips, Osram, Nichia, Illumitex, General Electric, Cree, or approved equal.
 10. Luminaire door shall remain securely and safely linked to luminaire body, through a hinge design, when in the door open "down" position during inspection or maintenance.
 11. Luminaire shall be capable of being operated by standard plug-in photoelectric cell, facing north, and shall not draw more than 1 watts of power in the off state. Photoelectric design shall comply with IESNA DG-13.
 - a. Shorting cap shall be provided with luminaire.
 12. Luminaire shall have the option for motion sensor controls and 0-10V step dimming. Motion sensors shall comply with the requirements of NEMA standard WD 7 and photocell controllability per ANSI C136.10.
 13. Luminaire shall include a heat dissipating sink with no fans, pumps, or liquids.
 - a. Luminaire shall be designed so that debris buildup or bird droppings do not degrade heat dissipation performance.
 - b. Luminaire shall meet the requirements of ANSI C136.25 and C136.31 for resistance to dust, solid objects and moisture.
 14. Luminaire shall weigh no more than 40 pounds. 80% of the luminaire material by weight shall be recyclable at the end of life.

- 15. Fixtures shall be UL or NRTL listed for wet locations.
 - 16. Fixtures shall be labeled in accordance with the Federal Trade Commission Green Guides, 16 CFR Part 260, Guide for the Use of Environmental Marketing Claims.
 - 17. Lighting fixtures shall be classified in accordance with IESNA TM-15.
- C. Luminaire shall have a manufacturer's stencil, or a permanent legible sticker, with the month and year of delivery.

2.03 PERFORMANCE REQUIREMENTS

- A. Luminaire must be subject to 100,000 cycles of 2 Gs at the resonant frequency of the luminaire (between 5 and 30 Hz) applied at the center of gravity per ANSI C136.31 without damage to the luminaire.
- B. Wiring cavity shall be field accessible for service or repairs.
- C. Coating shall be capable of surviving ASTM B117 salt environment for 500 hours minimum without blistering or peeling.
- D. Gloss retention shall be greater than 90% for the 500 hours exposure QUV test. Results shall conform to ASTM G35, 4 hours UV-B60°/4 hours condensation 50°C.
- E. Provide a minimum 6,000 hours of integral lamp operating data (not just LED data) and documented projection for 50,000 operating hours. Testing procedures and results documentation shall comply with the Department of Energy LED Luminaire Lifetime Recommendations for Testing and Reporting 1st Edition.
 - 1. LED shall comply with the requirements set forth in UL-1449.
- F. Lighting fixtures shall be rated for -20°C to +50°C.
- G. Color Rendering Index shall not be less than 70.
- H. Lighting fixtures shall have a minimum luminaire efficiency rating (LER) equal or greater than 75, and an Initial Lumen Efficacy (ILE) equal or greater than 70. Fixtures with lower LER and ILE shall not be accepted.
- I. The acceptable Correlated Color Temperature (CCT) shall be 4500 degrees K +/- 500 degrees K.
- J. Lumen Maintenance (LM) at 6000 Hrs must be greater or equal to 95%. Provide tests reports and photometric data.
- K. Projected Lumen Maintenance (LM) at 50000 hrs greater or equal to 90%.
- L. The Power Factor (PW) shall not be less than 0.90.
- M. The Total harmonic Distortion (THD) shall be less than 20%
- N. Fixtures shall operate on 120, 208, 240, 277, or 480 Volts in compliance with the requirements set forth in ANSI standard C136.15.
- O. Power supply shall have a Class A sound rating in compliance with the requirements set forth in ANSI standard C136.15.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Drivers and LED boards shall be permanently labeled with the day of installation with one inch high letters produced with a P-touch or similar permanent labeling system.
- B. Installations shall comply with CBC Seismic requirements, California Electrical code and applicable ordinances and industry standards.

- C. Standards shall be installed plumb and straight on concrete footings. Concrete requirements and procedures are as specified in Section 32 1313.
- D. Emergency light fixtures shall be labeled "Emergency Fixture" with one inch high letters produced with a P-touch or similar permanent labeling system.

3.02 TESTING

- A. Check and adjust fixtures for required illumination.
- B. Replace defective drivers and LED boards.
- C. Test and adjust lighting control equipment for proper operation.

3.03 SPARE PARTS

- A. Furnish ten percent spare drivers with a minimum of one spare LED board of each type.
- B. Furnish five percent spare motion detectors of each type with a minimum of one spare detector of each type.

3.04 HAZARDOUS WASTE DISPOSAL

- A. Hazardous waste disposals shall be handled and disposed of by licensed contractor.
- B. Store, remove, transport and dispose of hazardous materials in all accordance with state and federal regulations.
- C. Provide Owner with copy of manifest and certificate of destruction.

3.05 PROTECTION

- A. Protect the Work of this section until Substantial Completion.

3.06 CLEANUP

- A. Remove rubbish, debris, and waste materials from all areas of work each day.
- B. Clean fixture surfaces of dirt, cement, plaster and debris. Furnish cleansers compatible with material surfaces being cleaned.

END OF SECTION

Section 31 1000

Site Clearing

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Clearing and protection of vegetation.
- B. Removal of existing debris.

1.02 RELATED REQUIREMENTS

- A. See General Conditions - Article 64: Protection of Work and Property.
- B. Section 01 1000 - Summary: Limitations on Contractor's use of site and premises.
- C. Section 01 5000 - Temporary Facilities and Controls: Site fences, security, protective barriers, and waste removal.
- D. Section 01 7000 - Execution and Closeout Requirements: Project conditions; protection of bench marks, survey control points, and existing construction to remain; reinstallation of removed products.
- E. Section 02 4100 - Demolition: Removal of built elements and utilities.
- F. Section 31 2200 - Grading: Topsoil removal.
- G. Section 31 2323 - Fill: Fill material for filling holes, pits, and excavations generated as a result of removal operations.
- H. Section 31 2323 - Fill: Filling holes, pits, and excavations generated as a result of removal operations.
- I. Section 32 9300 - Plants: Relocation of existing trees, shrubs, and other plants.

1.03 REFERENCE STANDARDS

- A. City of Thousand Oaks - Oak Tree Ordinance No. 1610-NS: protection of existing oak trees.
- B. City of Thousand Oaks - Landmark Tree Ordinance No 1217-NS: protection of existing landmark trees.
- C. Arborist Report, dated March 24, 2020, prepared by Jake Minnick, RRM Design Group.

PART 2 PRODUCTS -- NOT USED

PART 3 EXECUTION

3.01 SITE CLEARING

- A. Refer to Oak Tree Preservation Notes on drawings.
- B. Comply with other requirements specified in Section 01 7000.
- C. Minimize production of dust due to clearing operations; do not use water if that will result in ice, flooding, sedimentation of public waterways or storm sewers, or other pollution.

3.02 VEGETATION

- A. Scope: Remove trees, shrubs, brush, and stumps in areas to be covered by building structure, paving, playing fields, lawns, and planting beds.
- B. Do not begin clearing until vegetation to be relocated has been removed.
- C. Do not remove or damage vegetation beyond the limits indicated on drawings.
- D. Install substantial, highly visible fences at least 3 feet high to prevent inadvertent damage to vegetation to remain:

1. At vegetation removal limits.
- E. In areas where vegetation must be removed but no construction will occur other than pervious paving, remove vegetation with minimum disturbance of the subsoil.
- F. Vegetation Removed: Do not burn, bury, landfill, or leave on site, except as indicated.
 1. Chip, grind, crush, or shred vegetation for mulching, composting, or other purposes; preference should be given to on-site uses.
 2. Trees: Relocate if possible. Refer to arborist report. 18 inches.
 3. Trees: Relocate per CRPD's instructions.
 4. Sod: Re-use on site if possible; otherwise sell if marketable, and if not, treat as specified for other vegetation removed.
- G. Restoration: If vegetation outside removal limits or within specified protective fences is damaged or destroyed due to subsequent construction operations, replace at no cost to CRPD.

3.03 DEBRIS

- A. Remove debris, junk, and trash from site.
- B. Leave site in clean condition, ready for subsequent work.
- C. Clean up spillage and wind-blown debris from public and private lands.

End of Section 31 1000

Section 31 2200

Grading

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Removal of topsoil.
- B. Rough grading the site for site structures.
- C. Finish grading.

1.02 RELATED REQUIREMENTS

- A. Section 31 1000 - Site Clearing.
- B. Section 31 2316 - Excavation.
- C. Section 31 2323 - Fill: Filling and compaction.

1.03 PRICE AND PAYMENT PROCEDURES

- A. See General Conditions - Article 41, for payment procedures.

1.04 SUBMITTALS

- A. See General Conditions - Article 9, for submittal procedures.
- B. Project Record Documents: Accurately record actual locations of utilities remaining by horizontal dimensions, elevations or inverts, and slope gradients.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Topsoil: See Section 31 2323.
- B. Other Fill Materials: See Section 31 2323.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that survey bench mark and intended elevations for the Work are as indicated.
- B. Verify the absence of standing or ponding water.

3.02 PREPARATION

- A. Identify required lines, levels, contours, and datum.
- B. Stake and flag locations of known utilities.
- C. Locate, identify, and protect from damage above- and below-grade utilities to remain.
- D. Notify utility company to remove and relocate utilities.
- E. Provide temporary means and methods to remove all standing or ponding water from areas prior to grading.
- F. Protect site features to remain, including but not limited to bench marks, survey control points, existing structures, fences, sidewalks, paving, and curbs, from damage by grading equipment and vehicular traffic.
- G. Protect trees to remain by providing substantial fencing around entire tree at the outer tips of its branches; no grading is to be performed inside this line.
- H. Protect plants, lawns, rock outcroppings, and other features to remain as a portion of final landscaping.

3.03 ROUGH GRADING

- A. Remove topsoil from areas to be further excavated, re-landscaped, or re-graded, without mixing with foreign materials.
- B. Do not remove topsoil when wet.
- C. Remove subsoil from areas to be further excavated, re-landscaped, or re-graded.
- D. Do not remove wet subsoil, unless it is subsequently processed to obtain optimum moisture content.
- E. When excavating through roots, perform work by hand and cut roots with sharp axe.
- F. Stability: Replace damaged or displaced subsoil to same requirements as for specified fill.
- G. Remove and replace soils deemed unsuitable by classification and which are excessively moist due to lack surface water control.

3.04 SOIL REMOVAL

- A. Stockpile excavated topsoil on site.
- B. Stockpile subsoil to be re-used on site; remove remainder from site.
- C. Stockpiles: Use areas designated on site; pile depth not to exceed 8 feet; protect from erosion.

3.05 FINISH GRADING

- A. Before Finish Grading:
 - 1. Verify building and trench backfilling have been inspected.
 - 2. Verify subgrade has been contoured and compacted.
- B. Remove debris, roots, branches, stones, in excess of 1/2 inch in size. Remove soil contaminated with petroleum products.
- C. Where topsoil is to be placed, scarify surface to depth of 12 inches.
- D. In areas where vehicles or equipment have compacted soil, scarify surface to depth of 12 inches.
- E. Place topsoil in areas indicated.
- F. Place topsoil where required to level finish grade.
- G. Place topsoil to thickness as indicated.
- H. Place topsoil during dry weather.
- I. Remove roots, weeds, rocks, and foreign material while spreading.
- J. Near plants spread topsoil manually to prevent damage.
- K. Fine grade topsoil to eliminate uneven areas and low spots. Maintain profiles and contour of subgrade.
- L. Lightly compact placed topsoil.
- M. Maintain stability of topsoil during inclement weather. Replace topsoil in areas where surface water has eroded thickness below specifications.

3.06 REPAIR AND RESTORATION

- A. Existing Facilities, Utilities, and Site Features to Remain: If damaged due to this work, repair or replace to original condition.
- B. Trees to Remain: If damaged due to this work, trim broken branches and repair bark wounds; if root damage has occurred, obtain instructions from Architect as to remedy.

- C. Other Existing Vegetation to Remain: If damaged due to this work, replace with vegetation of equivalent species and size.

3.07 FIELD QUALITY CONTROL

- A. See Section 31 2323 for compaction density testing.

3.08 CLEANING

- A. Remove unused stockpiled topsoil and subsoil. Grade stockpile area to prevent standing water.
- B. Leave site clean and raked, ready to receive landscaping.

End of Section 31 2200

Section 31 2316.13

Trenching

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Backfilling and compacting for utilities outside the building to utility main connections.

1.02 RELATED REQUIREMENTS

- A. Section 31 2200 - Grading: Site grading.
- B. Section 31 2316 - Excavation: Building and foundation excavating.
- C. Section 31 2323 - Fill: Backfilling at building and foundations.

1.03 DEFINITIONS

- A. Finish Grade Elevations: Indicated on drawings.

1.04 REFERENCE STANDARDS

- A. AASHTO T 180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54 kg (10-lb) Rammer and a 457 mm (18 in.) Drop; 2015.
- B. ASTM C136/C136M - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates; 2014.
- C. ASTM D698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³)); 2012.
- D. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN m/m³)); 2012.

1.05 SUBMITTALS

- A. See General Conditions - Article 9, for submittal procedures.
- B. See Section 01 3300 - Submittals, for submittal procedures.
- C. Materials Sources: Submit name of imported materials source.
- D. Compaction Density Test Reports.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. When necessary, store materials on site in advance of need.

PART 2 PRODUCTS

2.01 FILL MATERIALS

- A. General Fill: Subsoil excavated on-site.
 - 1. Free of lumps larger than 3 inches, rocks larger than 2 inches, and debris.
- B. Granular Fill - Gravel: Pit run washed stone; free of shale, clay, friable material and debris.
 - 1. Graded in accordance with ASTM C136/C136M, within the following limits:

2.02 SOURCE QUALITY CONTROL

- A. See General Conditions - Article 26, for tests and inspections.
- B. See Section 01 4000 - Quality Requirements, for general requirements for testing and analysis of soil material.
- C. If tests indicate materials do not meet specified requirements, change material and retest.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that survey bench marks and intended elevations for the work are as indicated.

3.02 PREPARATION

- A. Identify required lines, levels, contours, and datum locations.
- B. See Section 31 2200 for additional requirements.
- C. Grade top perimeter of trenching area to prevent surface water from draining into trench. Provide temporary means and methods, as required, to maintain surface water diversion until no longer needed, or as directed by the Architect.

3.03 TRENCHING

- A. Notify Architect of unexpected subsurface conditions and discontinue affected Work in area until notified to resume work.
- B. Slope banks of excavations deeper than 4 feet to angle of repose or less until shored.
- C. Do not interfere with 45 degree bearing splay of foundations.
- D. Cut trenches wide enough to allow inspection of installed utilities.
- E. Hand trim excavations. Remove loose matter.
- F. Remove excavated material that is unsuitable for re-use from site.
- G. Remove excess excavated material from site.
- H. Provide temporary means and methods, as required, to remove all water from trenching until directed by the Architect. Remove and replace soils deemed unsuitable by classification and which are excessively moist due to lack of dewatering or surface water control.
- I. Determine the prevailing groundwater level prior to trenching. If the proposed trench extends less than 1 foot into the prevailing groundwater, control groundwater intrusion with perimeter drains routed to sump pumps, or as directed by the Architect.

3.04 PREPARATION FOR UTILITY PLACEMENT

- A. Cut out soft areas of subgrade not capable of compaction in place. Backfill with general fill.
- B. Compact subgrade to density equal to or greater than requirements for subsequent fill material.
- C. Until ready to backfill, maintain excavations and prevent loose soil from falling into excavation.

3.05 BACKFILLING

- A. Backfill to contours and elevations indicated using unfrozen materials.
- B. Employ a placement method that does not disturb or damage other work.
- C. Systematically fill to allow maximum time for natural settlement. Do not fill over porous, wet, frozen or spongy subgrade surfaces.
- D. Maintain optimum moisture content of fill materials to attain required compaction density.
- E. Slope grade away from building minimum 2 inches in 10 feet, unless noted otherwise. Make gradual grade changes. Blend slope into level areas.
- F. Correct areas that are over-excavated.
 - 1. Other areas: Use general fill, flush to required elevation, compacted to minimum 97 percent of maximum dry density.

- G. Compaction Density Unless Otherwise Specified or Indicated:
- H. Reshape and re-compact fills subjected to vehicular traffic.

3.06 BEDDING AND FILL AT SPECIFIC LOCATIONS

3.07 TOLERANCES

- A. Top Surface of General Backfilling: Plus or minus 1 inch from required elevations.

3.08 FIELD QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements, for general requirements for field inspection and testing.
- B. Evaluate results in relation to compaction curve determined by testing uncompacted material in accordance with ASTM D1557 ("modified Proctor"), AASHTO T 180, or ASTM D698 ("standard Proctor").
- C. If tests indicate work does not meet specified requirements, remove work, replace and retest.
- D. Frequency of Tests: _____.

3.09 CLEANING

- A. Remove unused stockpiled materials, leave area in a clean and neat condition. Grade stockpile area to prevent standing surface water.

End of Section 31 2316.13

Section 31 2316

Excavation

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Excavating for building volume below grade, footings, pile caps, slabs-on-grade, paving, site structures, and utilities within the building.
- B. Trenching for utilities outside the building to utility main connections.

1.02 RELATED REQUIREMENTS

- A. Section 31 1000 - Site Clearing: Vegetation and existing debris removal.
- B. Section 31 2200 - Grading: Soil removal from surface of site.
- C. Section 31 2200 - Grading: Grading.
- D. Section 31 2316.13 - Trenching: Excavating for utility trenches outside the building to utility main connections.
- E. Section 31 2323 - Fill: Fill materials, backfilling, and compacting.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that survey bench mark and intended elevations for the work are as indicated.

3.02 PREPARATION

- A. Identify required lines, levels, contours, and datum locations.
- B. See Section 31 1000 for clearing, grubbing, and removal of existing debris.
- C. See Section 31 2200 for topsoil removal.
- D. Locate, identify, and protect utilities that remain and protect from damage.
- E. Notify utility company to remove and relocate utilities.
- F. Protect bench marks, survey control points, existing structures, fences, sidewalks, paving, and curbs from excavating equipment and vehicular traffic.
- G. Grade top perimeter of excavation to prevent surface water from draining into excavation. Provide temporary means and methods, as required, to maintain surface water diversion until no longer needed, or as directed by Architect.

3.03 EXCAVATING

- A. Excavate to accommodate new structures and construction operations.
 - 1. Cut utility trenches wide enough to allow inspection of installed utilities.
 - 2. Hand trim excavations. Remove loose matter.
- B. Notify Architect of unexpected subsurface conditions and discontinue affected Work in area until notified to resume work.
- C. Do not interfere with 45 degree bearing splay of foundations.
- D. Provide temporary means and methods, as required, to remove all water from excavations until directed by Architect. Remove and replace soils deemed suitable by classification and which are excessively moist due to lack of dewatering or surface water control.

3.04 REPAIR

- A. Correct areas that are over-excavated and load-bearing surfaces that are disturbed; see Section 31 2323.

3.05 CLEANING

- A. Stockpile excavated material to be re-used in area designated on site in accordance with Section 31 2200.
- B. Remove excavated material that is unsuitable for re-use from site.
- C. Remove excess excavated material from site.

3.06 PROTECTION

- A. Divert surface flow from rains or water discharges from the excavation.
- B. Prevent displacement of banks and keep loose soil from falling into excavation; maintain soil stability.
- C. Protect open excavations from rainfall, runoff, freezing groundwater, or excessive drying so as to maintain foundation subgrade in satisfactory, undisturbed condition.
- D. Protect bottom of excavations and soil adjacent to and beneath foundation from freezing.
- E. Keep excavations free of standing water and completely free of water during concrete placement.

End of Section 31 2316

Section 31 2323

Fill

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Filling, backfilling, and compacting for building volume below grade.
- B. Backfilling and compacting for utilities outside the building to utility main connections.
- C. Filling holes, pits, and excavations generated as a result of removal (demolition) operations.

1.02 RELATED REQUIREMENTS

- A. Section 31 2200 - Grading: Removal and handling of soil to be re-used.
- B. Section 31 2200 - Grading: Site grading.
- C. Section 31 2316.13 - Trenching: Excavating for utility trenches outside the building to utility main connections.

1.03 PRICE AND PAYMENT PROCEDURES

- A. See General Conditions - Article 41, payment procedures.
- B. General Fill:
 - 1. Measurement Method: By the cubic yard.
 - 2. Includes: Supplying fill, stockpiling, scarifying substrate surface, placing where required, compacting, and dewatering.

1.04 REFERENCE STANDARDS

- A. AASHTO T 180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54 kg (10-lb) Rammer and a 457 mm (18 in.) Drop; 2015.
- B. ASTM C136/C136M - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates; 2014.
- C. ASTM D698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³)); 2012.
- D. ASTM D1556 - Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method; 2007.
- E. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN m/m³)); 2012.
- F. ASTM D2167 - Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method; 2008.
- G. ASTM D6938 - Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth); 2010.

1.05 SUBMITTALS

- A. See General Conditions - Article 9, for submittal procedures.
- B. See Section 01 3300 - Submittals, for submittal procedures.
- C. Materials Sources: Submit name of imported materials source.
- D. Compaction Density Test Reports.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. When necessary, store materials on site in advance of need.

- B. When fill materials need to be stored on site, locate stockpiles where designated.
 - 1. Separate differing materials with dividers or stockpile separately to prevent intermixing.
 - 2. Prevent contamination.
 - 3. Protect stockpiles from erosion and deterioration of materials.

PART 2 PRODUCTS

2.01 FILL MATERIALS

- A. General Fill - Fill Type ____: Subsoil excavated on-site.
 - 1. Graded.
 - 2. Free of lumps larger than 3 inches, rocks larger than 2 inches, and debris.
- B. Structural Fill - Fill Type ____: Complying with State of _____ Highway Department standard.
- C. Sand: Natural river or bank sand; free of silt, clay, loam, friable or soluble materials, and organic matter.
 - 1. Graded in accordance with ASTM C136/C136M; within the following limits:
 - a. No. 4 sieve: 100 percent passing.
 - b. No. 14 sieve: 10 to 100 percent passing.
 - c. No. 50 sieve: 5 to 90 percent passing.
 - d. No. 100 sieve: 4 to 30 percent passing.
 - e. No. 200 sieve: 0 percent passing.
- D. Topsoil: See Section 31 2200.

2.02 ACCESSORIES

- A. Geotextile Fabric: Non-biodegradable, non-woven, _____.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Identify required lines, levels, contours, and datum locations.
- B. See Section 31 2200 for additional requirements.
- C. Verify subdrainage, dampproofing, or waterproofing installation has been inspected.
- D. Verify areas to be filled are not compromised with surface or ground water.

3.02 PREPARATION

- A. Scarify and proof roll subgrade surface to a depth of 6 inches to identify soft spots.
- B. Cut out soft areas of subgrade not capable of compaction in place. Backfill with general fill.
- C. Compact subgrade to density equal to or greater than requirements for subsequent fill material.
- D. Until ready to fill, maintain excavations and prevent loose soil from falling into excavation.

3.03 FILLING

- A. Fill to contours and elevations indicated using unfrozen materials.
- B. Employ a placement method that does not disturb or damage other work.
- C. Systematically fill to allow maximum time for natural settlement. Do not fill over porous, wet, frozen or spongy subgrade surfaces.
- D. Maintain optimum moisture content of fill materials to attain required compaction density.
- E. Slope grade away from building minimum 2 inches in 10 feet, unless noted otherwise. Make gradual grade changes. Blend slope into level areas.

- F. Correct areas that are over-excavated.
 - 1. Other areas: Use general fill, flush to required elevation, compacted to minimum 97 percent of maximum dry density.
- G. Compaction Density Unless Otherwise Specified or Indicated:
 - 1. Under paving, slabs-on-grade, and similar construction: 90 percent of maximum dry density.
 - 2. At other locations: 90 percent of maximum dry density.
- H. Reshape and re-compact fills subjected to vehicular traffic.
- I. Maintain temporary means and methods, as required, to remove all water while fill is being placed as required, or until directed by the Architect. Remove and replace soils deemed unsuitable by classification and which are excessively moist due to lack of dewatering or surface water control.

3.04 FIELD QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements, for general requirements for field inspection and testing.
- B. Perform compaction density testing on compacted fill in accordance with ASTM D1556, ASTM D2167, or ASTM D6938.
- C. Evaluate results in relation to compaction curve determined by testing uncompacted material in accordance with ASTM D698 ("standard Proctor"), ASTM D1557 ("modified Proctor"), or AASHTO T 180.
- D. If tests indicate work does not meet specified requirements, remove work, replace and retest.
- E. Frequency of Tests: _____.

3.05 CLEANING

- A. See Section 01 7419 - Construction Waste Management and Disposal, for additional requirements.
- B. Remove unused stockpiled materials, leave area in a clean and neat condition. Grade stockpile area to prevent standing surface water.

End of Section 31 2323

Section 32 1123

Aggregate Base Courses

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Aggregate base course.
- B. Permeable base course.
- C. Geotextile Fabric.
- D. Paving aggregates.

1.02 RELATED REQUIREMENTS

- A. Section 31 2200 - Grading: Preparation of site for base course.

1.03 REFERENCE STANDARDS

- A. AASHTO M 147 - Standard Specification for Materials for Aggregate and Soil-Aggregate Subbase, Base and Surface Courses; 1965 (2004).
- B. AASHTO T 180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54 kg (10-lb) Rammer and a 457 mm (18 in.) Drop; 2015.
- C. ASTM C136/C136M - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates; 2014.
- D. ASTM D698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³)); 2012.
- E. ASTM D1556 - Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method; 2007.
- F. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN m/m³)); 2012.
- G. ASTM D2167 - Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method; 2008.
- H. ASTM D2487 - Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System); 2011.
- I. ASTM D6938 - Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth); 2010.

1.04 SUBMITTALS

- A. See General Conditions - Article 9, for submittal procedures.
- B. Materials Sources: Submit name of imported materials source.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Coarse Aggregate: 3/4" crushed washed stone; free of shale, clay, friable material and debris.
 - 1. Graded in accordance with ASTM D2487 Group Symbol GW.
 - 2. Graded in accordance with ASTM C136/C136M, within the following limits:
 - a. 1 inch sieve: 100 percent passing.
 - b. 3/4 inch sieve: 90 to 100 percent passing.
 - c. No. 4 sieve: 35 to 60 percent passing.
 - d. No. 30 sieve: 10 to 30 percent passing.

- e. No. 200: 2 to 9 percent passing.
- B. Coarse Aggregate: 1/2" crushed washed stone; free of shale, clay, friable material and debris.
 - 1. Graded in accordance with ASTM D2487 Group Symbol GW.
 - 2. Graded in accordance with ASTM C136/C136M, within the following limits:
 - a. 3/4 inch sieve: __ 100 percent passing.
 - b. 1/2 inch sieve: 90 to 100 percent passing.
 - c. 3/8 inch sieve: 20 to 60 percent passing.
 - d. No. 4 sieve: 0 to 15 percent passing.
 - e. No. 30 sieve: 10 to 30 percent passing.
 - f. No. 8 sieve: 0 to 5 percent passing.
 - g. No. 200: 2 to 9 percent passing.
- C. Medium Aggregate Type 57: Natural stone; washed, free of clay, shale, organic matter.
- D. Medium Aggregate Type 2: Natural stone; washed, free of clay, shale, organic matter.
- E. Geotextile Fabric: Non-biodegradable, non-woven, Mirafi 140N or approved equal.; _____
manufactured by _____.

2.02 SOURCE QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements for general requirements for testing and analysis of aggregate materials.
- B. Where aggregate materials are specified using ASTM D2487 classification, test and analyze samples for compliance before delivery to site.
- C. Provide materials of each type from same source throughout the Work.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that survey bench marks and intended elevations for the work are as indicated.
- B. Verify substrate has been inspected, gradients and elevations are correct, and is dry.

3.02 PREPARATION

- A. Correct irregularities in substrate gradient and elevation by scarifying, reshaping, and re-compacting.
- B. Do not place aggregate on soft, muddy, or frozen surfaces.

3.03 INSTALLATION

- A. Place aggregate in maximum 4 inch layers and roller compact to specified density.
- B. Level and contour surfaces to elevations and gradients indicated.
- C. Add small quantities of fine aggregate to coarse aggregate as appropriate to assist compaction.
- D. Add water to assist compaction. If excess water is apparent, remove aggregate and aerate to reduce moisture content.
- E. Use mechanical tamping equipment in areas inaccessible to compaction equipment.

3.04 TOLERANCES

- A. Flatness: Maximum variation of 1/4 inch measured with 10 foot straight edge.
- B. Scheduled Compacted Thickness: Within 1/4 inch.
- C. Variation From Design Elevation: Within 1/2 inch.

3.05 FIELD QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements for general requirements for field inspection and testing.
- B. Compaction density testing will be performed on compacted aggregate base course in accordance with ASTM D1556, ASTM D2167, or ASTM D6938.
- C. Results will be evaluated in relation to compaction curve determined by testing uncompacted material in accordance with AASHTO T 180, ASTM D698 ("standard Proctor"), or ASTM D1557 ("modified Proctor").
- D. If tests indicate work does not meet specified requirements, remove work, replace and retest.
- E. Proof roll compacted aggregate at surfaces that will be under slabs-on-grade.

3.06 CLEANING

- A. Remove unused stockpiled materials, leave area in a clean and neat condition. Grade stockpile area to prevent standing surface water.

End of Section 32 1123

Section 32 1300

Skate Park Structure Concrete Paving

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Slabs on grade.
- B. Vertical walls and footings.
- C. Flatwork

1.02 DEFINITIONS

- A. 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.

1.03 SUBMITTALS

- A. See Article 9 of the General Conditions for submittal procedures.
- B. Submit to Owner's Representative; concrete mix design and letters from material suppliers certifying that materials comply with the standards referenced herein.
- C. Submit to Owner's Representative; shop drawings for all fabricated steel edging, fencing and steel accessories.
- D. Submit to Owner's Representative: Cut sheets for Evaporation Retardant and Finishing Aid, steel paint, and Concrete Stain.

1.04 QUALITY ASSURANCE

- A. Comply with provisions of the following standards, except where more stringent requirements are indicated.
 - 1. Concrete Reinforcing Steel Institute (CRSI) "Manual of Standard Practice".
 - 2. American Concrete Institute (ACI) "Manual of Standard Practice".
- B. Installer Qualifications: The Contractor or an experienced installer who has completed pavement work similar in material, design, and extent to that indicated for this Contract.
- C. Manufacturer Qualifications: Manufacturer of ready-mixed concrete products complying with ASTM C 94 requirements for production facilities and equipment.
- D. Concrete Testing: The Owner's Independent Testing Agency shall perform material evaluation tests.

1.05 QUALITY INSURANCE

- A. A. Perform all work in accordance with all rules and standards as required by the Owner's Representative.

PART 2 PRODUCTS

2.01 EDGE FORMS AND SCREED CONSTRUCTION

- A. Form Materials: Plywood, metal, metal-framed plywood, or other approved panel-type materials to provide full-depth, continuous, straight, smooth exposed surfaces.
 - 1. Use flexible or curved forms for horizontal curves of a radius 100-feet or less.
- B. Form-Release Agent: Commercially formulated form-release agent with a maximum of 350 mg/L volatile organic compounds (VOCS) that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.

- C. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides for pavement to required lines, grades, and elevations. Install forms to allow continuous progress of work and so forms can remain in place at least 24-hours after concrete placement. Forms shall provide a continuous straight, smooth surface. Forms shall be of sufficient thickness to withstand pressure of newly placed concrete without bowing or deflecting.
- D. Clean forms after each use and coat with form release agent to ensure separation from concrete without damage.
- E. Check completed formwork and screeds for grade and alignment to the following tolerances:
 - 1. Top of Forms: Not more than 1/8-inch in ten feet.
 - 2. Vertical Face on Longitudinal Axis: Not more than 1/8-inch in 10-feet.
- F. Moisten wood forms immediately prior to placing concrete.

2.02 STEEL REINFORCEMENT MATERIALS

- A. Reinforcement Bars shall be Number 4, Grade 40, deformed or per the plan details.
- B. General: Comply with CRSI's "Manual of Standard Practice" for fabricating reinforcement.
- C. Clean reinforcement of loose rust, oil and mill scale, earth, ice, or other bond-reducing materials.
- D. Deformed steel bars shall be located at 16-inches on center, both directions, continuous throughout the entire structure and as indicated on the plan details. Steel rebars shall extend out from the features for 24-inches, 2-inches above base rock. (Rebars for the flat work shall tie onto the rebars extending for 24-inches from the features.) Lap rebars 24-inches and tie. Stagger joints. Do not heat to bend.
- E. Provide Doble supports for rebars at 36-inches on center. Supports must keep the rebars at 2-inches above base rock and 2-inches below finish surfaces of concrete. Rebars shall be 2-inches away from outside surfaces of concrete in all locations. Rebars shall be free of rust, oil and other deleterious conditions.

2.03 FABRICATED STEEL EDGING AND COPING

- A. All edging and coping shall be per the plan details with all connections welded and ground smooth. Cold galvanize all areas where grinding and welding occur.

2.04 CONCRETE MATERIALS

- A. Portland Type II Cement.
- B. Fly Ash: ASTM C 618, Class F or C.
- C. Aggregate: ASTM C 33, Class 4, from a single source, with coarse aggregate as follows:
Aggregate Size: 3/4-inch min.; 1-1/2-inches max. nominal. Do not use fine or coarse aggregates containing substances that cause spalling.
- D. Water: Fresh, clean, potable water free of foreign materials.

2.05 REQUIRED CURING AND FINISHING MATERIALS

- A. Non-permeable Burleen™ curing blankets or approved equal; ASTM C 171. The concrete should be hard enough to prevent surface damage when covering with concrete blankets.
- B. Water: Potable.

2.06 CONCRETE MIXES

- A. Prepare design mixes, proportioned according to ACI 211.1 and ACI 301, for each type and strength of normal-weight concrete determined by either laboratory trial mixes or field experience.
- B. Proportion mixes to provide concrete with the following properties:
 - 1. Compressive Strength (28-Days): 4000-psi (6.5 sac min.)
 - 2. Slump Limit: no less than 2-inch and no more than 4-inch.
- C. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having air content as follows within a tolerance of plus or minus 1.5-4.0 percent.
- D. Ready-Mixed Concrete: Comply with requirements and with ASTM C 94 and ASTM C 1116.
- E. When air temperature is between 85-degrees Fahrenheit and 90-degrees Fahrenheit, reduce mixing and delivery time from 1-1/2-hours to 75-minutes; when air temperature is above 90-degrees Fahrenheit, reduce mixing and delivery time to 60-minutes. Do not use concrete that has been in transport or pump hoses for more than 90-minutes from time of initial mix.
- F. Concrete mix design shall be submitted to Owner's Representative for review and approval.

PART 3 EXECUTION

3.01 PREPARATION

- A. Proof-roll prepared subbase surface to check for unstable areas and verify need for additional compaction. (Crushed rock base shall be 3/4-inch: Class II Aggregate Base placed at a minimum depth of 6-inches in all locations to receive concrete or as noted otherwise. Proceed with pavement only after nonconforming conditions have been corrected and subgrade is ready to receive pavement and sample pour has been approved.
- B. Remove loose material from compacted subbase surface immediately before placing concrete.
- C. The Contractor shall keep the project area as clean as possible during construction. The Contractor shall be responsible to clean up and remove all spillage, overpour, discarded forming material, rejected work or material and all refuse or debris resulting from the installation work.

3.02 JOINTS

- A. Cold Joints: Construct true to line with faces perpendicular to surface planes of concrete. Construct transverse joints at right angles to centerline, unless otherwise indicated. When joining existing pavement, place transverse joints to align with previously placed joints, unless otherwise indicated.
- B. Sawcut Joints: Form weakened-plane contraction joints, sectioning concrete into areas of approximately 100-square feet. See Material Plan for locations. Construct Sawcut joints to a depth of 1-1/2-inches and as follows:
 - 1. Sawed Joints: Form control joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades within 48-hours of any said pour. Cut 1/8-inch-wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before developing random contraction cracks. See sawcut detail.

3.03 CONCRETE PLACEMENT

- A. Inspection: Before placing any transitional concrete, the Owner's Representative will inspect the completed formwork installation, screed forms, templates, reinforcement steel, and any other items to be embedded or cast in place.

- B. Remove snow, ice, frost or standing water from subbase surface and reinforcement before placing concrete. Do not place concrete on frozen surfaces.
- C. Moisten subbase to provide a uniform dampened condition at the time concrete is placed. Do not place concrete around manholes or other structures until they are at the required finish elevation and alignment.
- D. Deposit and spread concrete in a continuous operation between transverse joints when concrete placing is interrupted more than two hours, place a cold joint.
- E. 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.
- F. 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.
- G. 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.
- H. Concrete paving shall be a minimum of five 5-inches thick in all locations or as indicated per the plan details.

3.04 CONCRETE FINISHING

- A. General: Wetting of concrete surfaces during screeding, initial floating, or finishing operations is prohibited.
- B. Finish: The finished surface of all concrete shall be a hard troweled, smooth finish.
- C. All horizontal and vertical edges of concrete shall have 1/2-inch radii.
- D. All connections between pours must be absolutely flush and smooth.
- E. Grinding finished concrete to achieve the specified finishes will not be accepted.

3.05 CONCRETE PROTECTION AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.
- B. Evaporation Retarder: Apply evaporation retarder to concrete surfaces 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. Apply curing blankets 2-hours after finishing concrete. Overlap blankets two 2-feet all sides. Do not use fine or coarse aggregates containing substances that cause spalling.
- E. Maintain ongoing moisture of concrete by drip irrigation lines located under curing blankets. Provide ongoing moisture for a minimum of 14-days per finished area of concrete.
- F. Concrete shall be protected from any traffic for 30-days.
- G. The Contractor shall take necessary actions to protect the concrete from any vandalism or damage that may occur as a result of trespassing.

3.06 PAVEMENT TOLERANCES

- A. Comply with tolerances of ACI 117 and as follows:
 - 1. Elevation: 1/8-inch.
 - 2. Thickness: minus 1/4-inch.
 - 3. Surface: Gap below 10-foot-long, unlevelled straightedge not to exceed 1/4-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 Pavement Edge: 1/2-inch.
 - 7. Alignment of Dowel-Bar End Relative to Line Perpendicular to Pavement Edge.
 - 8. Length of dowel 1/4-inch per 12-inches.
 - 9. Joint Spacing: 3-inches.
 - 10. Contraction Joint Depth: Plus 1/4-inch, no minus.
 - 11. Joint Width: Plus 1/8-inch, no minus.
 - 12. Plan Dimension 1-inch.
 - 13. Vertical Radii: 1/4-inch over length of transition as checked with true template.

3.07 FIELD QUALITY CONTROL

- A. Independent Testing Agency: The Owner's Independent Testing Agency shall sample materials, perform tests, and submit test reports during concrete placement according to requirements specified.
- B. Testing Services: Testing will 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: AASHTO T119; one test at point of placement for each compressive-strength test, but not less than one test for each day's pour of each type of concrete. Additional tests will be required when concrete consistency changes.
 - 3. Air Content: ASTM C173 or AASHTO T152, pressure method; one test for each compressive-strength test, but not less than one test for each day's pour of each type of air- entrained concrete.
 - 4. Concrete Temperature: ASTM C1064; one test hourly when air temperature is 40-degrees Fahrenheit and below and when 80-degrees Fahrenheit and above, and one test for each set of compressive- strength specimens.
 - 5. Compression Test Specimens: ASTM C31; 1 set of 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. 6. Compressive-Strength Tests: ASTM C39; one set for each day's pour of each concrete class exceeding 5-cubic yards, but less than 25-cubic yards, plus 1-set for each additional 50-cubic yard. 1-specimen shall be tested at 7-days and 2-specimens at 28-days; one specimen shall be retained in reserve for later testing if required.
- C. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by the Owner's Representative, but will not be used as the sole basis for approval or rejection.
- D. 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 Owner's Representative. Testing agency may conduct tests to determine adequacy of concrete by cored cylinders complying with AASHTO 501.24(b), or by other methods as directed.

3.08 REPAIRS AND PROTECTION

- A. Remove and replace concrete pavement that is broken, under strength, spalling, damaged, or defective, or does not meet requirements in this Section.
- B. Protect concrete from damage. Exclude traffic from pavement for at least 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.
- C. Maintain concrete pavement free of stains, discoloration, dirt, and other foreign material.
- D. The Contractor shall remove the curing blankets and the temporary drip irrigation system, as well as hose and sweep concrete pavement not more than two days before date scheduled for Substantial Completion inspections.
- E. Grinding concrete to achieve specified finishes will not be allowed.

End of Section 32 1300

Section 32 1301

Shotcrete

PART 1 GENERAL

1.01 SUMMARY

- A. Work included: Provide sprayed-on concrete (concrete conveyed into place by air pressure through a flexible tube or gun with controlled nozzle) referred to herein as shotcrete, complete as shown and as specified for Pump track radius and banked transition work only.

1.02 RELATED WORK

- A. Section 32,1300 Skate Park Structure Concrete Paving

1.03 QUALITY ASSURANCE

- A. Skate Park Contractor Qualification
1. The skate park structure improvements including finish grading, rebar work, fabricated metal work, concrete pool coping, concrete work, and shotcrete work require qualification as described herein.
 2. Contractors bidding the skate park structure shall have satisfactory completed the installation of four (4 minimum number) similar skate park projects in accordance with the project plans and written specifications. The qualification can be met by either the prime bidding contractor or a subcontractor bidding to the prime. Qualifying projects must include concrete skate park structures of comparable size, finishes, bowl depths, coping types and features built within the last five (5) years. Qualifying projects by either the prime contractor or the skate park subcontractor must be listed in the bid proposal documents under the section CERTIFICATION OF BIDDER'S EXPERIENCE AND QUALIFICATIONS.
 3. If Contractor intends to use an ACI certified Nozzleman for Shotcrete installation other than the Nozzleman who performed work for the required qualifying projects, the Contractor must submit four (4) qualifying projects that the ACI Certified Nozzleman has performed. Qualifying project shall be of the same requirement as described herein.
 4. Only the Nozzleman referenced with the bid shall be permitted to perform shotcrete work for the said project. Should the Contractor want to substitute the qualifying Nozzleman of record with another Nozzleman, the Contractor shall make an application to the Owner providing all qualifying records of the proposed substitute Nozzleman at least five (5) days in advance of said work. The Owner shall reserve the right to reject any substitute Nozzleman not meeting the qualifying requirements.
 5. The Skate Park Contractor (either prime or subcontractor) shall provide reference for four (4) qualifying reference projects and proposed Nozzleman including location of qualifying projects, size, owner, and owner's contact information in the CERTIFICATION OF BIDDER'S EXPERIENCE AND QUALIFICATIONS.
- B. Standards: Comply with the requirements of the current edition of the following codes and standards, except as herein modified:
1. UBC "Uniform Building Code"
 2. American Concrete Institute (ACI): 506, Chapter 13, Wet Method; Chapter 5, Shotcrete Crew.
 3. American Concrete Institute (ACI) "Manual of Standard Practice" Concrete Reinforcing.
 4. Reinforcing Steel Institute (CRSI) "Manual of Standard Practice"
 5. American Society for Testing Materials (ASTM)
 - a. Concrete Testing:

- 1) Prepare test specimens by each application crew using the equipment materials and mix proportions proposed for the Project. Owner's Representative shall observe preparation of test panels noting placement of shotcrete by applications crew.
 - b. Maintain and protect sample transition during construction and test for compliance with Specifications.
 - c. Test strength of the shotcrete as work progresses as follows:
 - 1) Provide test panels and test in accordance with ASTM42. Test panels shall be taken not less than once each shift or less than one for each 50-cubic yards of shotcrete placed through the nozzle.
 - d. Shotcrete core grade-2 required.
- C. Acceptance: Final acceptance of the Pump track DRS2 Shotcrete will be based upon the results obtained from testing.
- D. Manufacturer Qualifications: Manufacturer of ready-mixed concrete products complying with ASTM C 94 requirements for production facilities and equipment.
- E. Shotcrete Nozzleman shall be certified in accordance with ACI 5063.R. Shotcrete operations shall not be permitted without certified Nozzleman present.
- F. Do not install concrete work over wet, saturated, muddy or frozen subgrade.
- G. No trucks shall be allowed within the areas that have been graded.

1.04 SUBMITTALS

- A. See Article 9 of the General Conditions for submittal procedures.
- B. Manufacturer's Data: Current Printed specifications with application and installation instruction for proprietary materials including concrete admixtures such as finishing agents/hardener.
- C. Shop Drawings: shop drawings for all fabricated steel edging and steel accessories.
- D. Mix Design: Submit to Construction Manager; concrete mix design and letters from material suppliers certifying that materials comply with the standards referenced herein.
- E. Pour Schedule: Contractor to indicate on plans locations to be shot within a days work and sequence of pours for review by Construction Manager.

PART 2 PRODUCTS

2.01 CONCRETE MATERIALS

- A. Portland Cement: ASTM C150, Types I or II, one brand only.
- B. Fly Ash: ASTM C618
- C. Normal Weight Aggregates: ASTM C33 and herein specified. Aggregate shall comply with gradation No. 2 as shown in ACI 506R Table 2.1 if the contractor can show satisfactory performance of an alternate grading under similar conditions of use, the engineer may waive the requirement for gradation No. 2.
 - 1. Combined gradation of coarse and fine aggregate as follows:

Sieve Size, U.S. Standard Square Mesh	Percent by Weight Passing Individual Sieves
3/8 in	90-100
No. 4	70-85

Sieve Size, U.S. Standard Square Mesh	Percent by Weight Passing Individual Sieves
No. 8	50-70
No. 16	35-55
No. 30	20-35
No. 50	8-20
No. 100	2-10

2. Batch fine coarse aggregates separately to avoid segregation.
3. Aggregates shall be free from clay, mud, loam, or other deleterious substances.
4. Dune sand, bank run sand, and manufactured sand are not acceptable for fine aggregate. Use one source of sand only for entire project.
5. Coarse aggregate shall be clean, un-coated, heavy media processed aggregate of crushed stone or river washed aggregate.

2.02 ACCESSORIES

- A. Water: Fresh, clean, potable, and free of deleterious acids, mixing, and curing water, as available from Construction Manager. Transport as required. Water shall not be used to finish, see admixtures.
- B. Admixtures: Use only accepted admixtures meeting the following requirements:
 1. Chemical Admixtures: ASTM C494
 2. Evaporation Retardant and Finishing Aid: Burke Film Concentrate - Available from Whitecap Inc. Burk Film Concentrate shall be used in accordance with the manufacture recommendations. All finishing of concrete surfaces must be completed with this product, finishing with water is not allowed.
 3. Air-entraining Admixtures: ASTM C1141. Air entraining prior to shooting shall be 1.5-percent to 3.0-percent with a plus-or-minus 1-percent tolerance.
 4. Contractor shall submit cut sheets for all proposed admixtures with the concrete mix design.

2.03 PROPORTIONING AND DESIGN OF CONCRETE MIXES

- A. Mix: Prepare design mix to achieve an in-place 28-day compressive strength of 4,000-pounds per square inch and an air content of 4-percent at 28-days. Maximum aggregate size shall not exceed 3/8-inch. Unit weight of in-place shotcrete shall be 494-pounds per cubic yard. Use an independent Testing Agency acceptable to the Construction Manager to prepare and report the proposed mix design. Testing is at the cost of the construction manager.
- B. Test Data: Submit for acceptance proportioning and test data from prior experience if available. If data from prior experience are not available or accepted, make and have tested specimens from three or more different mix proportions in accordance with pre-construction testing requirements of this Specification.
- C. Strength: Selected mix proportions on the basis of compressive strength tests of specimens shall be cut from the shotcreted sample transition not earlier than 5-days after shotcreting. For mix acceptance purposed, average core strengths shall be at least equal to f'_c for cores with L/D of 2.0. For cores with L/D between 1.0 and 2.0, use correction factors given in ASTM C42.
- D. Review: Mix design shall be submitted to Owner's Representative for review and approval.
- E. See skate park structure legend in plans for shotcrete requirements.

2.04 CONCRETE APPLICATION EQUIPMENT

- A. For Wet Mix Shotcrete:
 - 1. Mixing Equipment: capable of thoroughly mixing aggregate, cement and water in sufficient quantity to maintain continuous placement.
 - 2. Air Supply: Clean air adequate for maintaining sufficient nozzle velocity for parts of work, and for simultaneous operation of blow pipe for cleaning away rebound.
 - 3. Delivery Equipment: capable of discharging aggregate-cement-water mixture accurately, uniformly, and continuously through delivery hose.

2.05 FORMS

- A. Form Materials: Plywood, metal, metal-framed plywood, or other approved panel-type materials to provide full-depth, continuous, straight, smooth exposed surfaces.
 - 1. Use flexible or curved forms for horizontal curves of a radius 100-feet or less.
- B. Form-Release Agent: Commercially formulated form-release agent with a maximum of 350-mg/L volatile organic compounds (VOCS) that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.
- C. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides for pavement to required lines, grades, and elevations. Install forms to allow continuous progress of work and so forms can remain in place at least 24-hours after concrete placement. Forms shall provide a continuous straight, smooth surface. Forms shall be of sufficient thickness to withstand pressure of newly placed concrete without bowing or deflecting.
- D. Clean forms after each use and coat with form release agent to ensure separation from concrete without damage.
- E. Check completed formwork and screeds for grade and alignment to the following tolerances:
 - 1. Top of Forms: Not more than 1/8-inch in ten feet.
 - 2. Vertical Face on Longitudinal Axis: Not more than 1/8-inch in 10-feet.
- F. Moisten wood forms immediately prior to placing concrete.

2.06 STEEL REINFORCEMENT MATERIALS

- A. Reinforcement Bars shall be Number 4, Grade 40, deformed or per the plans.
- B. General: Comply with CRSI's "Manual of Standard Practice" for fabricating reinforcement.
- C. Clean reinforcement of loose rust, oil and mill scale, earth, ice, or other bond-reducing materials.

2.07 REQUIRED CURING AND FINISHING MATERIALS

- A. Non-permeable Burleen™ curing blankets or approved equal; ASTM C 171. The concrete should be hard enough to prevent surface damage when covering with concrete blankets.
- B. Water: Potable.

PART 3 EXECUTION

3.01 INSPECTION

- A. Examination: Construction Manager and Pump track Designer shall examine concrete formwork and verify that it is true to line and dimension, adequately braced against vibration, and constructed to permit escape of air and rebound but to prevent leakage during shotcreting.
- B. Inspection: Construction Manager and Pump track Designer shall inspect reinforcement steel and items to be embedded in concrete. Correct any deviations from the accepted shop drawings.

- C. Notification: Notify other trades involved in ample time to permit the proper installation of their work.
- D. Existing Surfaces: Examine existing concrete surfaces for unsound material. Correct deficiencies.

3.02 STEEL REINFORCEMENT

- A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating reinforcement.
- B. Clean reinforcement of loose rust, oil and mill scale, earth, ice, or other bond-reducing materials.
- C. Deformed steel bars shall be located at 12-inches on center, both directions, continuous throughout the entire structure and as indicted on the plans. Steel rebar shall extend out from the features for 24-inches, 2-inches above base rock. (Rebar for the flat work shall tie onto the rebar extending for 24-inches from the features.) Lap rebar 24-inches and tie. Stagger joints. Do not heat to bend.
- D. Provide dobe supports for rebars at 36-inches on center. Supports must keep the rebars at 2-inches above sub-grade and 2-inches below finish surfaces of concrete. Rebars shall be 2-inches away from outside surfaces of concrete in all locations. Rebars shall be free of rust, oil and other deleterious conditions.

3.03 PREPARATION FOR INSTALLATION OF CONCRETE

- A. Forms: Use a form-release agent on removable forms to prevent absorption of moisture and to prevent bond with shotcrete.

3.04 CONCRETE BATCHING AND MIXING

- A. Proportions: Mix proportions shall be controlled by weight batching. Owner's Testing Laboratory shall maintain quality control records during shotcrete production.

3.05 CONCRETE PLACEMENT

- A. Placement: Use suitable delivery equipment and procedures that will result in shotcrete in place meeting the requirement of the Specification. Determine operation procedures for placement in extended distances, and around any obstructions where placement velocities and mix consistency must be adjusted.
- B. Placement Techniques: Do not place shotcrete if drying or stiffening of the mix takes place at any time prior to delivery to the nozzle.
 - 1. Control thickness, method of support, air pressure, and/or water content of shotcrete to preclude sagging or sloughing off. Discontinue shotcreting or provide suitable means to screen the nozzle stream if wind or air currents cause separation of the nozzle stream during placement.
 - 2. Hold nozzle as perpendicular to surface as work will permit, to secure maximum compaction with minimum rebound.
 - 3. In shotcreting walls, begin application at bottom. Ensure work does not sag.
 - 4. Layering:
 - a. Build up layers by making several passes of nozzle over work area.
 - b. Broom or scarify the surface of freshly placed shotcrete to which, after hardening additional layers of shotcrete are to be bonded. Dampen surface just prior to application of succeeding layers.
 - c. Allow each layer of shotcrete to take initial set before applying succeeding layers.

- d. Use templates fabricated to the specified finish surfaces to insure exact radii for all Pump track terrain per the Plan Details. Template shall be fabricated from steel or 3/4-inch Plywood. Check every horizontal foot when applying shotcrete for conformance of intended wall radii. Brace template and place levels at arc to tangent connections to insure no kinks will be formed. Kinks at the bottom of transitions will not be acceptable. Slumping of the shotcrete causing coping setback will not be acceptable. See Shotcrete Template detail.
5. Placement around Reinforcement:
 - a. Hold the nozzle at such distance and angle to place materials behind reinforcement before any material is allowed to accumulate on its face.
 - b. Test to ascertain if any void or sand pockets have developed around or behind reinforcement by probing with an awl or other pointed tool after the shotcrete has achieved its initial set, by removal of randomly selected bars, or coring of other suitable standards.
- C. Finishing: Shotcrete installation crews must have appropriate scaffolding and radial ladders or equal to ensure access for application and finishing of shotcrete.

3.06 REMOVAL OF SURFACE DEFECTS IN CONCRETE

- A. General: Remove and replace shotcrete that lacks uniformity, exhibits segregation honeycombing, or lamination. Or which contains any dry patches, slugs, voids, or pockets. Remove defective areas.
- B. Sounding: Sound work with hammer for voids. Remove and replace damaged in-place shotcrete.

3.07 CONCRETE FINISH

- A. Finish-General: Medium broom finish that is uniform and free of kinks and irregularities.
- B. Transitions: Floated finish on radial face of wall shall consist of a smooth, hard, uniform surface of smooth trowel. Level the transition to a tolerance of 1/4-inch in 10-feet when vertical with a radial template using the appropriate radii. If horizontal, use a straight edge. Grinding the surfaces will not be an acceptable means of achieving the intended radii.
- C. All horizontal and vertical edges of concrete shall have 1/2-inch radii.
- D. All connections between pours must be absolutely flush and smooth.
- E. Grinding finished concrete to achieve the specified finishes will not be accepted.

3.08 CONCRETE JOINTS

- A. Cold Joints: Construct true to line with faces perpendicular to surface planes of concrete. Construct transverse joints at right angles to centerline, unless otherwise indicated. When joining existing pavement, place transverse joints to align with previously placed joints, unless otherwise indicated.
- B. Sawcut Joints: Form weakened-plane contraction joints, sectioning concrete into areas of approximately 100-square feet. See Material Plan for locations. Construct Sawcut joints to a depth of 1-1/2-inches and as follows:
 1. Sawed Joints: Form control joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades within 48-hours of any said pour. Cut 1/8-inch-wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before developing random contraction cracks. See Sawcut Detail.
- C. Expansion Joints:

1. Fill all expansion joints flush with polyurethane elastomeric sealant Sikaflex-2C or approved equal. See Expansion Joint detail in plans.

3.09 CONCRETE PROTECTION AND CURING

- A. General: Protect freshly placed shotcrete from premature drying and excessive cold or hot temperatures.
- B. Evaporation Retarder: Apply evaporation retarder according to manufacturer's written instructions after placing, screeding, and bull floating or darbying shotcrete, but before float finishing.
- C. Begin curing after finishing concrete, but not before free water has disappeared from concrete surface.
- D. Apply curing blankets 2-hours after finishing concrete. Overlap blankets 2-feet on all sides. The concrete should be hard enough to prevent surface damage when covering with concrete blankets.
- E. Maintain ongoing moisture of concrete by drip irrigation lines located under curing blankets. Provide ongoing moisture for a minimum of 14-days per finished area of concrete.
- F. Concrete shall be protected from any traffic for 30-days.
- G. The Contractor shall take necessary actions to protect the concrete from any vandalism or damage that may occur as a result of trespassing.
- H. Remove and replace concrete pavement that is broken, under strength, spalling, damaged, or defective, or does not meet requirements in this Section.
- I. Drill test cores where directed by Testing Agency 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.
- J. Maintain concrete pavement free of stains, discoloration, dirt, and other foreign material.
- K. The Contractor shall remove the curing blankets and the temporary drip irrigation system, as well as hose and Sweep concrete pavement not more than 2- days before date scheduled for Substantial Completion inspections.
- L. Grinding concrete to achieve specified finishes will not be allowed.

3.10 PAVEMENT TOLERANCES

- A. Comply with tolerances of ACI 117 and as follows:
 1. Elevation: 1/8-inch.
 2. Thickness: minus 1/4-inch.
 3. Surface: Gap below 10-foot-long, unleveled straightedge not to exceed 1/4-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 Pavement Edge: 1/2-inch.
 7. Alignment of Dowel-Bar End Relative to Line Perpendicular to Pavement Edge:
 8. Length of dowel 1/4-inch per 12-inches.
 9. Contraction Joint Depth: Plus 1/4-inch, no minus.
 10. Joint Width: Plus 1/8-inch, no minus.
 11. Plan Dimension 1-inch.
 12. Vertical Radii: 1/4-inch over length of transition as checked with true template.

3.11 FIELD QUALITY CONTROL

- A. Independent Testing Agency: The Owner's Independent Testing Agency shall sample materials, perform tests, and submit test reports during concrete placement according to requirements specified.
- B. Testing Services: Testing will 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: AASHTO T119; one test at point of placement for each compressive-strength test, but not less than one test for each day's pour of each type of concrete. Additional tests will be required when concrete consistency changes.
 - 3. Air Content: ASTM C173 or AASHTO T152, pressure method; one test for each compressive-strength test, but not less than one test for each day's pour of each type of air- entrained concrete.
 - 4. Concrete Temperature: ASTM C1064; one test hourly when air temperature is 40-degrees Fahrenheit and below and when 80-degrees Fahrenheit and above, and one test for each set of compressive- strength specimens.
 - 5. Compression Test Specimens: ASTM C31; 1 set of 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: ASTM C39; one set for each day's pour of each concrete class exceeding 5-cubic yards, but less than 25-cubic yards, plus 1-set for each additional 50-cubic yard. 1-specimen shall be tested at 7-days and 2-specimens at 28-days; one specimen shall be retained in reserve for later testing if required.
- C. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by the Owner's Representative, but will not be used as the sole basis for approval or rejection.
- D. 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 Owner's Representative. Testing agency may conduct tests to determine adequacy of concrete by cored cylinders complying with AASHTO 501.24(b), or by other methods as directed.

End of Section 32 1301

Section 32 1313
Concrete Paving

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Concrete sidewalks, stair steps, integral curbs, and gutters
- B. Concrete collars for water valves and cleanouts.

1.02 RELATED REQUIREMENTS

- A. Section 31 2200 - Grading: Preparation of site for paving and base.
- B. Section 31 2323 - Fill: Compacted subbase for paving.
- C. Section 32 1123 - Aggregate Base Courses: base course.
- D. Section 32 1216 - Asphalt Paving: Asphalt wearing course.
- E. Section 33 0561 - Concrete Manholes: Structures, including frames; gutter drainage grilles, covers, and frames for placement by this section.

1.03 REFERENCE STANDARDS

- A. ACI 211.1 - Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete; 1991 (Reapproved 2009).
- B. ACI 301 - Specifications for Structural Concrete; 2010 (Errata 2012).
- C. ACI 304R - Guide for Measuring, Mixing, Transporting, and Placing Concrete; 2000.
- D. ACI 305R - Hot Weather Concreting; 2010.
- E. ACI 306R - Cold Weather Concreting; 2010.
- F. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon Steel Bars for Concrete Reinforcement; 2015.
- G. ASTM A1064/A1064M - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete; 2015.
- H. ASTM C33/C33M - Standard Specification for Concrete Aggregates; 2016.
- I. ASTM C39/C39M - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens; 2015a.
- J. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete; 2015.
- K. ASTM C150/C150M - Standard Specification for Portland Cement; 2016.
- L. ASTM C260/C260M - Standard Specification for Air-Entraining Admixtures for Concrete; 2010a.
- M. ASTM C309 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete; 2011.
- N. ASTM C494/C494M - Standard Specification for Chemical Admixtures for Concrete; 2013.
- O. ASTM C618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete; 2015.
- P. ASTM C685/C685M - Standard Specification for Concrete Made by Volumetric Batching and Continuous Mixing; 2014.

- Q. ASTM D1751 - Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types); 2004 (Reapproved 2013).
- R. ASTM D1752 - Standard Specification for Preformed Sponge Rubber Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction; 2004a (Reapproved 2013).

1.04 SUBMITTALS

- A. See General Conditions - Article 9, for Submittal Requirements.
- B. Product Data: Provide data on joint filler, admixtures, and curing compound.
- C. Concrete mix design.

PART 2 PRODUCTS

2.01 PAVING ASSEMBLIES

- A. Comply with applicable requirements of ACI 301.
- B. Concrete Sidewalks and Curbs: minimum 4 inches thick, natural color and per project soils report.

2.02 FORM MATERIALS

- A. Wood form material, profiled to suit conditions.
 - 1. Materials shall be free from defects which would impair the appearance of structural quality of the completed work
 - 2. Provide stakes and bracing materials as required to hold forms securely in place.
- B. Joint Filler: Preformed; non-extruding bituminous type (ASTM D1751) or sponge rubber or cork (ASTM D1752).
 - 1. Thickness: 1/2 inch.

2.03 REINFORCEMENT

- A. Reinforcing Steel: ASTM A615/A615M, Grade 60 (60,000 psi) yield strength; deformed billet steel bars; unfinished.
- B. Steel Welded Wire Reinforcement: Plain type, ASTM A1064/A1064M; in flat sheets; unfinished.
- C. Dowels: ASTM A615/A615M, Grade 40 - 40,000 psi yield strength; deformed billet steel bars; unfinished finish.

2.04 CONCRETE MATERIALS

- A. Obtain cementitious materials from same source throughout.
- B. Concrete Materials: Provide in accordance with State of CA Highways standards.
- C. Cement: ASTM C150/C150M, Normal - Type I Portland cement, gray color.
- D. Fly Ash: ASTM C618, Class C or F.
- E. Water: Clean, and not detrimental to concrete.
- F. Air-Entraining Admixtures: ASTM C260/C260M.
- G. Chemical Admixtures: ASTM C494/C494M, Type A - Water Reducing, Type C - Accelerating, and Type G - Water Reducing, High Range and Retarding.

2.05 ACCESSORIES

- A. Curing Compound: ASTM C309, Type 1, Class A.

B. Surface Retarder:

2.06 CONCRETE MIX DESIGN

- A. Proportioning Normal Weight Concrete: Comply with ACI 211.1 recommendations.
- B. Admixtures: Add acceptable admixtures as recommended in ACI 211.1 and at rates recommended by manufacturer.
- C. Concrete Properties:
 - 1. Compressive strength, when tested in accordance with ASTM C39/C39M at 28 days; 3000 psi.
 - 2. Water-Cement Ratio: Maximum 50 percent by weight.
 - 3. Maximum Slump: 3 inches.

2.07 MIXING

- A. On Project Site: Mix in drum type batch mixer, complying with ASTM C685/C685M. Mix each batch not less than 1-1/2 minutes and not more than 5 minutes.
- B. Transit Mixers: Comply with ASTM C94/C94M.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify compacted subgrade is acceptable and ready to support paving and imposed loads.
- B. Verify gradients and elevations of base are correct.

3.02 SUBBASE

- A. See Section 32 1123 for construction of base course for work of this Section.

3.03 PREPARATION

- A. Moisten base to minimize absorption of water from fresh concrete.

3.04 FORMING

- A. Place and secure forms to correct location, dimension, profile, and gradient.
- B. Assemble formwork to permit easy stripping and dismantling without damaging concrete.
- C. Place joint filler vertical in position, in straight lines. Secure to formwork during concrete placement.

3.05 REINFORCEMENT

- A. Place reinforcement as indicated.

3.06 COLD AND HOT WEATHER CONCRETING

- A. Follow recommendations of ACI 305R when concreting during hot weather.
- B. Follow recommendations of ACI 306R when concreting during cold weather.
- C. Do not place concrete when base surface temperature is less than 40 degrees F, or surface is wet or frozen.

3.07 PLACING CONCRETE

- A. Place concrete in accordance with ACI 304R.
- B. Do not place concrete when base surface is wet.
- C. Ensure reinforcement, inserts, embedded parts, formed joints are not disturbed during concrete placement.

- D. Place concrete continuously over the full width of the panel and between predetermined construction joints. Do not break or interrupt successive pours such that cold joints occur.
- E. Apply surface retarder to all exposed surfaces in accordance with manufacturer's instructions.

3.08 JOINTS

- A. Align curb, gutter, and sidewalk joints.
- B. Place expansion joints at intervals indicated in the Improvement Plans, Specifications and Landscape's Construction Plan.
- C. Place 3/8 inch wide expansion joints at 20 foot intervals and to separate paving from vertical surfaces and other components and in pattern indicated.
- D. Provide Control joints as indicated in the County of San Luis Obispo standards, specifications and Landscape's Construction Plan.

3.09 FINISHING

- A. Area Paving: Light broom, texture parallel to pavement direction.
- B. Sidewalk Paving: match existing. ____ .
- C. Curbs and Gutters: Light broom, texture parallel to pavement direction.
- D. Place curing compound on exposed concrete surfaces immediately after finishing. Apply in accordance with manufacturer's instructions.

3.10 TOLERANCES

- A. Maximum Variation of Surface Flatness: 1/4 inch in 10 ft.
- B. Maximum Variation From True Position: 1/4 inch.

3.11 FIELD QUALITY CONTROL

- A. An independent testing agency will perform field quality control tests, as specified in Section 01 4000 - Quality Requirements.
 - 1. Provide free access to concrete operations at project site and cooperate with appointed firm.
 - 2. Tests of concrete and concrete materials may be performed at any time to ensure compliance with specified requirements.
- B. Maintain records of placed concrete items. Record date, location of pour, quantity, air temperature, and test samples taken.

3.12 PROTECTION

- A. Immediately after placement, protect pavement from premature drying, excessive hot or cold temperatures, and mechanical injury.
- B. Do not permit pedestrian traffic over pavement until 75 percent design strength of concrete has been achieved.

End of Section 32 1313

Section 32 1413
Precast Concrete Unit Paving

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Interlocking concrete paver units.
- B. Sand setting bed.
- C. Sand joint filler.

1.02 RELATED REQUIREMENTS

- A. Section 31 2200 - Grading: Preparation of subsoil for pavers.
- B. Section 31 2323 - Fill: Compacted fill for pavers.
- C. Section 32 1123 - Aggregate Base Courses: Aggregate subbase for pavers.
- D. Section 32 1123 - Aggregate Base Courses: Pavement subbase.

1.03 PRICE AND PAYMENT PROCEDURES

- A. See Article 41 of the General Conditions for Payment Procedures.
- B. See Section 01 2200 - Unit Prices, for additional unit price requirements.
- C. Pavers on Sand Bed: By the square foot. Includes preparation of substrate, sand setting bed, pavers, sand jointing, finishing.

1.04 REFERENCE STANDARDS

- A. ASTM C33/C33M - Standard Specification for Concrete Aggregates; 2016.
- B. ASTM C936/C936M - Standard Specification for Solid Concrete Interlocking Paving Units; 2013.

1.05 SUBMITTALS

- A. See Article 9 of the General Conditions for Submittal Procedures.
- B. See Section 01 3300 - Submittals, for submittal procedures.
- C. Product Data: Provide characteristics of paver unit, dimensions, and special shapes.
- D. Samples: Submit two samples of each paver type, illustrating style, size, color range and surface texture of units being provided.
- E. Manufacturer's Installation Instructions: Indicate substrate requirements, _____, and installation methods.
- F. Maintenance Materials: Provide the following for CRPD's use in maintenance of project.
 - 1. See Section 01 6000 - Product Requirements, for additional provisions.
 - 2. Extra Pavers: 10 of each type and size.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Concrete Pavers:
 - 1. Aqualine Permeable Paver
 - a. Supplier: Belgard
 - b. Address: 10714 Poplar Ave., Fontana, CA 92337
 - c. Contact Person: Yvonna Garcia, (909) 355-6422
 - d. <https://www.belgardcommercial.com/>

- B. Substitutions: See General Conditions for substitutions.

2.02 MATERIALS

- A. Concrete Pavers: Hydraulically pressed concrete, configured for interlocking with adjacent units and complying with ASTM C936/C936M.
1. Compressive Strength: 8000 pounds per square inch average, with minimum of 7200 pounds per square inch.
 2. Absorption: 5 percent average, with maximum of 7 percent.
 3. Size: 3x12 inch.
 4. Thickness: 3-1/8 inches or 80 mm.
 5. Type: Rectangular.
 6. Color: Selected from manufacturer's full range: Equal blend of Graphite, Rio, and Foundry. Verify with CRPD in writing prior to ordering.
- B. Sand for Setting Bed: Clean washed natural sand or crushed stone complying with gradation requirements of ASTM C33/C33M for fine aggregates.
- C. Sand for Joints: Fine washed sand with 100 percent passing No. 16 sieve and not more than 10 percent passing No. 200 sieve.
- D. Joints and bedding course for permeable installation: No. 8 Aggregate.
- E. Geogrid Fabric: Woven polypropylene soil reinforcement for tension and tensile strength under pavers.
1. Product: Tensar, TriAx TX160 or approved equal.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that substrate is level or to correct gradient, smooth, capable of supporting pavers and imposed loads, and ready to receive work of this Section.
- B. Verify gradients and elevations of substrate are correct.

3.02 INSTALLATION OF PERMEABLE PAVER UNITS

- A. Prepare open-graded base courses per Drawings.
- B. Spread aggregate bedding course 1-1/2" to 2" thick.
- C. Place paver units in pattern shown on Drawings.
- D. Cut paver units at edges with masonry saw.
- E. Joint widths shall be 3/16".
- F. Sprinkle joint aggregate over surface and sweep into joints. Moisten joints and recover with additional aggregate until firm joints are achieved. Remove excess material.
- G. Spread sand bedding evenly over prepared substrate surface to a maximum thickness of 1-1/2 inch.
- H. Dampen and roller compact sand to level and even surface.
- I. Screed and scarify top 1 inch to 1 1/2 inch of sand.
- J. Place paver units in parallel running bond pattern creating staggered joints, from straight reference edge.
- K. Cut paver units at edges with masonry saw.
- L. Place half units at edge and interruptions. Maintain tight joints.

- M. Sprinkle sand over surface and sweep into joints. Moisten joints and recover with additional sand until firm joints are achieved. Remove excess sand.
- N. Tamp and level paver units with mechanical vibrator until units are firmly bedded, level, and to correct elevation and gradients. Do not tamp unrestrained edges.

3.03 CLEANING

- A. Do not clean pavers until pavers are dry.
- B. Clean soiled surfaces using cleaning solution. Do not harm pavers, joint materials, or adjacent surfaces.
- C. Use non-metallic tools in cleaning operations.
- D. Rinse surfaces with clean water.
- E. Broom clean paving surfaces. Dispose of excess sand.

3.04 PROTECTION

- A. Do not permit traffic over unprotected paver surface.
- B. Protect paver surface with sheets of plywood.

End of Section 32 1413

Section 32 1816.13

Playground Protective Surfacing

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Protective surfacing for fitness area.
 - 1. Poured-in-Place Rubber.
- B. Subbase under resilient surfacing.

1.02 RELATED REQUIREMENTS

- A. Section 03 3000 - Cast-in-Place Concrete.
- B. Section 11 6833 Athletic Equipment.
- C. Section 11 6813 - Playground Equipment: Playground layout (staking).
- D. Section 32 1123 - Aggregate Base Courses: Subbase for resilient surfacing.
- E. Section 32 1313 - Concrete Paving: Subbase for resilient surfacing.

1.03 REFERENCE STANDARDS

- A. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN m/m³)); 2012.
- B. ASTM D2047 - Standard Test Method for Static Coefficient of Friction of Polish-Coated Floor Surfaces as Measured by the James Machine; 2011.
- C. ASTM F1292 - Standard Specification for Impact Attenuation of Surface Systems Under and Around Playground Equipment; 2009.
- D. ASTM F1487 - Standard Consumer Safety Performance Specification for Playground Equipment for Public Use; 2011.
- E. CPSC Pub. No. 325 - Public Playground Safety Handbook; 2010.

1.04 DEFINITIONS

- A. Use Zone: The area beneath and immediately adjacent to a play structure or equipment (play event) that is designated for unrestricted circulation around equipment, and on whose surface it is predicted that a user would land when falling from or exiting the equipment.
- B. Critical Fall Height: The maximum fall height at which the protective surfacing meets the requirements of ASTM F1292.
- C. Fall Height: The vertical distance between the finished elevation of the designated play surface and the finished elevation of the protective surfacing beneath it as defined by ASTM F1487.
- D. Protective Surfacing: Resilient ground surfacing. The characteristics of the protective surfacing are based on the fall height of the playground equipment. Changes in either the surfacing or the fall height, particularly reducing the resilience of the protective surfacing or increasing the fall height, will reduce safety-related performance.
- E. Subbase: A layer under the resilient layer of the protective surfacing but over the subgrade; may be rigid, as in concrete or bituminous, or aggregate.
- F. Subgrade: The surface of the ground on which the protective surfacing is installed.

1.05 SUBMITTALS

- A. See General Conditions - Article 9, for submittal procedures.

- B. Product Data: For all manufactured surfacing products, provide manufacturer's product data showing materials of construction, compliance with specified standards, installation procedures, and safety limitations.
 - 1. Include IPEMA certifications where required.
- C. Samples: For each product for which color must be selected provide color chart showing full range of colors.

1.06 QUALITY ASSURANCE

- A. Maintain one copy of the latest edition of ASTM F1487 and CPSC Pub. No. 325 at project site.
- B. Manufacturer Qualifications: Company regularly engaged in manufacturing products specified in this section, with not less than ten years of documented experience.
 - 1. Surfacing installed in minimum 20 sites and been in successful service minimum 7 years.
- C. Installer Qualifications: Company certified by manufacturer for training and experience installing the protective surfacing; provide installer's company name and address, and training and experience certificate.

1.07 PRE-INSTALLATION MEETING

- A. Coordinate with Section 11 6813.
- B. Convene a meeting one week before starting earthwork for playground to discuss coordination between various installers.
 - 1. Require attendance by personnel responsible for grading and installers of playground equipment, protective surfacing, footings, and adjacent work.
 - 2. Include representatives of Contractor.
 - 3. Notify Architect at least 2 weeks prior to meeting.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, handle, and store protective surfacing to project site in accordance with manufacturer's recommendations.
- B. Store materials in a dry, covered area, elevated above grade.

1.09 WARRANTY

- A. See Section 01 7800 - Closeout Submittals - Closeout Submittals, for additional warranty requirements.
- B. Provide minimum 5 year warranty for playground surfacing.

PART 2 PRODUCTS

2.01 Performance CRITERIA

- A. Because the safety of the playground depends on strict compliance with the performance criteria, this information is provided for Contractor's information.
 - 1. The protective surfacing constitutes a resilient layer installed over a non-resilient layer, which is installed over the subgrade, with the top of playground equipment footings and anchorage devices covered by full depth of the resilient portion of the protective surfacing.
 - 2. The top elevation of the protective surfacing is intended to be flush with adjacent grades.
 - 3. Use Zone: The protective surfacing has been designed to provide acceptable impact attenuation as defined in ASTM F1292 for Critical Height of ____ feet.
- B. If deviation from specified depth is required, it is the Contractor's responsibility to make all changes required to maintain specified top elevation and required impact attenuation at no

extra cost to CRPD; obtain approval prior to proceeding; follow approval request procedure as specified for substitutions.

2.02 MATERIALS

- A. Poured-In-Place Membrane Surfacing: Weather-resistant wear layer over impact attenuating substrate over aggregate subbase.
 - 1. Wear Layer: Ethylene propylene diene monomer (EPDM) particles adhered with a ultraviolet-stabilized polyurethane binder to produce an even, uniformly colored surface.
 - 2. Wear Layer Thickness: 1/2 inch, minimum.
 - 3. Coefficient of Friction, when wet: 0.8, minimum, when tested in accordance with ASTM D2047.
 - 4. Wear Layer Color(s): As selected from manufacturer's full range of bright colors. Colors shall be 1/3 Black, 1/3 Premium color #1, and 1/3 Premium color #2. CRPD to approve final select colors. Submit samples. Selection shall be in writing.
 - 5. Impact Attenuating Substrate: 100 percent recycled shredded styrene butadiene rubber (SBR) shreds or granules with 100 percent solids polyurethane binder to form a resilient material; do not use foam rubber.
 - 6. Resilient Depth: As required to achieve specified Critical Fall Height as defined in ASTM F1292 but not more than depth indicated; maintain top elevation flush with adjacent grades.
 - 7. Certification: Provide IPEMA certification of ASTM F1292 Critical Fall Height at thickness specified.
- B. Geotextile: Nonwoven polypropylene sheet.
- C. Aggregate Subbase: See Section 32 1123.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Fitness equipment installer will perform playground layout prior to installation of footings; verify correctness of layout before starting this work.
- B. Verify that playground equipment and site furnishings and irrigation system located within playground area are complete.
- C. Verify location of underground utilities and facilities in the playground area. Damage to underground utilities and facilities will be repaired at Contractor's expense.
- D. Verify that subgrades are at proper elevations and that smooth grading is complete.
- E. Verify that proper depth of surfacing is marked on base supports of playground equipment.

3.02 PREPARATION

- A. Correct subgrade irregularities to ensure that required depth of protective surfacing can be installed, and subgrade elevation is in accordance with manufacturer's requirements.
- B. Inside Use Zones remove all obstructions that would extend into the resilient protective surfacing.
- C. Remove rocks, debris, and other similar items.

3.03 SUBBASE

- A. Install aggregate subbase as indicated on drawings and in Section 32 1123. Compact aggregate to maximum 95 percent, in accordance with ASTM D1557.

- B. Install with top surface of subbase no higher than grades and levels indicated and not more than 1/4 inch lower than grades and levels indicated.
- C. Install in true, even plane, sloped to provide positive drainage.
- D. Flatness Tolerance: 1/4 inch in 10 feet, maximum.

3.04 RESILIENT SURFACING LAYER

- A. Install in accordance with CPSC Pub. No. 325, ASTM F1487, manufacturer's instructions, and requirements of authorities having jurisdiction (AHJ).
- B. Install proper thickness throughout Use Zone(s).
- C. Clean and dry surface of subbase.
- D. Cover aggregate subbase with geotextile:
 - 1. Verify that aggregate is free of ruts or protruding objects.
 - 2. Lap minimum 4 inches width at seams. Adhere seams in accordance with manufacturer's recommendations.
 - 3. Install smooth, and free of tensile stresses, folds, or wrinkles.
 - 4. Protect from clogging, tears, or other damage during surfacing installation.
 - 5. Repair or replace damaged geotextile in accordance with manufacturer's recommendations.
- E. Poured In Place Surfacing:
 - 1. Mix components mechanically on-site in accordance with manufacturer's directions; do not mix by hand.
 - 2. Install seamlessly; ensure complete bond to subbase.
 - 3. Cover footings and foundations and adhere tightly around penetrating elements.
 - 4. Maintain full thickness of resilient layers within Use Zone; cover or abut containment curbs as indicated on drawings; completely cover tapered transition edges.
 - 5. Hand trowel exposed surface to smooth, even finish.
 - 6. Impact Attenuation Layer: Install entire layer in one continuous pour on the same day.
 - 7. Wear Surface: Bond wear surface to substrate with adhesive. Apply adhesive in small quantities so that wear surface can be applied before adhesive dries.
 - a. Install surfacing seamlessly. When wear surface is composed of different color patterns, pour surface continuously and seamlessly.
 - b. When seams are required due to color change or field conditions, place adjacent wear surface as soon as possible, before initial pour has cured. Coat edge of initial pour with adhesive and apply wear surface mixture immediately.
 - c. Add a minimum of 1/16 inch depth to specified surfacing depth to ensure required impact attenuation performance is met.
 - d. Install wear surface to cover foundations and adhere tightly around elements penetrating the surface.

3.05 FIELD QUALITY CONTROL

- A. CRPD or CRPD's representative will inspect playground surfacing after installation to verify that surfacing is of proper type and depth and that playground meets specified design safety and accessibility requirements.
- B. Repair or replace rejected work until compliance is achieved.

3.06 CLEANING AND PROTECTION

- A. Restore adjacent existing areas that have been damaged from the construction.

- B. Clean fitness equipment of construction materials, dirt, stains, filings, and blemishes due to shipment or installation. Clean in accordance with manufacturer's instructions, using cleaning agents as recommended by manufacturer.
- C. Clean playground area of excess construction materials, debris, and waste.
- D. Remove excess and waste material and dispose of off-site in accordance with requirements of authorities having jurisdiction.
- E. Protect installed products until Date of Substantial Completion.
- F. Replace damaged products before Date of Substantial Completion.

End of Section 32 1816.13

Section 32 1820.00
Basketball Court Surfacing

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Colored, heavy duty concrete coating system.
- B. Custom colored logo.

1.02 RELATED SECTIONS

- A. Section 32 1313 - Concrete Paving

1.03 REFERENCES

- A. American Sports Builders Association (A.S.B.A.) guide specifications.

1.04 SCOPE OF WORK

- A. This specification covers the construction and installation for (1) basketball court, one volleyball court, and two pickleball courts, see Drawings.
- B. Courts shall be cleaned prior to application using a stiff bristle broom and gas powered blower or water based pressure spray unit capable of generating 2500 psi at the nozzle tip, to remove all dirt and debris.
- C. The work to be performed under this specification includes all labor, equipment, materials and supplies necessary for the installation of the court surfacing and striping included in this contract.

1.05 SUBMITTALS

- A. See General Conditions - Article 9, for submittal procedures.
- B. Product Data: For all manufactured surfacing products, provide manufacturer's product data showing materials of construction, compliance with specified standards, installation procedures, and safety limitations.
- C. Samples: Provide 2 actual material samples for each color indicated on the drawings. Samples shall be 6"x6" minimum.

PART 2 - PRODUCTS

2.01 Court surface materials:

- A. Novacrylic, as manufactured by Nova Sports U.S.A., 6 Industrial Rd., Bldg. #2., Milford, MA 01757. 800-USA-NOVA. www.novasports.com
 - 1. Colors:
 - a. As shown on drawings.
 - b. Custom Logo colors as shown on the drawings.
 - c. CRPD shall approve colors prior to ordering. Approval shall be in writing.
 - 2. Approved equal
- B. All coatings shall be pure acrylic, containing no asphaltic or tar emulsions, nor any vinyl, alkyd or non-acrylic resins.
- C. The color system shall be factory-mixed compounds requiring only the addition of water at the jobsite except for the addition of sand to Novasurface. All materials shall be delivered to the jobsite in sealed containers with the manufacturer's label affixed.

2.02 PART 3 - EXECUTION

A. Preparation

1. Vapor barrier must be installed prior to pouring concrete, minimum 15-mil thick polyolefin geo membrane.
2. No wax or curing agents that are not certified as coatable shall be used.
3. New concrete shall cure for twenty-eight days prior to application of any surfacing materials.
4. Concrete shall have a medium broom finish.
5. Contractors must notify the Landscape Architect of all applications, 48 hours prior to installation.
6. Etch concrete with a Phosphoric Acid solution; allow to set and flush completely with water.
7. The surface to be coated shall be inspected and made sure to be free of grease, oil, dust, dirt and other foreign matter before starting work.
8. The surface shall be flooded. Any ponding water remaining that is deep enough to cover the thickness of a five-cent piece shall be corrected using a patch mix consisting of Novabond, 50-mesh sand and Portland cement, as per manufacturers directions. Depressions must be primed with a 50% dilution of Novabond and water prior to patching.

B. Application

1. Application shall proceed only if the surface is dry and clean and the temperature is at least fifty degrees (50°F) and rising, and the surface temperature is not in excess of one hundred forty degrees (140°F). Do not apply coatings when rain is imminent.
2. Each coat in this system must dry completely before next application. Between each coat, inspect entire surface. Any defects should be repaired. Scrape surface to remove any lumps, and broom or blow off all loose matter.
3. Apply one (1) coat of CP761 Concrete Primer, diluted one (1) part CP761 to one (1) part clean water. Application may be with squeegee, broom or roller. Allow CP761 to dry thoroughly.
4. Using a neoprene rubber squeegee, apply one (1) coat of Novasurface acrylic resurfacer, diluted with one (1) part clean water, to two (2) parts Novasurface. Clean, bagged sand shall be incorporated into the diluted Novasurface at the rate of five (5) to ten (10) Lbs. per gallon. Sand gradation shall be 50 to 60-mesh. Allow application to dry thoroughly.
5. Using a neoprene rubber squeegee, apply two (2) coats of Novaplay. Allow each application to dry thoroughly. A small (not to exceed 8 fl. oz per gal.) quantity of water may be used in diluting these coatings, only if coatings are drying too rapidly. Permission of the owner shall be obtained before adding additional water.

C. Line Markings

1. Upon completion and acceptance of the court surface, Contractor shall prepare and paint lines for basketball as shown on the drawings.
2. All lines are to be applied by painting between masking tape with a paintbrush or roller, according to U.S.T.A specifications.
3. Prime masked lines with Seal-A-Line. Allow application to dry.
4. Paint lines with Novatex textured line paint. Allow application to dry.
5. Remove masking tape immediately after lines are dry.

6. Protect adjacent areas and structures (fences, posts, sidewalks, buildings, etc.), which are not to be coated. In the event that coatings are applied to above, remove immediately before drying is complete.
- D. Completion
1. Upon completion, the contractor shall insure proper removal of all construction debris, surplus materials, empty containers and wash water, and shall leave the site in a condition acceptable to the owner. The court is to be left secure so as to prevent vandalism.
- E. Limitations
1. Apply coatings only when ambient temperature is fifty degrees (50°F) and rising, and the surface temperature is not in excess of one hundred forty degrees (140°F).
 2. Coatings are waterborne and cannot cure in cold temperatures or when subject to moisture. Care should be taken not to apply coatings when rain is forecast or sudden drop of temperature is expected. Climatic conditions such as very cool evenings and high dew points dictate that work should be completed early in the day so the coatings can be exposed to enough warm sunlight to form a film before sunset. The opposite applies during times of high heat, low humidity and drying breezes: under these conditions, work very early in the morning or very late in the day. If the product seems to be drying too fast in hot weather, mist the pavement with water to make the application easier. Care must be taken to allow each application to dry thoroughly prior to recoating.

End of Section 32 1820.00

Section 32 3119

Decorative Metal Fences and Gates

PART 1 GENERAL

1.01 Work Included – Work includes, but is not necessarily limited to:

- A. Decorative steel picket fencing system.
- B. Decorative steel single rolling gate system with, guide rails and posts, gate uprights, wheels and hardware, embedded track, shock absorbers, and safety devices.
- C. Decorative steel picket single swing gate with locking latch and perforated screen.
- D. All hardware, attachments, and accessories as required to provide a complete installation.
- E. Coordination of gate and fencing systems with adjacent building walls and all associated finishes.

1.02 Related Work Described Elsewhere

- A. Section 03 3000 Cast-in-Place Concrete
- B. Section 05 5000 Metal Fabrications
- C. Section 08 7000 Hardware
- D. Section 09 9000 Paints and Coatings
- E. Section 32 1313 Concrete Paving

1.03 Quality Assurance

- A. Installer – Work to be performed only by workers thoroughly skilled and specially trained in the techniques of the manufacturer, and who are completely familiar with the published recommendations of the manufacturer and have at least three (3) years of experience installing the selected system. Installer to be approved by the manufacturer.
- B. Products Requiring Electrical Connection: Listed and classified by testing firm acceptable to the authority having jurisdiction as suitable for the purpose specified and indicated.

1.04 References -- In addition to complying with all pertinent codes and regulations:

- A. ASTM A36 - Standard Specification for Carbon Structural Steel
- B. ASTM A 123 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
- C. ASTM A500 - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
- D. ASTM A513 - Standard Specification for Electric-Resistance-Welded Carbon and Alloy Steel Mechanical Tubing
- E. ASTM A-653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
- F. ASTM B117 - Standard Practice for Operating Salt Spray (Fog) Apparatus
- G. ASTM D523 - Test Method for Specular Gloss.
- H. ASTM D714 - Test Method for Evaluating Degree of Blistering Paint.
- I. ASTM D822 - Practice for Conducting Tests on Paint and Related Coatings and Materials using Filtered Open-Flame Carbon-Arc Light and Water Exposure Apparatus.

- J. ASTM D1654 - Test Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments.
- K. ASTM D2244 - Test Method for Calculation of Color Differences from Instrumentally Measured Color Coordinates.
- L. ASTM D2794 - Test Methods for Resistance to Organic Coatings to the Effects of Rapid Deformation (Impact).
- M. ASTM D3359 - Test Method for Measuring Adhesion by Tape Test.
- N. ASMT F2408 - Ornamental Fences Employing Galvanized Steel Tubular Pickets.

1.05 Submittals

- A. See Article 9 of the General Conditions for Submittal Procedures.
- B. Product Data – Submit material specifications and manufacturer’s installation instructions
- C. Shop Drawings to include:
 - 1. Layout of fences and gates showing all dimensions, sizes, thickness, gauges, finishes, joining, attachments, gate attachments, gate loops, and relationships to adjacent work.
 - 2. Gate elevations indicating the Finish Grade along the length of the gate.
 - 3. Post foundations details.
 - 4. Gate hardware (including hinges, latches, drop bar for inactive leaf, etc.).

1.06 Product Handling

- A. Protection
 - 1. Materials to be stored at the job site in a safe, dry place with all labels intact and legible at time of installation.
 - 2. Use all means to protect materials before, during, and after installation. Do not allow products to become wet or damp.
- B. Replacements: In the event of damage, including water intrusion, immediately make all repairs and replacements necessary to the approval of the Landscape Architect and at no additional cost to the Owner.

1.07 Product Warranty

- A. All structural fence components (i.e. rails, pickets, and posts) shall be warranted by the manufacturer for a period of 20 years from date of acceptance of the work. Warranty shall cover and defects in material finish, including cracking, peeling, chipping, blistering, or corroding.
- B. Reimbursement for labor necessary to restore or replace components that have been found to be defective under the terms of manufacturer's warranty shall be guaranteed for five (5) years from date of acceptance of the work.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Ameristar Fence Products, Inc.: www.ameristarfence.com.
- B. Approved equal.

2.02 PRODUCTS

- A. Fence System: Montage II Welded and Rackable Ornamental Steel.
 - 1. "Classic" design.
 - 2. Extended picket bottom rail.

3. 4-Rail style.
 4. 6-foot high panels.
 5. Color: black.
- B. Swing Gates: Montage II, design and style to match fence panels.
1. Single and double swing gates as shown on the Drawings.
 2. 6-foot high.
 3. Heavy commercial hinge kits.
 4. Lockable latch.
 5. Color: black.
- C. Sliding Rolling Gate: Montage II, design and style to match fence panels.
1. "Classic" design.
 2. Rolling gates as shown on the Drawings.
 3. 6-foot high.
 4. Color: black.

2.03 Materials

- A. Steel material for fence panels and posts shall conform to the requirements of ASTM A653/A653M, with a minimum yield strength of 45,000 psi (310 MPa) and a minimum zinc (hot-dip galvanized) coating weight of .90 oz/ft² (276 g/m²), Coating Designation G-90.
- B. Materials for pickets shall be 1" square x 14 Ga tubing. The rails shall be steel channel, 1.75" x 1.75" x 12 Ga. Fence posts and gate posts shall meet the minimum size requirements indicated on the drawings.
- C. Materials for sliding gate and posts shall meet the minimum size requirements indicated on the drawings.

2.04 Fabrication

- A. Pickets, rails, and posts shall be pre-cut to specified lengths. Rails shall be pre-punched to accept pickets.
- B. Pickets shall be inserted into the pre-punched holes in the rails and shall be aligned to standard spacing. The aligned pickets and rails shall be joined at each picket-to-rail intersection by fusion welding to result in a rigid panel assembly.
- C. The manufactured panels and posts shall be subjected to an inline electrodeposition coating (E-Coat) process consisting of a multi-stage pretreatment/wash, followed by a duplex application of an epoxy primer and an acrylic topcoat.
1. The minimum cumulative coating thickness of epoxy and acrylic shall be 2 mils (0.058 mm).
 2. The color shall be black.
- D. The manufactured fence system shall be capable of meeting the vertical load, horizontal load, and infill performance requirements for Industrial weight fences under ASTM F2408.
- E. Swing gates shall be fabricated using 1.75 x 14ga double channel rail, 2" sq. x 12ga gate ends, and 1" sa. x 14ga pickets. Gates that exceed 6' in width will have a 1.75" sq. x 14ga intermediate upright. All rail and upright intersections shall be joined by welding. All picket and rail intersections shall also be joined by welding. Gusset plates will be welded at each upright to rail intersection. Provide cable kits for additional trussing for all gates leaves over 6'.
- F. Pickets, rails, uprights and posts for rolling gates shall be precut to specified lengths. Diagonals shall be precut to specified lengths and angles. Frame materials shall be joined by welding. Pickets shall be face welded to roll gate frame, except for Invincible gates over 18'

long. Invincible style gates over 18' long shall have pickets face-welded to 2" x 2" angle iron to form panels equal in length to the gate frame bay width.

- G. The manufactured roll gates and bolt-on panels (if applicable) shall be subjected to the PermaCoat® thermal stratification coating process (high-temperature, in-line, multi-stage, multi-layer) including, as a minimum, a six-stage pre-treatment/wash (with zinc phosphate), an electrostatic spray application of an epoxy base, and a separate electrostatic spray application of a polyester finish. The base coat shall be a thermosetting epoxy powder coating (gray in color) with a minimum thickness of 2 mils (0.0508mm). The topcoat shall be a "no-mar" TGIC polyester powder coat finish with a minimum thickness of 2 mils (0.0508mm). The color shall be black.
- H. Completed roll gates shall be capable of supporting a 200 lb. load applied at midspan without permanent deformation.

PART 3 EXECUTION

3.01 Inspection

- A. Inspection – Examine the areas and conditions under which gate items are to be installed, and correct conditions detrimental to the proper and timely completion of the work. Do not proceed until unsatisfactory conditions have been corrected.

3.02 Preparation

- A. Preparation – Follow manufacturer's recommendations for installation preparations. Furnish setting drawings, diagrams, templates, instructions, and directions for installation of anchorage, such as steel column, welded angle, and miscellaneous items having integral anchors, which are to be embedded in concrete construction. Coordinate delivery of such items to project site. Verify the gate posts are plumb and gate moves freely.

3.03 Rolling Gates - Preparation and Installation

- A. Preparation: All new gate installation shall be laid out in accordance with the construction plans.
- B. Installation
 - 1. Gateposts shall be set in accordance with the spacing's shown in the construction plans. The "Earthwork" and "Concrete" sections of this specification shall govern post base material requirements. 6" wheels shall be bolted to the gate (between the wheel plates welded near the ends of the gate bottom rail). The gate shall be set upright with the V-grooved wheels positioned over the pre-installed steel V-track that traverses the gate opening. Roller guides shall be affixed to the gateposts at a height even with the gate top rail to hold the gate in a vertical position. Gate stops shall be welded to the end of the gate or track so gate cannot pass rollers in either direction.
 - 2. Touch up hardware.
 - a. Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with same material as used for shop painting. Apply or brush or spray to provide minimum dry film thickness of 0.051 mm (2.0 mils).
 - 3. Adjusting: Adjust gates as required and at the direction of the owner to provide the owner with fully operational gates.

3.04 Fencing Installation

- A. Fence posts shall be spaced according to manufacturer's instructions, plus or minus 1/2-inch.

- B. For installations that must be raked to follow sloping grades, the post spacing dimension must be measured along the grade.
- C. Fence panels shall be attached to posts with brackets supplied by the manufacturer.
- D. Posts shall be set in concrete footing as shown on the Drawings.
- E. Contractor to arrange fence posts to maximize clearance between fence posts and existing trees. Contractor to use care when digging footings for fence posts to avoid damage to existing tree trunks and roots.
- F. Cutting, Fitting, and Placement
 1. Perform cutting, drilling, and fitting required for installation of miscellaneous metal fabrications.
 2. Set work accurately in location, alignment, and elevation, and make plumb, level, true and free from rack, measured from established lines and levels.
 3. Provide temporary bracing or anchors in formwork for items, which are to be built into concrete or similar construction.
 4. Fit exposed connections accurately together to form tight hairline joints.
 5. Weld connections, which are not to be left as exposed joints, but cannot be shop welded because of shipping size limitations. 6. Grind exposed joints smooth, and touch up shop paint coat or galvanizing. Do not weld, cut, or abrade the surfaces of exterior units which have been hot-dip galvanized after fabrication and are intended for bolted or screwed field connections.
- G. Touch-Up Painting
 1. Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with same material as used for shop painting. Apply or brush or spray to provide minimum dry film thickness of 0.051 mm (2.0 mils).
 2. At all galvanized products, clean all damaged areas and re-coat using specified galvanizing coating per manufacturer's criteria.

3.05 Erection Tolerances

- A. Maximum Variation From Plumb: 1/4 inch.

3.06 Fence Installation Maintenance

- A. Do not make field modifications to the pre-fabricated components, such as cutting or drilling rails or posts, that will negate the manufacturer's warranty. Such modifications, if necessary, shall be done per the manufacturer's instructions.

3.07 Gate Installation

- A. Gate posts shall be spaced according to the manufacturer's gate drawings. The manufacturer's gate drawings shall identify the necessary gate hardware required for the application. Gate hardware shall be provided by the manufacturer of the gate and shall be installed per manufacturer's recommendations.

3.08 Cleaning

- A. Clean the jobsite of excess materials.
- B. Clean fence and gate panels, and touch up blemishes and scratches per manufacturer's instructions. Match color.
- C. Remove mortar from exposed posts and other fencing material using a 10 percent solution of muriatic acid followed immediately by several rinses with clean water.

End of Section 32 3119

Section 32 3300
Site Furnishings

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Benches.
- B. Hydration Station.
- C. Grill.
- D. Stool.
- E. Hammock.
- F. Portable Tables.

1.02 RELATED REQUIREMENTS

- A. Section 03 3000 - Cast-in-Place Concrete: footings for mounting.
- B. Section 05 5000 - Metal Fabrications: Anchors to attach site furnishings to mounting surfaces.
- C. Section 32 8423 - Irrigation: potable water connection for hydration stations.

1.03 SUBMITTALS

- A. See Article 9 of the General Conditions for submittal procedures.
- B. Product Data: Provide manufacturer's specifications and descriptive literature, installation instructions, and maintenance information, and warranty filled out in Owner's name.
- C. Shop Drawings: Indicate plans for each unit or group of units, elevations with model number, overall dimensions, construction, and anchorage details.

1.04 SUBSTITUTIONS

- A. Comply with Article 7 of the General Conditions

PART 2 PRODUCTS

2.01 PRECAST CONCRETE FURNISHINGS

- A. Manufacturer: Outdoor Creations, Inc.; www.outdoorcreations.com. Approved Equal.
 - 1. Quote No. Q2080.
 - 2. Bench Type 1: Five Point Star Bench
 - a. Size: 83"x67"x75"x17"
 - b. Finish:
 - 1) Smooth with factory-applied acrylic anti-graffiti clear sealer.
 - c. Color: Light Grey
 - 3. Bench Type 2: Five Point Star Bench
 - a. Size: 106"x97"x17"
 - b. Finish:
 - 1) Smooth with factory-applied acrylic anti-graffiti clear sealer.
 - c. Color: ODC Black

2.02 HYDRATION STATON

- A. Manufacturer: ELKAY (www.elkay.com).
 - 1. Description: Drinking Outdoor bottle filling station and ual drinking fountains.
 - 2. Model: LK4430BF1UGRY EZH20
 - 3. Finish: Grey

4. Mounting: Floor mount per manufacturer's specifications.
5. Intall with shut off valve and install new drain line in adjacent area per detail D/CC501.

2.03 GRILL

- A. Manufacturer: RCS (rcsgasgrills.com).
 1. Description: Natural Gas Drop-in Grill
 2. Model: 42" Cutlass Pro Drop-In Grill - RON42A
 3. Mounting: Per Manufacturer's instructions.
- B. Accessories
 1. Stainless steel doors with lockable handle. Submit specifications to Owner for approval for both the BBQ Counter and Built-in Counter. Door sizes are approximate.

2.04 STOOL

- A. Manufacturer: WyndenHall (target.com).
 1. Description: Metal bar stools, set of two.
 2. Model: 30" Josephine Metal Barstools, WyndenHall Collection
 3. Quantity: 6 (12 stools total)
 4. Color: Gray.

2.05 HAMMOCK

- A. Manufacturer: PNAEUT (Amazon.com).
 1. Description: Double Hammock
 2. Model: B08KSTJWLW
 3. Quantity: 3
 4. Color: Desert Moon with Charcoal Frame.

2.06 PORTABLE TABLES

- A. Type A: Manufacturer: Victor Stanley (victorstanley.com).
 1. Description: 42" Round, Portable Picnic Table
 2. Model: A-426
 3. Quantity: 10 tables
 4. Color: Teal
 5. Seat Slats: Grey Recycled Plastic
 6. Table Top: Perforated Slot Pattern
- B. Type B: Manufacturer: Victor Stanley (victorstanley.com).
 1. Description: 42"Round, Portable Picnic Table
 2. Model: A-H-425
 3. Quantity: 2 tables
 4. Color: Teal
 5. Seat Slats: Grey Recycled Plastic
 6. Table Top: Perforated Slot Pattern

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify proper installation of mounting surfaces, preinstalled anchor bolts, and other mounting devices; and ready to receive site furnishing items.
- B. Do not begin installation until unacceptable conditions are corrected.

3.02 INSTALLATION

- A. Install site furnishings in accordance with approved shop drawings, and manufacturer's installation instructions.
- B. Provide level mounting surfaces for site furnishing items.
- C. Connect hydration station to water and drain per manufacturer's instructions and as shown on the drawings.

End of Section 32 3300

Section 32 4000
Landscape Cobble

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Landscape Cobble.

1.02 RELATED REQUIREMENTS

1.03 PRICE AND PAYMENT PROCEDURES

- A. See Article 41 of the General Conditions for Payment Procedures.
- B. Payment will be based on the Unit Method: Measurement by the ton. Includes excavating, placing boulders, installing geotextile, placing cobble.

1.04 SUBMITTALS

- A. See Article 9, General Conditions, for submittal procedures.
- B. Samples - submit the following:
 - 1. Cobble - provide 5 cobbles, representative of size, color, shape, smoothness, and rock type.

1.05 QUALITY ASSURANCE

- A. Provide all rock in this section from the same source.

PART 2 PRODUCTS

2.01 LANDSCAPE COBBLE

- A. Supplier: Santa Paula Materials, Inc. 805-525-6858
- B. Description: Landscape cobble, smooth, 6" to 8" as indicated on Drawings.
- C. Color: "Malibu" earth tone.

2.02 GEOTEXTILE

- A. Non-woven polypropylene: Mirafi 40N or approved equal.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify subgrades are ready to receive work.

3.02 INSTALLATION AND PLACEMENT

- A. Install in accordance with drawings.
- B. Cobble:
 - 1. Install geotextile fabric.
 - 2. Place cobble. Geotextile should not be exposed or visible.

End of Section 32 4000

Section 32 8423
Irrigation System

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Pipe and fittings, bubblers, and accessories.
- B. Automatic valves
- C. Manual valves
- D. Drip Irrigation
- E. Pop-up rotor systems

1.02 DESCRIPTION

- A. Provide all material, labor, equipment transportation, and services necessary for the furnishing and installation of the complete automatic sprinkler irrigation system as shown on the drawings and as specified herein. The work includes, but is not limited to:
 - 1. Trenching, stockpiling excavation materials and refilling trenches.
 - 2. Providing a complete system including piping, valves, fittings, rotors, sprinklers, dripline, and emitters and final adjustment of heads to ensure complete coverage.
 - 3. Line voltage connections to all irrigation controllers; low voltage control wiring from controller to remote control valves.
 - 4. Electrical service and hookup to automatic controller
 - 5. Submittals, tests, as-built and record drawings.
 - 6. Erosion control and repair of damage due to over watering and erosion.
 - 7. Warranty replacement.
 - 8. Cleanup, inspection and approval.

1.03 RELATED REQUIREMENTS

- A. Section 26 0519 - Low-Voltage Electrical Power Conductors and Cables.
- B. Section 31 2316.13 - Trenching
- C. Section 31 2323 - Fill
- D. Section 32 9300 - Plants.

1.04 PRICE AND PAYMENT PROCEDURES

- A. See Article 41 of the General Conditions for payment procedures.
- B. Piping:
 - 1. Basis of Measurement: By the linear foot.
 - 2. Basis of Payment: Includes trenching, placing pipe and fittings, valves, control box, conduit and wiring, and accessories.
- C. Sprinkler Heads:
 - 1. Basis of Measurement: By the unit.
 - 2. Basis of Payment: Includes sprinkler head and fittings.

1.05 REFERENCE STANDARDS

- A. ASTM D2235 - Standard Specification for Solvent Cement for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe and Fittings; 2004 (Reapproved 2011).
- B. ASTM D2241 - Standard Specification for Poly (Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series); 2015.

- C. ASTM D2564 - Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems; 2012.
- D. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2014.

1.06 SUBMITTALS

- A. See Article 9 of the General Conditions for submittal procedures.
- B. Product Data: Provide component and control system and wiring diagrams.
- C. Dimension from two permanent points of reference, building corners, sidewalk, or road intersections, etc., the location of the following items:
 - 1. Connection to existing water lines.
 - 2. Connection to existing electrical power.
 - 3. Gate valves.
 - 4. Routing and/or directional turns of sprinkler pressure lines (dimension max. 100' along routing).
 - 5. Sprinkler control valves.
 - 6. Routing of control wiring.
 - 7. Quick coupling valves.
 - 8. Other related equipment as directed by the Landscape Architect.
- D. Detail Drawings: Submit detailed drawings for Owner approval, for all assemblies not detailed on the drawings.
- E. Controller Charts:
 - 1. The Architect shall accept Record drawings before controller charts are prepared. Provide one controller chart for each controller supplied. The chart shall show the area controlled by the automatic controller and shall be the maximum size that the controller door will allow.
 - 2. The chart is to be a reduced drawing of the actual "as-built" system. However, in the event the controller sequence is not legible when the drawing is reduced, it shall be enlarged to a size that will be readable when reduced. The chart shall be a black line or blue line ozalid print and a different color shall be used to indicate the area of coverage for each station. When completed and approved, the chart shall be hermetically sealed between two pieces of plastic, each piece being a minimum of 10 mils. These charts shall be completed by the Contractor and approved by the Landscape Architect prior to final observation of the irrigation system.
- F. Operation and Maintenance Data:
 - 1. Provide instructions for operation and maintenance of system and controls, seasonal activation and shutdown, and manufacturer's parts catalog.
 - 2. Provide schedule indicating length of time each valve is required to be open to provide a determined amount of water.
- G. Record Documents: Refer to Article 46. Record actual locations of all concealed components and piping system, to scale, with dimensions to nearest hardscape or structure.
- H. Maintenance Materials: Provide the following for CRPD's use in maintenance of project.
 - 1. Extra Sprinkler/Rotor Heads: One of each type and size.
 - 2. Extra Valve Keys for Manual Valves: One.
 - 3. Extra Valve Box Keys: One.
 - 4. Extra Quick Coupler Keys: One.
- I. Irrigation Schedule:

1. Watering schedule shall include watering times and start times for each valve. Schedule shall indicate watering times for each day of the week as applicable. The schedule shall be broken out to include seasonal adjustments.

1.07 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Handling of PVC Pipe and Fittings: The Contractor is cautioned to exercise care in handling, loading, unloading, storing and installation of PVC pipe and fittings. All PVC pipe shall be transported in a vehicle that allows the length of pipe to lie flat so as not to subject it to undue bending or concentrated external load at any point. Any section of pipe that has been dented or damaged will be discarded and, if installed, shall be replaced with new piping.

1.08 JOB CONDITIONS

- A. The Contractor shall not willfully install the irrigation system as shown on the drawings when it is obvious in the field that obstructions, grade differences or discrepancies in area dimensions exist that might not have been considered in engineering. Such obstructions or differences should be brought to the attention of the Landscape Architect. In the event this notification is not performed, the irrigation Contractor shall assume full responsibility for any revision necessary.

1.09 SUBSTITUTIONS

- A. Procedure: Submit information in conformance with the substitution requirements of Article 7, General Provisions.
- B. Provide descriptive catalog literature, performance charts and flow charts for each item to be substituted.
- C. If substitution requires redesign of the system, costs of redesign, water calculations, etc. will be the responsibility of the contractor.

1.10 REGULATORY REQUIREMENTS

- A. Requirements of Regulatory Agencies: All work and materials shall be in full conformance with the latest rules and regulations of the California Plumbing and Electric codes.
- B. Manufacturer's Directions: Manufacturer's directions and detailed drawings shall be followed in all cases where the manufacturers of articles used in this contract furnish directions covering points not shown in the drawings and specifications.
- C. Underwriters Laboratories: Electrical wiring, controls, motors, and devices shall be UL listed, and so labeled.

1.11 INSTALLATION MEETINGS

- A. Contractor shall be responsible for notifying the Landscape Architect or Designated Representative in advance for the following observation meetings, according to the time indicated: (Certain meetings may be grouped if prior approval is granted).
 1. Coordinate one week prior to commencing work of this Section.
 2. Pressure supply line installation and testing: 48 hours.
 3. Coverage test: 48 hours.
 4. Final site review: 7 days.
- B. Final Observation:
 1. The Contractor shall operate each system in its entirety for the Landscape Architect or Designated Representative at time of final observation. Any items deemed not acceptable by the Landscape Architect or Designated Representative, or not in compliance with these

specifications and drawings, shall be reworked to the complete satisfaction of the Landscape Architect or Designated Representative.

2. The Contractor shall show evidence to the Landscape Architect or Designated Representative that the CRPD has received all accessories, charts, record drawings, and equipment as required before final observation can occur.

1.12 COORDINATION

- A. Coordinate the work with site backfilling, landscape grading and delivery of plant life.

1.13 WARRANTY

- A. The warranty for the sprinkler irrigation system shall be made in accordance with the following form.
- B. A copy of the warranty form shall be included in the operations and maintenance manual.
- C. The warranty form shall be retyped onto the Contractor's letterhead and contain the following information

D. WARRANTY FOR SPRINKLER IRRIGATION SYSTEM

1. We hereby warrant that the sprinkler irrigation system we have furnished and installed is free from defects in materials and work quality, and the work has been completed in accordance with the drawings and specification. We agree to repair or replace any defects in material or work quality that may develop during the period of one year from the date of acceptance, except those that may be caused by ordinary wear and tear, unusual abuse or neglect. We also agree to repair or replace any damage resulting from the repairing or replacing of such defects at no additional cost to the CRPD. We shall make such repairs or replacements within a reasonable time, as determined by the CRPD, 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 CRPD, we authorize the CRPD to proceed to have said repairs or replacements made at our expense, and we will pay the costs and charges therefore upon demand.
2. PROJECT: _____
3. CONTRACTOR: _____ PHONE NO.: _____
4. ADDRESS: _____ BY: _____
5. _____
6. DATE OF ACCEPTANCE: _____ BY: _____

PART 2 PRODUCTS

2.01 Manufacturers:

- A. As shown on plans.

2.02 PIPE MATERIALS

- A. Lateral PVC Pipe (Sizes up through 2 1/2"): ASTM D 2241; 200 psi pressure rated upstream from controls, 160 psi downstream; solvent welded sockets.
- B. Mainline PVC Pipe (3" - 6" sizes): ASTM D 2241; 200 psi (1.38 MPa) pressure rated upstream from controls, 160 psi (1.10 MPa) downstream; rubber gasketed joints.
- C. Pressure and Non-Pressure Main Line Piping and Fittings: Sizes 2 1/2 inches and smaller shall be Schedule 40 PVC.
- D. Non-pressure lines (buried): Shall be PVC Schedule 40.
- E. Fittings: Type and style of connection to match pipe and shall meet the requirements for service at an operating pressure of 150 pounds per square inch, unless otherwise specified.

- F. Pipe Risers at Valves: 160 psi PVC pipe.
- G. Solvent Cement: ASTM D2564 for PVC pipe and fittings.
- H. Sleeve Material: PVC Material per plan.
- I. PVC nipples: Schedule 80 with molded threads.
- J. All PVC pipe must bear the following markings:
 - 1. Manufacturer's name.
 - 2. Nominal pipe size.
 - 3. Schedule or class.
 - 4. Pressure rating in AST (not required on drip tubing).
 - 5. NSF (National Sanitation Foundation) approval (not required on drip tubing).
 - 6. Date of extrusion.

2.03 OUTLETS

- A. Manufacturer:
 - 1. As indicated on the drawings.
 - 2. Substitutions: See Article 7, General Provisions
- B. Emitter: Non-clogging, self-cleaning per the model numbers shown on the drawings.
- C. Tree Bubbler: Fixed outlet capable of watering deep root systems directly.
- D. Quick Coupler: in valve box.

2.04 VALVES

- A. Manufacturers:
 - 1. As indicated on the drawings
 - 2. Substitutions: See Article 7, General Provisions
- B. Gate Valves: Bronze construction non-rising stem.
- C. Ball Valves: Brass construction with locking lever..
- D. Quick Coupling Valves: Two-piece brass body construction, 150-pound class, with 1-inch female threads opening at base permitting operation with a special connecting device (coupler) designed for this purpose.
 - 1. Coupler threads: Lug type.
 - 2. Hinge cover: Provide with rubber-like locking N/A vinyl cover.
- E. Remote Control Valves
 - 1. Valve Type: Spring loaded, packless diaphragm activated, normally closed type with brass body, equipped with flow control and pressure regulation capabilities where noted.
 - 2. Valve Solenoid: 24 volt AC, 4.5 watt maximum, 500 milli-amp maximum surge, corrosion-proof, stainless steel construction, epoxy encapsulated to form a single integral unit unless otherwise noted on plans.
 - 3. Provide bleeder valve to permit operation in the field without power at the controller.
 - 4. Valves shall be spaced Min. 5 ft. apart.
- F. Valve Boxes
 - 1. Remote control Valves: 14" x 19" or shall be sized to accomodate valve assembly with 2" clearance each side, min. of concrete material with locking concrete cover.
 - 2. Gate valves, ball valves and quick couplers: 10" round of concrete material with locking concrete cover.
 - 3. Valve box extensions shall be by the same manufacturer as the valve box.

4. Emboss, letters on valve boxes to indicate contents of valve box. (ie. GV = Gate Valve, QC = Quick Coupler, RC = Remote Control Valve, MV = Master Valve, BV = Ball Valve)

2.05 ELECTRICAL (LOW VOLTAGE)

- A. Connections between controller and remote control valves shall be made with direct burial AWG-UH, 600-volt wire, insulation thickness 3/64 inch, utilizing low-density high molecular weight polyethylene insulation.
- B. Splices, where permitted, shall be waterproofed using Rain Bird, Pen-Tite Connectors or fusible heat shrinking tubing, and housed in a box. Boxes for other irrigation use may be utilized for this purpose.
- C. All electrical connections must be waterproof and moisture-resistant and shall be done with 3M™ Scotchcast™ 3570G Connector Sealing Packs.
- D. Electrical conduit for control wires shall be Schedule 40 PVC grey conduit.
- E. All pull boxes shall be plastic in all landscape areas. Where pull boxes are required to be located in hardscape areas, they shall be concrete material.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify location of existing utilities.
- B. Verify that required utilities are available, in proper location, and ready for use.

3.02 PREPARATION

- A. A pre-construction meeting with the General Contractor and ownership staff is required for discussion and clarification of the following:
 1. Site and job conditions
 2. Safety
 3. Scope of work
 4. Trenching and backfill operations
 5. Pipe laying, inspection, and testing requirements
 6. Certification, submittals and acceptance requirements
 7. Protection of existing improvements and utilities
 8. Repair of existing improvements not scheduled for removal
 9. Disposal of surplus earth materials to approved disposal site(s)
 10. Coordination with water main Contractor
 11. Coordination of temporary interruption of utility service
- B. Drawings are generally diagrammatic and indicative of the work to be installed. Due to the scale of drawings, it is not possible to indicate all offsets, fittings, sleeves, etc., which may be required. The Contractor shall carefully investigate the structural and finished conditions affecting all of his work and plan accordingly, furnishing such fittings, etc., as may be required.
- C. All scaled dimensions are approximate. The Contractor shall check and verify all size dimensions and receive Architect or Designated Representative's approval prior to proceeding with work under this section.
- D. Coordinate installation of irrigation system, including pipe, so there will be NO interference with utilities or other construction or difficulty in planting trees, shrubs, and ground covers.

The Contractor shall carefully check all grades to satisfy him/her that he may safely proceed before starting work on the irrigation system.

- E. All piping or equipment shown diagrammatically on drawings outside planting areas shall be installed inside planting areas whenever possible.
- F. Layout and stake locations of system components.
- G. Review layout requirements with other affected work. Coordinate locations of sleeves under paving to accommodate system.

3.03 TRENCHING

- A. Trench and backfill in accordance with Section 31 2316.13 and Section 31 2323.
- B. Excavate trenches to required depths. Follow approved layout for each system.
- C. Trench bottom shall be flat to ensure piping is supported continuously on an even grade.
- D. Where lines occur under paved areas, consider dimension to be below the subgrade.
- E. Trench Size:
 - 1. As indicated on the drawings.
- F. Trench to accommodate grade changes and slope to drains.
- G. Maintain trenches free of debris, material, or obstructions that may damage pipe.

3.04 INSTALLATION

- A. Assemblies:
 - 1. Install pipe, valves, controls, and outlets in accordance with manufacturer's instructions.
 - 2. Line Clearance: All lines shall have a minimum clearance of 6 inches from each other and from lines of other trades. Parallel lines shall not be installed directly over one another.
 - 3. Connect to utilities.
 - 4. Install all assemblies specified herein in accordance with respective detail. In absence of detail drawings or specification pertaining to specific items required to complete work, perform such work in accordance with best standard practice, with prior approval from Landscape Architect or Designated Representative.
 - 5. PVC pipe and fittings shall be thoroughly cleaned of dirt, dust and moisture before installation. Installation and solvent welding methods shall be as recommended by the pipe and fitting manufacturer.
 - 6. On PVC to metal connections, the Contractor shall work the metal connections first. Teflon tape or approved equal shall be used on all threaded PVC to PVC, and on all threaded PVC to metal joints. Light wrench pressure is all that is required. Where threaded PVC connections are required, use threaded PVC adapters into which the pipe may be welded.
 - 7. Quick Coupling Valves: Unless otherwise indicated, locate valves within 12 inches of hardscape.
 - 8. Set outlets and box covers 1 inch above finish grade in turf areas and 2 inches above finish grade in shrub planters.
 - 9. Provide for thermal movement of components in system.
 - 10. Use threaded nipples for risers to each outlet.
- B. Electrical Supply:
 - 1. Low voltage wiring shall be placed in the same ditch and taped on bottom side of main lines unless otherwise approved.

2. Wire is to be taped a maximum 12 feet on center.
 3. Provide a minimum 12-inch expansion loop at each connection and directional change.
 4. Use a continuous wire between controller and remote control valves. Except as otherwise approved, do not splice wire at any point. All approved splices shall be enclosed in an acceptable box.
- C. Mark valves with neoprene valve markers containing locking device. Set valve markers in pipe risers extending from top of valve to finish grade.
- D. System Flush: After piping is installed, but before outlets are installed and backfilling commences, open valves and flush system with full head of water.
- E. Sprinkler Heads:
1. Install the sprinkler heads as designated on the drawings and in accordance with their respective detail.
 2. Spacing of heads shall not exceed the maximum indicated on the drawings. In no case shall the spacing exceed the maximum recommended by the manufacturer.
- F. Valve Boxes:
1. All buried valves and equipment shall be installed with a proper box as specified in part 2 - products.

3.05 FIELD QUALITY CONTROL

- A. Prior to backfilling, test system for leakage at main piping to maintain 100 psi pressure for two hours.
- B. System is acceptable if no leakage or loss of pressure occurs and system self drains during test period.
- C. Testing of pressure main lines shall occur prior to installation of electrical control valves, quick couplers or any other equipment that might prevent a proper test from being performed.
- D. All piping under paved areas shall be tested under hydrostatic pressure of 150 pounds per square inch, and proved watertight, prior to paving.
- E. If leaks develop, replace joints and repeat test until entire system is proven watertight.
- F. All hydrostatic tests shall be made only in the presence of the Landscape Architect or Designated Representative of the CRPD. No pipe shall be completely backfilled until it has been inspected, tested and approved in writing.
- G. Furnish necessary force pump and all other test equipment.
- H. Upon completion of each phase of work, entire system shall be tested and adjusted to meet site requirements.
- I. Low voltage wire under paving shall be tested for continuity, prior to paving.

3.06 BACKFILLING

- A. Backfill trench and compact to specified subgrade elevation. Protect piping from displacement.
- B. Buried pipe in trenches shall be center loaded only until all required tests are performed. Trenches shall be carefully backfilled with the excavated materials approved for backfilling, consisting of earth, loam, sandy clay, sand or other approved materials, free from large clods of earth or stones. Backfill shall be mechanically compacted in landscaped areas to a dry density equal to adjacent undisturbed soil in planting areas. Backfill will conform to adjacent grades without dips, sunken areas, humps or other surface irregularities.

- C. A fine granular material backfill will be initially placed on all lines. No foreign matter larger than 1/2 inch in size will be permitted in the initial backfill.
- D. Flooding of trenches will be permitted only with approval of the Landscape Architect or Designated Representative.
- E. If settlement occurs and subsequent adjustments in pipe, valves, sprinkler heads, lawn or planting, or other construction are necessary, the Contractor shall make all required adjustments without cost to the CRPD.

3.07 TEMPORARY REPAIRS

- A. The CRPD reserves the right to make temporary repairs as necessary to keep the sprinkler system equipment in operating condition. The exercise of this right by the CRPD shall not relieve the Contractor of his responsibilities under the terms of the warranty as herein specified.

3.08 SYSTEM STARTUP

- A. Prepare and start system in accordance with manufacturer's instructions.
- B. Adjust control system to achieve time cycles required.

3.09 GUARANTEE

- A. The main line system shall be guaranteed by the Contractor as to material and workmanship, including settlement of excavations for a period of one (1) year from the date of final acceptance of work.
- B. Warranties, either implied or written, by the manufacturer, do not relieve the Contractor of his/her responsibility for the guarantee period.

3.10 AS-BUILT DRAWINGS

- A. The Contractor shall be responsible for making a set of construction prints and recording work accomplished for that day on the prints in red ink. Prior to completion of the entire project, a final set of as-built drawings on bond paper shall be completed, (2) hardcopy sets and a scanned digital copy in PDF format of all drawings shall be provided to the District. These drawings shall indicate the following:
 - 1. Dimension from two (2) permanent points of reference (building corners, fixed hardscape corners, road intersections, permanent existing utilities) the location of the following items: Connection to existing water lines, routing of pressure supply lines at 100 ft. intervals or closer as necessary to provide accurate routing, gate valves, quick coupling valves, control wire routing (if separate from main lines), back flow prevention devices, water meters, controllers, and other equipment as directed by the Architect.
 - 2. Final As-Built plans shall be submitted to the District's approved representative and the Architect for review and approval.
 - 3. The Contractor shall be responsible for making a set of construction prints.

3.11 MAINTENANCE PERIOD

- A. The entire sprinkler irrigation system shall be under full automatic operation for a period of seven days prior to any planting.
- B. The Maintenance Period for the main line system shall extend to one year from the date of acceptance of work by the District's authorized representative and the Architect. The Contractor shall warrant materials against defects and guarantee workmanship for the Maintenance Period as specified and for coordinating warranty items with the

manufacturer/distributor and District, Settlement of trenches, which may occur during the maintenance period, shall be repaired by the Contractor at no cost to the District.

- C. Maintenance Walk-Through: Prior to a release of responsibility at the end of the maintenance period, the Contractor shall schedule a walk-through with the District and Landscape Architect.
- D. The Architect or Designated Representative reserves the right to waive or shorten the operation period.

3.12 CLEANUP

- A. Cleanup shall be performed as each portion of the work progresses. Refuse and excess dirt shall be removed from the site, all walks and paving shall be broomed or washed down, and any damage sustained to the work of others shall be repaired and work returned to its original condition.

3.13 OPERATING INSTRUCTIONS

- A. The Contractor shall be required to train CRPD's maintenance personnel in proper operation of all major equipment. Provide written evidence of the person or persons so trained to the Landscape Architect or Designated Representative.

3.14 CLOSEOUT ACTIVITIES

- A. Instruct CRPD's personnel in operation and maintenance of system. Use operation and maintenance material as basis for demonstration.
- B. Irrigation Schedule: See Submittal Requirements above.
- C. Irrigation Audit: Shall be performed by a third party representative hired by the CRPD. Contractor shall coordinate keys to controllers and valve boxes for use by the auditor.

3.15 QUALITY CONTROL

- A. Verify materials conformance with Landscape Architect.
- B. Verify location of equipment with Landscape Architect.
- C. Verify satisfactory completion of work with Landscape Architect, including proper operation of equipment, system coverage, and job clean-up.
- D. Verify satisfactory completion of As-Built Drawings.

End of Section 32 8423

Section 32 9223

Sodding

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Preparation of subsoil.
- B. Placing topsoil.
- C. Fertilizing.
- D. Sod installation.
- E. Maintenance.

1.02 RELATED REQUIREMENTS

- A. Section 31 2200 - Grading: Preparation of subsoil and placement of topsoil in preparation for the work of this section.

1.03 DEFINITIONS

- A. Weeds: Includes Dandelion, Jimsonweed, Quackgrass, Horsetail, Morning Glory, Rush Grass, Mustard, Lambsquarter, Chickweed, Cress, Crabgrass, Canadian Thistle, Nutgrass, Poison Oak, Blackberry, Tansy Ragwort, Bermuda Grass, Johnson Grass, Poison Ivy, Nut Sedge, Nimble Will, Bindweed, Bent Grass, Wild Garlic, Perennial Sorrel, and Brome Grass.

1.04 REFERENCE STANDARDS

- A. TPI (SPEC) - Guideline Specifications to Turfgrass Sodding; 2006.

1.05 SUBMITTALS

- A. See General Conditions - Article 9, for submittal procedures.
- B. Certificate: Certify grass species and location of sod source.
- C. Maintenance Data: Include maintenance instructions, cutting method and maximum grass height; types, application frequency, and recommended coverage of fertilizer .
- D. Herbicides: Submit manufacturer's analysis. Schedule for application of herbicides must be approved by the Inspector.
- E. Test Reports: Provide the following soils tests and submit the results to the Inspector: Test reports shall be performed by a certified soils laboratory.
 - 1. Existing Site Soil: Test for agricultural suitability, fertility, particle size analysis; including recommendations for soil amendment, and fertilization during the maintenance period.
 - 2. Import Soil: Submit test reports of representative sample(s) for approval prior to delivery and for every 100 yards delivered to the site. Test for agricultural suitability, fertility, particle size analysis; including recommendations for soil amendment, and fertilization during the maintenance period.
 - 3. Organic Amendments, Fir Bark: Test for partial organic amendment evaluation.
 - 4. All Other Fertilizers and Amendments: For standard products, submit manufacturer's analysis. For all other products, submit analysis by testing laboratory.
- F. All submittals for soil amendments and fertilizers must be accompanied by a letter on contractor's company stationary listing exact quantities in gallons, lbs, tons, cubic yards or cubic feet. These quantities will be checked for accuracy before construction and with delivery tickets during construction.

G. Maintenance Contract.

1.06 QUALITY ASSURANCE

- A. Sod Producer: Company specializing in sod production and harvesting with minimum five years experience, and certified by the State of California.
- B. Installer Qualifications: Company approved by the sod producer.
- C. Testing Laboratory: Recognized laboratory for soil and plant disease analysis for ornamental horticulture, approved by the Inspector. Testing laboratory is to perform all work in accordance with the current methods of the Association of Official Agricultural Chemists.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Sod:
 - 1. Deliver sod on pallets. Protect exposed roots from dehydration.
 - 2. Do not deliver more sod than can be laid within 24 hours.
 - 3. Notify Owner's Representative of delivery schedule in advance so material can be inspected upon arrival at project site. Immediately remove unacceptable material from project site.
- B. Fertilizer:
 - 1. Fertilizer: Deliver inorganic or chemical fertilizer to site in original unopened containers bearing manufacturer's guaranteed chemical analysis, name, trade name, trademark and conformance to state law, bearing name and warranty of producer.

1.08 PROJECT/SITE CONDITIONS

- A. General: Do not perform work when climate and existing site conditions will not provide satisfactory results.
- B. Vehicular accessibility on site shall be as directed by CRPD authorized representative. Repair damage to prepared ground and surfaces caused by vehicular movement during work under this section to original condition at no additional cost to the CRPD.
- C. Perform soil preparation just prior to planting operations and in accordance with final planting schedule. Coordinate with irrigation system installation to avoid damage to work of one by the other.
- D. Utilities: Determine location of underground utilities (irrigation lines included) and perform work in a manner which will avoid damage, Hand excavate, as required.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Sod:
 - 1. TPI, Field Turfgrass Sod quality; cultivated grass sod; type indicated in plant schedule on Drawings; with strong fibrous root system, free of stones, burned or bare spots; containing no more than 5 weeds per 1000 sq ft. Minimum age of 18 months, with root development that will support its own weight without tearing, when suspended vertically by holding the upper two corners.
 - 2. Supplier: Pacific Sod
 - a. 305 Hueneme Rd, Camarillo, CA 93012
 - b. 800-942-5296
- B. Topsoil:
 - 1. General: Sandy Loam Soil with 70-75% sand, silt 12.5-20%, clay 8%-15%

2. All soils to be used in areas to be planted on the project shall be free of rocks over one inch in diameter, and free of foreign debris. Soil shall be free from sub-soil, refuse, plants or roots, clods, weeds, viable weed seeds, sticks, solvents, petroleum products, concrete, base rock, or other deleterious or extraneous material. Soil shall be free of soil-borne diseases, and capable of sustaining healthy plant life.
 - a. Imported Topsoil:
 - 1) Make all arrangements for obtaining and testing imported topsoil. Submit test results of a representative sample of the proposed supply for approval by the Inspector well in advance of its scheduled delivery to the site. The approved sample will establish the standards to which all imported topsoil used on the job must conform.
 - 2) Do all work necessary to bring imported topsoil to standards specified above.
 - 3) Transport imported topsoil directly from source to final position. If stockpiling is required, locations and amounts of stockpiles will be designated by the Inspector.
 - 4) The Inspector reserves the right to take additional samples of imported topsoil at the site. If subsequent testing proves material to be at variance with the approved sample, remove rejected soil from the site and replace immediately at no additional cost to the City of Modesto.
 - 5) All topsoil shall be tested as outlined above. No turfgrass sod shall be placed on soil which has been treated with soil sterilants or herbicides until sufficient time has elapsed to permit the dissipation of toxic materials. The landscape contractor shall assume full responsibility for any loss or damage to turfgrass sod arising from improper use of sterilants or due to his or her failure to allow sufficient time to permit dissipation of toxic materials, whether or not such sterilants are specified herein.
- C. Organic Composted Soil Amendment
 1. General: Soil tests shall be made to determine requirements for organic soil amendments.
 2. Basic Requirements: Basic requirements are intended for bidding purposes only. Actual organic soil amendment requirements shall be determined by results of soils test.
 - a. Compost must have the following characteristics:
 - 1) pH of less than 8.5
 - 2) Screened to 1/2" minus
 - 3) Organic content above 30% (dry sample)
 - 4) Shall be free of glass, metal and visible plastics
 - 5) Odor shall be soil-like (musty or moldy) not sour, ammonia-like or putrid
 - 6) Can have no nitrogenized wood product in it, or redwood, or cedar
 - 7) Quantities:
 - (a) All turf areas: 3.1 cubic yards/1,000 sq. ft.
- D. Fertilizers:
 1. General: Soil tests shall be made to determine requirements for lime, and fertilizer. All fertilizers shall be uniform in composition and free-flowing.
 2. Basic Requirements: Basic requirements are intended for bidding purposes only. Actual fertilizer requirements shall be determined by results of soils test.
 - a. Pre-Plant Fertilizer:
 - 1) Acid/Calcium based control release liquid phosphorus
 - (a) pH less than 1
 - (b) Nutrient analysis: 5.5-10-0-2.4Ca

- (c) Approved product -THI PHOS 10 (no known equal)
- (d) Quantity: 2 gallons/1000 sq. ft.
- 2) Concentrated Organic Growth Medium
 - (a) pH less than 8.5
 - (b) 25%+ organic content
 - (c) Salts EC less than 3
 - (d) Calcium (Ca) 10%+
 - (e) Magnesium (Mg) 2%+
 - (f) Iron (Fe) 2.5%+
 - (g) Approved product: THI Concentrated Organic Growth Medium #604 (no known equal).
 - (h) Quantity: 3.41 tons/acre
- 3) Concentrated Granule Gypsum with the following analysis:
 - (a) Ca: 23%,
 - (b) Quantity: 1.1136 tons/acre
- 4) Granular 11-52-0 Phosphorus Fertilizer
 - (a) Quantity: 2.5 lbs/1,000 sq. ft.
- 5) Granular 0-0-50 Potassium Fertilizer
 - (a) Quantity: 1.88 lbs/1,000 sq. ft.
- b. Post-Plant Fertilizer
 - 1) Liquid Organic Fertilizer
 - (a) From soybean extract
 - (b) 10-4-4 nitrogen product or as otherwise approved.
- 3. Water: Clean, fresh and free of substances or matter that could inhibit vigorous growth of grass.

2.02 ACCESSORIES

- A. Herbicide: As approved. Herbicide shall not inhibit or damage grass development.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that prepared soil base is ready to receive the work of this section.
- B. Verify the soils analysis reports are adequate.

3.02 PREPARATION

- A. Prepare subgrade in accordance with Section 31 2200.
- B. Place topsoil in accordance with Section 31 2200.

3.03 FERTILIZING

- A. Apply soil amendments in accordance with soils analysis results and manufacturer's instructions.
- B. Apply fertilizer in accordance with soils analysis results and manufacturer's instructions.
- C. Verify adequate time has elapsed to allow herbicides to deplete enough from soils to avoid damage to sod.
- D. Apply after smooth raking of topsoil and prior to installation of sod.
- E. Apply fertilizer no more than 48 hours before laying sod.
- F. Mix thoroughly into upper 2 inches of topsoil.

- G. Lightly water to aid the dissipation of fertilizer.

3.04 LAYING SOD

- A. Moisten prepared surface immediately prior to laying sod.
- B. Lay sod immediately after delivery to site to prevent deterioration.
- C. Lay sod smooth and tight with no open joints visible, and no overlapping; stagger end joints 12 inches minimum. Do not stretch or overlap sod pieces.
- D. Where new sod adjoins existing grass areas, align top surfaces.
- E. Where sod is placed adjacent to hard surfaces, such as curbs, pavements, etc., place top elevation of sod 1/2 inch below top of hard surface.
- F. Water sodded areas immediately after installation. Saturate sod to 4 inches of soil.

3.05 MAINTENANCE

- A. Provide a separate maintenance contract for specified maintenance service.
- B. Provide maintenance of sodded areas for 3 months from Date of Substantial Completion.

End of Section 32 9223

Section 32 9300

Plants

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Preparation of subsoil and topsoil.
- B. Topsoil bedding.
- C. New trees, plants, and ground cover.
- D. Relocated trees.
- E. Mulch and Fertilizer.
- F. Soil Testing and Amendment
- G. Tree staking.
- H. Root barriers.
- I. Warranty Replacement
- J. Tree Pruning.

1.02 RELATED REQUIREMENTS

- A. Section 31 2200 - Grading: Preparation of subsoil and placement of topsoil in preparation for the work of this section.
- B. Section 31 2323 - Fill: Topsoil material.
- C. Section 32 8200 - Irrigation
- D. Section 32 9223 - Sodding

1.03 DEFINITIONS

- A. Weeds: Any plant life not specified or scheduled.
- B. Plants: Living trees, plants, and ground cover specified in this Section, and described in ANSI Z60.1.

1.04 REFERENCE STANDARDS

- A. ANSI/ANLA Z60.1 - American National Standard for Nursery Stock; 2004.
- B. ANSI A300 Part 1 - American National Standard for Tree Care Operations -- Tree, Shrub and Other Woody Plant Maintenance -- Standard Practices; 2008.

1.05 APPROVALS

- A. The irrigation system shall be installed, adjusted, and approved along with planting as needed for irrigation coverage starting any work of this section.

1.06 SOIL TESTING

- A. After completion of site preparation but prior to commencement of planting activities, Contractor shall, at their expense, obtain Agronomic Soil Report as follows:
 - 1. Test sample location and quantities - take the following sample:
 - a. Alex Fiore Teen Center: minimum of 5 samples, blended together, from different locations to receive planting.
 - 2. Tests shall be performed by an approved professional agronomic soils testing laboratory. Contractor shall submit the name, address and phone number of the consulting soil testing laboratory for approval prior to obtaining services.

3. The approved soil testing laboratory report shall indicate soil analysis for plant growth suitability, including permeability rate, and recommendations for each plan area for soil preparation in all planting areas and soil mix for backfill of planting container material.
4. The recommendations of the agronomic soil report shall take precedence over the quantities of soil amendments and material mix specified in the backfill mix on the drawings; and only when those specifications exceed the minimum requirements specified herein.
5. Contractor shall submit one (1) electronic copy of the agronomic soil report to the District's representative, and shall not begin any landscape planting work until the report has been evaluated and approved.

1.07 SUBMITTALS

- A. See Article 9 of the General Conditions for submittal procedures.
- B. Submit list of plant life sources.
- C. Submit purchase invoices from nurseries for review.
- D. Samples: Submit the following to the CRPD for acceptance:
 1. Soil Separator: One square foot minimum, accompanied by product data.
 2. Drain Rock: One-half cubic foot.
 3. Wood Bark Mulch: One-half cubic foot.
 4. Root Control Barrier: One square foot sample panel, accompanied by product data.
- E. Product Data: Submit the following product information to the CRPD for acceptance:
 1. Tree Staking Materials: Manufacturer's literature.
 2. Herbicides: Schedule for application of herbicides must be approved by the CRPD.
- F. Test Reports: Soil tests shall be performed by a certified soils analyst by the state of California. Provide the following tests and submit the results to the CRPD:
 1. Existing Site Soil: Provide two separate tests at distinctly separate on-site locations, for agricultural suitability, fertility, particle size analysis; including recommendations for soil amendment, and fertilization during the maintenance period.
 2. Import Soil: Submit test reports of representative sample(s) for approval prior to delivery and for every 100 yards delivered to the site. Test for agricultural suitability, fertility, particle size analysis; including recommendations for soil amendment, and fertilization during the maintenance period.
 3. Organic Amendments, Fir Bark: Test for partial organic amendment evaluation.
 4. All Other Fertilizers and Amendments: For standard products, submit manufacturer's analysis. For all other products, submit analysis by testing laboratory.
- G. Soil Mix: Submit cut-sheets of each accepted planter soil mix component and one-ounce samples of the fertilizers to the Inspector.

1.08 QUALITY ASSURANCE

- A. Nursery Qualifications: Company specializing in growing and cultivating the plants with three years documented experience.
- B. Installer Qualifications: Company specializing in installing and planting the plants with five years experience.
- C. Testing Laboratory: Recognized laboratory for soil and plant disease analysis for ornamental horticulture, approved by the Inspector. Testing laboratory is to perform all work in accordance with the current methods of the Association of Official Agricultural Chemists.

- D. Tree Pruner Qualifications: Company specializing in pruning trees with proof of Arborist Certification.
- E. Tree Pruning: Comply with ANSI A300 Part 1.

1.09 DELIVERY, STORAGE, AND HANDLING

- A. Deliver fertilizer in waterproof bags showing weight, chemical analysis, and name of manufacturer. Store fertilizers and amendments, bark mulch, soil mixes, and other materials which could stain concrete and similar surfaces in such a manner that staining does not occur.
- B. Plants: Maintain all plant material in a healthy growing condition prior to and during planting operations. Protect plants at all times from sun and drying winds. Plants that cannot be planted immediately upon delivery shall be kept in the shade, well protected and watered. Plant material delivered to the site must be planted within 3 days of site delivery. Plants that cannot be installed on this work schedule shall be returned to the grower until installation requirements can be met.

1.10 SUBSTITUTIONS, ADDITIONS, DELETIONS

- A. Substitutions will not be permitted without written approval by District's representative.
- B. When requesting substitutions for plant material, the Contractor shall provide the Architect with the following:
 - 1. Contact information for nurseries Contractor was unable to obtain plant material. Minimum of three are required.
 - 2. Three (3) alternate plant suggestions as part of the initial request. Provide foliage/flower color, growth habit, and sunset zone of each.
 - 3. Substitution requests which do not include the above requirements will be denied until requirements have been met.

1.11 FIELD CONDITIONS

- A. General: Become familiar with the anticipated growing conditions prior to commencement of work. Notify the Inspector immediately in writing of any conditions, which will prevent the proper execution of the warranty responsibilities specified. Failure to so notify the Inspector constitutes acceptance of the growing conditions. Any removal, repair or replacement of plant material required by unsuitable conditions found after work has begun shall be done at no additional cost to the CRPD.
- B. Do not install plant life when ambient temperatures may drop below 35 degrees F or rise above 90 degrees F.
- C. Do not install plant life when wind velocity exceeds 30 mph.

1.12 WARRANTY

- A. Plant Material: Warrant that all trees under this Contract will be vigorous, healthy, free of dead or dying branches and branch tips, bearing foliage of normal density and color, and will otherwise comply with the requirements of this Section, for a period of one year from date of Final Acceptance. Warrant that all shrubs and plants under this Contract for a period of 90 days. Any delay in completion of planting operations which extends the planting into more than one growing season shall extend the warranty period correspondingly.
- B. Replacements: Without cost to the CRPD, in a timely manner and as directed by the Inspector, replace all plants not meeting the requirements above throughout the course of the warranty period. Replacements shall closely match adjacent specimens of the same species in size and shall comply with all requirements of this specification.

- C. Species: Replace all plant material determined by the CRPD within two years following the final acceptance of the project, to be untrue to the species, clone and/or variety specified, to the equal condition of adjacent plants at the time of replacement, at no additional cost to the CRPD.

PART 2 PRODUCTS

2.01 PLANTS

- A. Trees, Plants, and Ground Cover: Species and size identifiable in plant schedule, grown in climatic conditions similar to those in locality of the Work.
 - 1. Size:
 - a. Plants shall conform to measurements specified. Measure plants when branches are in their normal position. Height and spread dimensions specified refer to the main body of plant and not branch tip to tip. Take caliper measurements at a point on the trunk 6 inches above natural ground line for trees up to 4 inches in caliper, and at a point 12 inches above the natural ground line for trees over 4 inches in caliper.
 - b. The measurements specified are the measurements after pruning, where pruning is required. Plants that meet the measurements specified, but do not possess a normal balance between height, spread, and caliper, shall be rejected.
 - c. Plants larger than specified may be used if approved by the CRPD, and if provided at no additional cost to the CRPD. If larger plants are approved, the root ball shall be increased in proportion to the size of the plant; irrigation system shall also be adjusted as required to accommodate larger plants.
- B. Acclimatization: The General Contractor is responsible for supplying plant material that has been properly acclimated and conditioned, in accordance with good horticultural practices, for the exposure, wind and humidity levels, soil conditions, etc., encountered at the project site and in the proposed plant location.
- C. Coordination: The Contractor shall coordinate his acclimatization schedule with the CRPD as to allow an adequate conditioning period for the plant material prior to the approved date of planting commencement. Notify the CRPD in writing prior to proceeding with any acclimatization work if approved work schedule allows insufficient time to acclimate the material.
- D. Quality: Plants shall be superior in form, compactness and symmetry; sound, healthy and vigorous, well branched and densely foliated when in leaf; free of disease, insect pests, eggs or larvae, and free from physical damage or adverse conditions that would prevent thriving growth.
- E. Species: Tag one of each plant prior to delivery to the site; label with genus, species and variety. Any plants not so identified will be subject to rejection by the CRPD. Plants may be cross referenced with nurseries invoice at the discretion of the Architect.
- F. Root Ball:
 - 1. Do not supply any bare root or ball and burlapped stock unless approved by the CRPD.
 - 2. Sizes: As specified on the plans. Where no root ball dimensions have been specified, supply material in container sizes specified.
 - 3. Material: Root ball shall consist of a soil or soil mix that is compatible with the soil or soil mix into which the plant will be planted, and that provides for thorough drainage, aeration, and adequate moisture and nutrient retention. Having sufficient density and firmness that when planted, the plant will stand upright and stable without need for additional support.

- 4. Containers: All plant material shall have been grown in the containers in which delivered for at least six months, but not over two years. Stock appearing to not have been in their containers for this term shall be rejected.
- 5. Root Pruning: Where root pruning is required to provide material of the specified size, or for planting in the sloped containers, the pruning is to be done under the direction of a Certified Arborist. No root pruning is to be done within one year of installation unless approved by the CRPD.
- G. Trunks and Branches: Do not prune plants before delivery. All trunks are to be straight and of uniform taper, larger at the bottom unless otherwise specified. Plants with damaged or crooked leaders, or multiple leaders, unless specified, will be rejected. Plants with abrasions of the bark, sun scalds, disfiguring knots, or fresh cuts of limbs over 3/4 inch, which have not completely callused, will be rejected. Any plant unable to stand upright without support will be rejected.

2.02 SOIL MATERIALS

- A. General: All soils to be used in areas to be planted on the project shall be free of rocks over one inch in diameter, and free of foreign debris. Soil shall be free from sub-base/aggregate, refuse, plants or roots, clods, weeds, viable weed seeds, sticks, solvents, petroleum products, concrete, base rock, or other deleterious or extraneous material. Soil shall be free of soil-borne diseases, and capable of sustaining healthy plant life.
- B. Imported Topsoil:
 - 1. Topsoil shall be fertile, friable soil of loamy character, containing an amount of organic matter normal to the region. All imported topsoil used on the job shall be from the same source.
 - a. Make all arrangements for obtaining and testing imported topsoil. Submit test reports of a representative sample of the proposed supply for approval by the CRPD well in advance of its scheduled delivery to the site. The approved sample will establish the standards to which all imported topsoil used on the job must conform.
 - b. Transport imported topsoil directly from source to final position. If stockpiling is required, locations and amounts of stockpiles will be designated by the CRPD.
 - c. The CRPD reserves the right to take additional samples of imported topsoil at the site. If subsequent testing proves material to be at variance with the approved sample, remove rejected soil from the site and replace immediately at no additional cost to the CRPD.
- C. Imported Planter Pot Soil Mix: For use in planters and planter pots. The following ingredients, thoroughly blended into a homogeneous mix:

Amount	Ingredient
0.5 cubic yards	1/8 inch Fine Fir Bark as Specified
0.5 cubic yards	Fine Sand as Specified
3 pounds	Single Superphosphate 0-20-0
1 pound	Calcium Nitrate 15.5-0-0
1 pound	Iron Sulfate
8 pounds	Kaiser 65 Dolomite Lime

- D. Existing On-Site Soils: Existing site soils shall be amended per the recommendations of the approved soils testing laboratory. The following soil amendments and fertilizers are to be used FOR BIDDING PURPOSES ONLY.

1. Site Soil: Top 6 inches of site soil shall be amended with following blend of amendments per 1000 square feet.

Amount	Ingredient
6 cubic yards	Nitrogen Stabilized 0" - 1/4" Fir Bark
15 lbs	12-12-12 Commercial Fertilizer as approved
15 lbs	Soil Sulfur
100 lbs	Agricultural Gypsum

2. Backfill Mix (on-grade locations): Amend site soil as follows per cubic yard.

Amount	Ingredient
3/5 cubic yard	Surface Soil
2/5 cubic yard	Nitrogen Stabilized 0" to 1/4" Fir Bark
1 lb	12-12-12 Commercial Fertilizer as Specified
2 lbs	Iron Sulfate as Specified
10 lbs	Agricultural Gypsum

3. Additional Amendments: Soil amendment recommendations will vary for planting areas if imported topsoil is required to establish finish grade. Provide all additional amendments as may be required by subsequent soil testing of approved imported topsoil and as directed by the Inspector.

2.03 SOIL AMENDMENT MATERIALS

- A. Nitrogen Stabilized Fir Bark On-Grade: Meeting the following specifications:

1. Particle Size (dry weight basis):

Sieve Size	Percent Passing
6.35 mm (1/4 inch)	95 - 100
2.38 mm (No. 8, 8 mesh)	50 - 80
500 micron (No. 35, 32 mesh)	0 - 25

2. Organic Content: Determined by ash analysis. Minimum 92% based on dry weight.
3. Nitrogen: Minimum 0.8% nitrogen based on dry weight.
4. Salinity: Maximum saturation extract conductivity 3.5 millimhos per cm at 25 degrees centigrade.
5. Iron: Minimum 0.08% dilute acid soluble Fe based dry weight, if iron treated.
6. Bulk Density: 400 pounds per cubic yard.

- B. Fertilizer: Containing fifty percent of the elements derived from organic sources; of proportion necessary to eliminate any deficiencies of topsoil, as indicated in analysis.

1. Fertilizers shall be approved by the Organic Materials Review Institute (OMRI).
2. Contractor shall obtain CRPD's written approval of proposed fertilizer(s) prior to use.

- C. Water: Clean, fresh, and free of substances or matter that could inhibit vigorous growth of plants.

- D. Pre-Emergent Herbicide: For all on-grade ground cover and shrub areas, provide "Surflan A.S." as manufactured by Elanco Products Co., Indianapolis, IN, with no acceptable substitutions. Apply per manufacturer's instructions.

2.04 MULCH MATERIALS

- A. Mulching Material: ES-2 Mulchspecies wood shavings, free of growth or germination inhibiting ingredients.
 - 1. Agromin, or approved equal.
 - a. 201 Kinetic Drive
 - b. Oxnard, CA 93030
 - c. (805) 458-9200
 - d. www.agromin.com

2.05 ACCESSORIES

- A. Drain Rock: 3/4" diameter river rock or approved equal.
- B. Soil Separator: Soil Separator: "Mirafi 140N", as manufactured by Mirafi, Charlotte, NC, "Trevira Spunbond 1120", as manufactured by Hoechst Fibers Industries, Spartanburg, SC, or approved equal.
- C. Stakes: Softwood lumber, pointed end.
 - 1. Lodgepole stakes. Length as required to meet dimensions required per plans.
 - a. Container sizes up to 24-inch box: 2-inch diameter.
 - b. Container sizes larger than 24-inch box: 3-inch diameter.
- D. Cable, Wire, Eye Bolts and Turnbuckles: Non-corrosive, of sufficient strength to withstand wind pressure and resulting movement of plant life.
- E. Root Control Barrier: "Deep Root Control Barrier", stock number UB24-2 as manufactured by Deep Root Corp., 15040 Golden West Circle, Westminster, CA 92683 (714) 898-0563, or approved equal.

2.06 SOURCE QUALITY CONTROL

- A. Provide testing of imported topsoil.
- B. Analyze to ascertain percentage of nitrogen, phosphorus, potash, soluble salt and organic matter; pH value and any deficiencies.
- C. Submit minimum 10 oz sample of topsoil proposed. Forward sample to testing laboratory in sealed containers to prevent contamination.
- D. Testing is not required if recent tests are available for imported topsoil. Submit these test results to the testing laboratory for approval. Indicate, by test results, information necessary to determine suitability.

PART 3 EXECUTION

3.01 ORDERING, REVIEW AND ACCEPTANCE OF PLANT MATERIAL

- A. Ordering:
 - 1. Within 30 days after award of contract, submit written certification to the CRPD of the quantity and species of plant material ordered, and the nursery(s) supplying the material.
 - 2. The Contractor is responsible for providing all plant material in the quantities and sizes specified on the drawings, and for making all arrangements in advance that may be required to obtain these materials. If any material specified will be unavailable at the time of planting, submit written verification to the CRPD along with the bid.
- B. Review of Plant Material: Before planting operations begin, all plant materials shall be reviewed for conformance to the design intent of the Contract Documents by the CRPD. Submit written request for review of plant material at least 10 days prior to commencement of

planting operations. Review by the CRPD does not waive the right of rejection during planting or any time thereafter.

- C. Rejection of Material: The CRPD reserves the right to review and reject plant material at any time, and at the place of growth, for nonconformance to the Specifications. Do not install plant material, which has not been reviewed at the project site by the CRPD.

3.02 EXAMINATION

- A. Verify that prepared subsoil and planters are ready to receive work.
- B. Saturate soil with water to test drainage.
- C. Verify that required underground utilities are available, in proper location, and ready for use.

3.03 GRADING

- A. General: All areas to be planted on the project shall be free of rocks over one inch in diameter to a depth of 8" minimum below finish grade, and free of foreign debris, subsoil, refuse, plants or roots, clods, weeds, sticks, solvents, petroleum products, concrete, base rock, or other deleterious or extraneous material. Areas to be planted shall be free of soil-borne diseases and capable of sustaining healthy plant life. Do all work necessary to bring site soil, import soil and planter backfill to compliance with these requirements. Remove from the project site and dispose of in a legal manner any soils and material not meeting these requirements. Subject to acceptance of the CRPD, all soil and material not meeting these requirements shall be the property of the Contractor.
 - 1. Surface Drainage: Contractor is responsible for proper surface drainage of planted areas. Report in writing to the CRPD any discrepancies in the Contract Documents, obstructions on the site, or any other conditions, which the Contractor feels prevent establishing proper drainage, and obtain the Inspector's instructions prior to proceeding with the work affected.
 - 2. Final Contouring:
 - a. Handle and place the soil to depths required. Remove all rocks and clods over one inch in diameter. Provide for surface drainage and cut all necessary drain swales.
 - b. Work soil sufficiently so that after rolling and after full settlement has occurred, the site will be graded to within ± 0.10 of a foot from the lines, grades and elevations shown, and as may be directed by the Inspector. Finished surface shall be smooth and uniform and shall be free of depressions that retain standing water or any surface irregularities that would impede proper drainage. Unless otherwise noted, all soil finish grades shall be 1-1/2 inches below finish grade of adjacent walks, pavements and curbs, and top of wall elevations.
 - 3. Erosion Repair: Repair all erosion damage that occurs until Final Acceptance. Take all measures necessary to prevent erosion occurring during work under this Section. Provide and amend replacement soil in accordance with this Section.

3.04 PREPARATION OF SUBSOIL

- A. Amend subsoil as indicated in analysis.
- B. Prepare subsoil to eliminate uneven areas. Maintain profiles and contours. Make changes in grade gradual. Blend slopes into level areas.
- C. Remove foreign materials, weeds and undesirable plants and their roots. Remove contaminated subsoil.
- D. Scarify subsoil to a depth of 3 inches where plants are to be placed. Repeat cultivation in areas where equipment, used for hauling and spreading topsoil, has compacted subsoil.

- E. Dig plant pits and beds twice the size of the rootball as directed per the drawings.

3.05 PLACING TOPSOIL

- A. Spread topsoil to a minimum depth of 6 inches over area to be planted. Rake smooth.
- B. Place topsoil during dry weather and on dry unfrozen subgrade.
- C. Remove vegetable matter and foreign non-organic material from topsoil while spreading.
- D. Grade topsoil to eliminate rough, low or soft areas, and to ensure positive drainage.
- E. Install topsoil into pits and beds intended for plant root balls, to a minimum thickness of 6 inches.
- F. Place topsoil mix to the depths specified to obtain finish grades shown on the drawings. Soil mix shall be handled in a manner so as to prevent segregation of ingredients. Thoroughly water planter backfill mix after placement to compact and settle mix.

3.06 FERTILIZING

- A. Apply fertilizer in accordance with manufacturer's instructions.
- B. Apply after initial raking of topsoil.
- C. Mix thoroughly into upper 2 inches of topsoil.
- D. Lightly water to aid the dissipation of fertilizer.

3.07 EXCAVATION OF PLANTING PITS ON-GRADE

- A. General: Excavate plant pits by hand or with a backhoe; use of augers will not be permitted. Prior to planting and backfill, scarify the sides and bottom of the pit as required to eliminate any glazed surfaces. Excavate container-grown tree, shrub, and vine holes to the following dimensions:
 - 1. 1, 5, and 15 gallon containers: Two times the size of the root ball in width and depth.
 - 2. 24-inch boxes and larger: Large enough to allow one foot of space around the ball in all directions.
 - 3. Holes on mounds: Dig plant holes on mounds deeper than normal.
 - 4. Excess Soil: Transport and dispose of off-site in a legal manner any excess excavated soil.
 - 5. Obstructions: If rocks, underground construction work, tree roots or other unknown obstructions are encountered in the excavation of plant holes, alternate locations may be selected by CRPD. Report all such conditions in writing to the CRPD. If a change in the location of the planting pit is unacceptable to the CRPD, the original planting pit shall be over-excavated to remove the obstructions to a minimum dimension of 12" beyond the sides and bottom of the tree pit as typically specified. Obtain the CRPD's instructions prior to proceeding with the work affected.

3.08 DETRIMENTAL SOILS AND DRAINAGE

- A. General: Prior to planting, test drain all planting areas as follows:
 - 1. On-Grade Plant Pits: Fill with 12 inches of water. Water should drain completely in 48 hours.
 - 2. Plant Beds: Irrigate until soil is saturated. Saturated condition should not remain after 24 hours.
- B. Drainage Chimneys:
 - 1. General: For plant pits failing the initial drainage test, provide drainage chimneys as shown on the drawings and as directed by the CRPD.

2. Neatly auger drainage chimneys to a depth directed by the CRPD. Remove loose soil from hole and plant pit. Locate chimneys at perimeter of plant pit. Repeat test for proper drainage.
 3. Once required drainage test has been passed, backfill chimneys with drain rock, flush with bottom of pit. Cover chimneys with soil separator.
- C. Failure of Drainage Test: report in writing to the CRPD all areas not passing these tests and all soil conditions that the Contractor considers detrimental to growth of plant material. State condition and proposal and cost estimate for correcting the condition. Obtain the CRPD's instructions prior to proceeding with the work affected. Repeat drainage testing and correction of conditions in this manner as necessary until tests are passed. Failure to perform drainage tests and/or to notify the CRPD in writing of the conditions specified above renders the Contractor responsible for all plant failure that occurs as a result of inadequate drainage or detrimental soil conditions, as determined by the CRPD.

3.09 PLANTING

- A. General: Do not plant any material that has not been reviewed by the Inspector upon delivery to the project site or that has been rejected for any reason. Do not plant under unfavorable weather conditions.
- B. Place plants for best appearance.
- C. Set plants vertical.
- D. Remove non-biodegradable root containers. After removing plants from their containers, disentangle any small roots that encircle the container. Do not cut or otherwise disturb the root ball. Inspect all plants for rootbound condition; do not install rootbound plants or plants found to have cracked or broken root balls when taken from the container.
- E. Care should be exercised to prevent damage or breakage to limbs, and ropes or other lines should not be allowed to damage bark.
 1. Container Stock:
 - a. General: Do not lift or handle container plants by tops, stems, or trunks at any time.
 - b. Boxed Stock: Remove bottom of box prior to placement of plant in planting pit. Cut bands and remove box sides just prior to backfilling.
 - c. Canned Stock: Remove canned stock carefully after cans have been cut on two sides with acceptable cutter. Do not use spade to cut cans.
 - d. Ball and Burlap Stock: Dig ball and burlap (B & B) plants with firm balls of earth of diameter not less than that recommended by the American Standard for Nursery Stock, and of sufficient depth to include the fibrous and feeder roots. Plants moved with ball will not be accepted if the ball is cracked or broken before or during planting operations.
- F. Set plants in pits or beds, partly filled with prepared plant mix, at a minimum depth of 6 inches under each plant. Remove burlap, ropes, and wires, from the root ball.
- G. Place bare root plant materials so roots lie in a natural position. Backfill soil mixture in 6 inch layers. Maintain plant life in vertical position.
- H. Saturate soil with water when the pit or bed is half full of topsoil and again when full.
- I. Top-dress Fertilizing On-Grade: When plant installation is complete, fertilize all planting areas (excluding lawn areas) with top-dress fertilizer at the rate of 4 lbs. per 100 square feet.
- J. Anti-Desiccant: At Contractor's option, spray all evergreen and deciduous plant material in full leaf with anti-desiccant, in accordance with manufacturer's instructions. Apply an

adequate film over trunks, branches, twigs and foliage. Take precautions as necessary to prevent damage, particularly from sun scald.

- K. Mulching: Mulch all planting areas (excluding lawn areas) with 3 inch layer of wood bark mulch unless otherwise shown. Spread mulch uniformly to form a smooth cover free of bare spots and mounds.
 - 1. Settlement: As shown on the drawings, the crowns of all plants shall be at least 1/2 inch above the surrounding grade after all settlement has occurred.
 - 2. Watering Basins On-Grade: Form a watering basin, an excavated ring around the root ball of the plant for each tree and shrub. Do not form watering basins in lawn areas.

3.10 GROUND COVER PLANTING

- A. Pre-emergent herbicide Application On-Grade Only: Apply pre-emergent herbicide, Surflan A.S. at the rate of 5-1/3 pounds per acre applied in 25 gallons of water to all on-grade locations. Apply before wood bark mulch application.
- B. Planting: Plant ground cover plants through wood bark mulch at the specified triangular spacings. Make planting hole with a hand mattock avoiding mixing surface applied herbicide into planting hole.
 - 1. Activation of Herbicide On-Grade Only: After planting, irrigate with at least one inch of water to activate the herbicide. Water areas carefully taking care to avoid erosion. Repair erosion occurring from careless watering immediately. Remove, repair and replace adjacent planting and soil damaged by careless watering and translocation of herbicide.

3.11 LAYOUT OF PLANT MATERIAL

- A. General: The CRPD will review for conformance to the design intent of the Contract Documents locations of all plants in the field prior to planting. Notify the CRPD and schedule layout review sufficiently in advance of planting to allow for review and adjustment without disrupting construction schedule.
- B. Adjustments: The CRPD reserves the right to make minor adjustments in the layout of all plant material; adjust irrigation system as necessary.

3.12 PLANT SUPPORT

- A. General: Complete staking and guying immediately after planting. Perform in accordance with reference standards, unless otherwise shown on the drawings or directed by the CRPD. Securely stake or guy all trees planted on the site using staking or guying type shown on the drawings. The CRPD reserves the right to make modifications to staking and guying procedures as required to accommodate field conditions at no additional cost to the CRPD.
 - 1. Staking: Stake trees with one as shown on the drawings.

3.13 PRUNING

- A. Prune plants only at the direction of the CRPD and according to reference standards to preserve the natural character of the plant. Remove all dead wood, suckers and broken or badly bruised branches. Remove sucker basal and lateral growth to prevent resprouting; retain normal side branching. Use only disinfected, sharp tools. Improperly pruned trees will be subject to rejection by the CRPD. Apply tree seal to cuts over one inch diameter in accordance with manufacturer's instructions.
- B. Prune trees as recommended in ANSI A300 Part 1.
- C. Prune newly planted trees as required to remove dead, broken, and split branches.

3.14 FIELD QUALITY CONTROL

- A. Plants will be rejected if a ball of earth surrounding roots has been disturbed or damaged prior to or during planting.
- B. Deficient Soils: Remove all soils determined by the CRPD to be deficient and provide all additional amendments as directed to modify deficient soils at no additional cost to the CRPD.

3.15 MAINTENANCE - 90 DAYS FROM DISTRICT ACCEPTANCE OF WORK

- A. Contractor shall maintain all planting areas, plants, and related items for the guarantee period by watering, weeding, fertilizing, pruning, trimming, spraying, and any other standard horticultural maintenance practice required in keeping plants in a vigorous healthy and presentable growing condition.
- B. Watering shall be provided as often as necessary to keep the soil condition of the plant in a moist condition at all times. Plants shall not be allowed to dry out at any time.
- C. All planting beds shall be kept clear of weeds at all times.
- D. Control of rodents such as gophers and ground squirrels as needed.

3.16 PLANTING GUARANTEE

- A. All trees shall be guaranteed for one year, and all plants shall be alive and in satisfactory growing condition at the end of the guarantee period. The beginning of the guarantee period shall be upon acceptance of the completed planting.
- B. Plants which die or become unhealthy or appear to be in a badly impaired condition shall be removed promptly and replaced, and any plants which settled below or rise above the desired finished grades shall be reset at proper grade. All replacements shall be plants of the same size and quality as originally specified in the "Plant List" and be furnished, planted, guyed, and maintained as specified herein at no additional cost.
- C. At the guarantee period conclusion, a final inspection of all work included in this contract will be made. Any plant found to be not in a healthy growing condition, broken, damaged, or otherwise in such a condition as to impair or destroy the symmetrical or other desired appearance shall be removed immediately from the site and replacement made by the Contractor, as specified under this section, at no additional cost to the District.

3.17 CLEANUP

- A. Sweep site clean of all excess materials used in these operations. Excess soils shall be swept up and removed off site. Do not wash excess materials into adjacent drainage facilities.

End of Section 32 9300

Section 33 0110.58

Disinfection of Water Utility Piping Systems

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Disinfection of site domestic water lines and site fire water lines specified in Section 33 1416.

1.02 RELATED REQUIREMENTS

- A. Section 33 1416 - Site Water Utility Distribution Piping.

1.03 REFERENCE STANDARDS

- A. AWWA B300 - Hypochlorites; 2011.
- B. AWWA B301 - Liquid Chlorine; 2010.
- C. AWWA B302 - Ammonium Sulfate; 2010.
- D. AWWA B303 - Sodium Chlorite; 2010.
- E. AWWA C651 - Disinfecting Water Mains; 2005.

1.04 SUBMITTALS

- A. See Section 01 3300 - Administrative Requirements, for submittal procedures.
- B. Test Reports: Indicate results comparative to specified requirements.
- C. Certificate: Certify that cleanliness of water distribution system meets or exceeds specified requirements.
- D. Disinfection report:
 - 1. Type and form of disinfectant used.
 - 2. Date and time of disinfectant injection start and time of completion.
 - 3. Test locations.
 - 4. Initial and 24 hour disinfectant residuals (quantity in treated water) in ppm for each outlet tested.
 - 5. Date and time of flushing start and completion.
 - 6. Disinfectant residual after flushing in ppm for each outlet tested.
- E. Bacteriological report:
 - 1. Date issued, project name, and testing laboratory name, address, and telephone number.
 - 2. Time and date of water sample collection.
 - 3. Name of person collecting samples.
 - 4. Test locations.
 - 5. Initial and 24 hour disinfectant residuals in ppm for each outlet tested.
 - 6. Coliform bacteria test results for each outlet tested.
 - 7. Certification that water complies, or fails to comply, with bacterial standards of _____.

1.05 QUALITY ASSURANCE

- A. Water Treatment Firm: Company specializing in disinfecting potable water systems specified in this Section with minimum three years documented experience.
- B. Testing Firm: Company specializing in testing potable water systems, certified by governing authorities of California.
- C. Submit bacteriologist's signature and authority associated with testing.

PART 2 PRODUCTS

2.01 DISINFECTION CHEMICALS

- A. Chemicals: AWWA B300, Hypochlorite, AWWA B301, Liquid Chlorine, AWWA B302, Ammonium Sulfate, and AWWA B303, Sodium Chlorite.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that piping system has been cleaned, inspected, and pressure tested.
- B. Schedule disinfecting activity to coordinate with start-up, testing, adjusting and balancing, demonstration procedures, including related systems.

3.02 DISINFECTION

- A. Use method prescribed by the applicable state or local codes, or health authority or water purveyor having jurisdiction, or in the absence of any of these follow AWWA C651.
- B. Provide and attach equipment required to perform the work.
- C. Inject treatment disinfectant into piping system.
- D. Maintain disinfectant in system for 24 hours.
- E. Flush, circulate, and clean until required cleanliness is achieved; use municipal domestic water.
- F. Replace permanent system devices removed for disinfection.

3.03 FIELD QUALITY CONTROL

- A. Perform field inspection and testing in accordance with Section 01 4000.
- B. Test samples in accordance with AWWA C651.

End of Section 33 0110.58

Section 33 1416

Site Water Utility Distribution Piping

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Water pipe for site conveyance lines.
- B. Pipe valves.
- C. Fire hydrants.

1.02 RELATED REQUIREMENTS

- A. Section 03 3000 - Cast-in-Place Concrete: Concrete for thrust restraints.
- B. Section 21 1100 - Facility Fire-Suppression Water-Service Piping.
- C. Section 31 2316.13 - Trenching: Excavating, bedding, and backfilling.

1.03 REFERENCE STANDARDS

- A. ASTM B88 - Standard Specification for Seamless Copper Water Tube; 2014.
- B. ASTM D1785 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120; 2015.
- C. ASTM D2466 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40; 2013.
- D. ASTM D2467 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80; 2015.
- E. ASTM D2855 - Standard Practice for Making Solvent-Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings; 1996 (Reapproved 2010).
- F. ASTM D3139 - Standard Specification for Joints for Plastic Pressure Pipes using Flexible Elastomeric Seals; 1998 (Reapproved 2011).
- G. AWWA C500 - Metal-Seated Gate Valves for Water Supply Service; 2009.
- H. AWWA C504 - Rubber-Seated Butterfly Valves 3 In. (75 mm) Through 72 In. (1,800 mm); 2010.
- I. AWWA C509 - Resilient-Seated Gate Valves for Water Supply Service; 2009.
- J. AWWA C900 - Polyvinyl Chloride (PVC) Pressure Pipe, 4 In. Through 12 In. (100 mm Through 300 mm), for Water Transmission and Distribution; 2007.
- K. UL 246 - Hydrants for Fire-Protection Service; Current Edition, Including All Revisions.

1.04 SUBMITTALS

- A. See Section 01 3300 - Submittals, for submittal procedures.
- B. Product Data: Provide data on pipe materials, pipe fittings, valves and accessories.
- C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- D. Names and addresses of the nearest service and maintenance organization that readily stocks repair parts.
- E. Manufacturer's recommended installation procedures.

1.05 QUALITY ASSURANCE

- A. Perform Work in accordance with utility company requirements.

- B. Use adequate numbers of skilled workers who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store valves in shipping containers with labeling in place.

PART 2 PRODUCTS

2.01 WATER PIPE

- A. Copper Tubing: ASTM B88, Type K, Annealed:
 - 1. Fittings: ASME B16.18, cast copper, or ASME B16.22, wrought copper.
 - 2. Joints: Compression connection or AWS A5.8M/A5.8, BCuP silver braze.
- B. PVC Pipe: ASTM D1785, Schedule 40.
 - 1. Fittings: ASTM D2466, PVC.
 - 2. Joints: ASTM D2855, solvent weld.
- C. PVC Pipe: AWWA C900 Class 100:
 - 1. Fittings: AWWA C111/A21.11, Schedule 40 per ASTM D2466 or schedule 80 per ASTM D2467.
 - 2. Joints: ASTM D3139 compression gasket ring.
- D. Trace Wire: Magnetic detectable conductor, clear plastic covering, imprinted with "Water Service" in large letters.

2.02 VALVES

- A. Valves: Manufacturer's name and pressure rating marked on valve body.
- B. Gate Valves Up To 3 Inches:
 - 1. Brass or Bronze body, non-rising stem, inside screw, single wedge or disc, compression ends, with control rod, post indicator, valve key, and extension box.
- C. Gate Valves 3 Inches and Over:
 - 1. AWWA C509, iron body, bronze trim, non-rising stem with square nut, single wedge, resilient seat, flanged ends, control rod, post indicator, valve key, and extension box.

2.03 HYDRANTS

- A. Hydrants: Type as required by the City.

2.04 BEDDING AND COVER MATERIALS

- A. Bedding: As specified in Section 31 2316.13.
- B. Cover: As specified in Section 31 2316.13.

2.05 ACCESSORIES

- A. Concrete for Thrust Restraints: Concrete type specified in Section 03 3000.
- B. Backflow Preventer: _____.
- C. Meter: _____.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that building service connection and municipal utility water main size, location, and invert are as indicated.

3.02 PREPARATION

- A. Cut pipe ends square, ream pipe and tube ends to full pipe diameter, remove burrs.
- B. Remove scale and dirt on inside and outside before assembly.
- C. Prepare pipe connections to equipment with flanges or unions.

3.03 TRENCHING

- A. See the sections on excavation and fill for additional requirements.
- B. Backfill around sides and to top of pipe with cover fill, tamp in place and compact, then complete backfilling.

3.04 INSTALLATION - PIPE

- A. Route pipe in straight line.
- B. Install pipe to allow for expansion and contraction without stressing pipe or joints.
- C. Slope water pipe and position drains at low points.
- D. Install trace wire 6 inches above top of pipe; coordinate with Section 31 2316.13.

3.05 INSTALLATION - VALVES AND HYDRANTS

- A. Set valves on solid bearing soil.
- B. Center and plumb valve box over valve. Set box cover flush with finished grade.
- C. Set hydrants plumb; locate pumper nozzle perpendicular to and facing roadway in accordance with Section 21 1100.
- D. Set hydrants to grade, with nozzles at least 20 inches above ground in accordance with Section 21 1100.

3.06 SERVICE CONNECTIONS

- A. Provide water service to utility company requirements with reduced pressure backflow preventer and water meter with bypass valves and sand strainer.

3.07 FIELD QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements, for additional requirements.
- B. Perform field inspection and testing in accordance with Section 01 4000.
- C. Closing un-inspected work:
 - 1. Do not allow or cause any of the work of this Section to be covered up or enclosed until after it has been completely inspected and tested, and has been approved by the Engineer.
- D. Hydrostatic tests:
 - 1. Where any section of a water line is provided with concrete thrust blocking for fittings, do not make hydrostatic tests until at least five days after installation of the concrete thrust blocking, unless otherwise directed by the Engineer.
 - 2. Devise a method for disposal of wastewater from hydrostatic tests, and for disinfection, as approved in advance by the Engineer.
 - 3. Backfill and compaction shall be completed prior to the final 2-hour pressure test.
 - 4. Each section of the pipe to be tested shall be slowly filled with water, and all air shall be expelled from the pipe.
 - a. The release of the air can be accomplished by opening hydrants and service cocks at the high points of the system and the blowoffs at all dead ends.

- b. The valve controlling the admission of water into the section of pipe to be tested shall be opened wide before shutting the hydrants or blowoffs.
 - c. After the system has been filled with water and all air expelled, all the valves controlling the section to be tested shall be closed.
 - d. The line shall be allowed to set for a period of not less than 24 hours.
 - e. The pipe shall then be refilled, if necessary, prior to the pressure tests.
- E. Pressure tests:
1. Bring newly laid piping and valved sections of water distribution and service piping to a hydrostatic pressure of 200 psi for two hours.
 2. Open and close each valve several times during the test.
 3. Carefully examine exposed pipe, joints, fittings, and valves.
 4. Replace or remake joints showing visible leakage.
 - a. Remove cracked pipe, defective pipe, and cracked or defective joints, fittings, and valves. Replace with sound material and repeat the test until results are satisfactory.
 - b. Make repair and replacement without additional cost to the Owner.
- F. Leakage test:
1. Conduct leakage test after the pressure test has been completed satisfactorily.
 2. Duration of each leakage test: Minimum two (2) hours.
 3. During the test, subject water lines to a pressure of 200 psi.
 4. Leakage is defined as the quantity of water to be supplied into the newly laid pipe, or any valved or approved section thereof, necessary to maintain the specified leakage test pressure after the pipe has been filled with water and the air expelled.
 - a. No piping installation will be accepted until the leakage is less than the number of gallons per hour as determined by the formula:
 - 1) $L = 0.00304 ND \times \text{sq. root of } P$
 - 2) $(L = 0.00054 ND \times \text{sq root of } P)$; where
 - 3) $L =$ allowable leakage in gallons per hour;
 - 4) $N =$ number of joints in length of pipe under test;
 - 5) $D =$ nominal diameter of pipe in inches; and
 - 6) $P =$ average test pressure in lbs per sq inch.
 - 7) The allowable leakage in gallons per hour, per joint, at 200 psi average test pressure shall be in accordance with Table II.
 - 8) Should any test of pipe disclose leakage greater than that specified in Table II, locate and repair the defective joint or joints until the leakage is within the specified allowance, and at no additional cost to the Owner.
 - b. Table II:

Diameter:	Leakage in gal:	Diameter:	Leakage in gal:
a.	0.015312"	0.0915	
b.	0.023114"	0.1070	
c.	0.030616"	0.1225	
d.	0.045818"	0.1375	
e.	0.061020"	0.1530	
f.	0.076524"	0.1830	
- G. Time for making test:
1. Except for joint material setting, or where concrete reaction backing necessitates a five day delay, pipelines jointed with rubber gaskets, mechanical, or push-on joints, or

couplings may be subjected to hydrostatic pressure, inspected, and tested for leakage at any time after partial completion of backfill.

H. Disinfection:

1. Disinfect per Section 33 0110.58 - Disinfection of Water Utility Piping Systems.

End of Section 33 1416

Section 33 3113

Site Sanitary Sewerage Gravity Piping

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Sanitary sewerage drainage piping, fittings, and accessories.
- B. Connection of building sanitary drainage system to municipal sewers.

1.02 RELATED REQUIREMENTS

- A. Section 31 2316 - Excavation: Excavating of trenches.
- B. Section 31 2316.13 - Trenching: Excavating, bedding, and backfilling.
- C. Section 31 2323 - Fill: Bedding and backfilling.

1.03 REFERENCE STANDARDS

- A. ASTM D1785 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120; 2015.
- B. ASTM D2321 - Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications; 2014.
- C. ASTM D2729 - Standard Specification for Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings; 2011.
- D. ASTM D3034 - Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings; 2015.

1.04 SUBMITTALS

- A. See Section 01 3300 - Submittals, for submittal procedures.
- B. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- C. Project Record Documents:
 - 1. Record location of pipe runs, connections, manholes, cleanouts, and invert elevations.
 - 2. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

PART 2 PRODUCTS

2.01 SEWER PIPE MATERIALS

- A. Plastic Pipe: ASTM D3034, Type PSM, Poly(Vinyl Chloride) (PVC) material; inside nominal diameter of ____ inches, bell and spigot style solvent sealed joint end.
- B. Use extra strength, minimum of SDR 35.
- C. Fittings: Same material as pipe molded or formed to suit pipe size and end design, in required tee, bends, elbows, cleanouts, reducers, traps and other configurations required.

2.02 PIPE ACCESSORIES

- A. Trace Wire: Magnetic detectable conductor, clear plastic covering, imprinted with "Sewer Service" in large letters.

2.03 CLEANOUT MANHOLE

2.04 BEDDING AND COVER MATERIALS

- A. Pipe Bedding Material: As specified in Section 31 2316.13.
- B. Pipe Cover Material: As specified in Section 31 2316.13.

PART 3 EXECUTION

3.01 TRENCHING

- A. See Section 31 2316.13 for additional requirements.
- B. Backfill around sides and to top of pipe with cover fill, tamp in place and compact, then complete backfilling.

3.02 INSTALLATION - PIPE

- A. Verify that trench cut is ready to receive work and excavations, dimensions, and elevations are as indicated on layout drawings.
- B. Install pipe, fittings, and accessories in accordance with manufacturer's instructions. Seal watertight.
 - 1. Plastic Pipe: Also comply with ASTM D2321.
- C. Lay pipe to slope gradients noted on layout drawings; with maximum variation from true slope of 1/8 inch in 10 feet.
- D. Connect to building sanitary sewer outlet .
- E. Install trace wire 6 inches above top of pipe; coordinate with Section 31 2316.13.

3.03 INSTALLATION - CLEANOUTS

- A. Form bottom of excavation clean and smooth to correct elevation.
- B. Form and place cast-in-place concrete base pad, with provision for sanitary sewer pipe end sections.
- C. Establish elevations and pipe inverts for inlets and outlets as indicated.
- D. Mount lid and frame level in grout, secured to top cone section to elevation indicated.

3.04 FIELD QUALITY CONTROL

- A. Perform field inspection and testing in accordance with Section 01 4000.
- B. If tests indicate Work does not meet specified requirements, remove Work, replace and retest at no cost to CRPD.

3.05 PROTECTION

- A. Protect pipe and bedding cover from damage or displacement until backfilling operation is in progress.

End of Section 33 3113

Section 33 4211
Stormwater Gravity Piping

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Stormwater drainage piping.

1.02 RELATED REQUIREMENTS

- A. Section 31 2316 - Excavation: Excavating of trenches.
- B. Section 31 2316.13 - Trenching: Excavating, bedding, and backfilling.
- C. Section 31 2323 - Fill: Bedding and backfilling.

1.03 REFERENCE STANDARDS

- A. ASTM F-405/f-667 - Corrugated polyethylene tubing and fittings.
- B. AASHTO M252 - Specification for Corrugated Polyethylene Drainage Tubing, 3- to 10- inch Diameter.
- C. AASHTO M294 - Specification for Corrugated Polyethylene Pipe, 12- to 36- Inch Diameter.
- D. ASTM D1056 - Specification for Flexible Cellular Materials - Sponge or Expanded Rubber.
- E. ASTM D1248 - Specification for Polyethylene Plastics Molding and Extrusion Material.
- F. ASTM D3350 - Specification for Polyethylene Plastics Pipe and Fittings Materials.
- G. ASTM D2321 - Standard practice for underground installation.

1.04 SUBMITTALS

- A. Comply with pertinent provisions of Division 01 - General Requirements – Administrative Requirements.
- B. Product data: Within 35 calendar days after the Contractor has received the City’s Notice to Proceed, submit:
 - 1. Materials list of items proposed to be provided under this Section;
 - 2. Manufacturer’s specifications and other data needed to prove compliance with the specified requirements.
 - 3. Manufacturer’s recommended installation procedures which, when approved by the Engineer, will become the basis for accepting or rejecting actual installation procedures used on the work.

1.05 PRODUCT HANDLING

- A. Comply with pertinent provisions of Division 01 - General Requirements - Product Requirements

PART 2 PRODUCTS

2.01 STORM WATER DRAINAGE PIPE MATERIALS

- A. Provide pipe and associated materials of the size indicated on the Drawings and meeting the following requirements.
 - 1. High Density Polyethylene Pipe (HDPE):
 - a. Acceptable products:
 - 1) “Hi-Q” High Density Polyethylene storm drain and fittings, manufactured by Hancor, Inc., P.O. Box 1047, Findlay, OH 45839. Phone: (800)892-3351

- 2) "N-12" High Density Polyethylene storm drain and fittings, manufactured by Advanced Drainage Systems, 4640 Trueman Boulevard, Hillard, OH 43026. Phone: (800) 821-6710, Fax: (614) 658-0204.
- 3) Approved equivalent.
2. High Density Polyethylene material shall comply with:
 - a. AASHTO M252 for material from 3" – 10" in size.
 - b. AASHTO M294 for material 12" – 36" in size.
 - c. STM D1248 for standard specifications for Polyethylene Plastics Molding and Extrusion Materials.
 - d. ASTM D3350 for pipe and fitting.
 - e. ASTM D2321 standard practice for underground installation.
3. High Density Polyethylene Pipe:
 - a. The material supplied under this specification shall be high density polyethylene corrugated exterior/smooth interior pipe. The 12" – 36" diameter shall conform to AASHTO M294 Type S; the 3" – 10" diameter material shall meet the strength requirement of AASHTO M252 with the addition that the pipe shall have a smooth interior liner. Material shall conform to ASTM D3350.
4. Joints and Fittings:
 - a. Pipe joints and fitting shall conform to AASHTO M252 and AASHTO M294, or be approved by the engineer.
 - b. Coupling bands shall cover at least one full corrugation on each section of pipe. When gasketed couple bands are required, the gasket shall be made of closed-cell synthetic expanded rubber meeting the requirements of ASTM D1056, Grade RE42. All coupling bands shall meet or exceed the soils-tightness requirements of the AASHTO Standard Specifications for Highway Bridges, Section 23, paragraph 23.3.2.5.4.(e).
 - c. All fittings shall conform to AASHTO M294.

2.02 CATCH BASIN, TRENCH DRAIN, CLEANOUT, AND AREA DRAIN COMPONENTS

A. General:

1. Construct manholes, inlets, and junction structures of reinforced concrete or precast reinforce concrete, complete with metal frames and covers or gratings, and with fixed ladder rungs where indicated on the Drawings or required by codes. Prefabricated structures may be used when shown on the plans and approved by the engineer.
2. Rungs shall be individual wall-mounted aluminum, plastic-covered steel, or galvanized steel rungs are acceptable.

B. Materials:

1. Concrete: Comply with provisions for 3,250 psi concrete specified in Section 02750 Concrete Pavement.
2. Mortar for pipe joints and connections to other drainage structures, and manhole construction.
 - a. Comply with requirements of ASTM C270, type M, except the maximum placement time shall be one hour.
 - b. Hydrated lime complying with ASTM C141, type B, may be added to the mixture of sand and cement in an amount equal to 25% of the volume of cement used.
 - c. Provide a quantity of water in the mixture sufficient to produce a stiff workable mortar, which shall be clean and free from harmful acids, alkalis, and organic impurities. Use the mortar within 30 minutes after water is added to the mix.

3. Precast reinforced concrete manholes:
 - a. Comply with ASTM C478, precast rings and cone sections.
 - b. Fully bed the joints between precast concrete risers and tops in mortar, and smooth both interior and exterior surfaces uniformly.
 - c. Acceptable products:
 - 1) Manufactured by Ameron Pipe Products Group, El Monte, California.
 - 2) Manufactured by Santa Rosa Cast Products Company, 471 West College Avenue, Santa Rosa, CA 95401. Phone: (707) 546-5016, Fax: (707) 571-7768.
 - 3) Manufactured by Associated Concrete Products, Inc., 4301 W. Mac Arthur Boulevard, Santa Ana, CA 92704. Phone: (800) 862-6465, Fax: (714)540-0538.
 - 4) Approved equivalent.
4. Reinforcement: Provide intermediate grade billet steel complying with ASTM A 615, grade 40.
5. Frames and covers or gratings:
 - a. Provide all gratings or covers from the same manufacturer.
 - b. Provide standard black finish, supplied as a total unit, sized as shown on the Drawings or larger sizes except where in a pavement area, and with the wording "STORM DRAIN" cast into the cover.
 - c. Acceptable products:
 - 1) Manufactured by Alhambra Foundry, Alhambra, California.
 - 2) Approved equivalent.
6. Precast concrete catch basins:
 - a. Provide reinforced and bottom open for field pouring to ensure slope through the structure.
 - b. Contractor may select this option in lieu of cast-in-place concrete catch basins.
 - 1) Acceptable products:
 - 2) Manufactured by Christy, 44100 Christy Street, Fremont, CA 94538. Phone: (800) 486-7070, Fax: (510) 490-6804.
 - 3) Manufactured by Central Precast Concrete Inc., 471 West College Avenue, Santa Rosa, CA 95401. Phone: (707) 546-5016, Fax: (707) 571-7768.
 - 4) Manufactured by Brooks Products, 1850 Parco Avenue, Ontario, CA 91761. Phone: (888) 307-7470, Fax: (909) 947-7741.
 - 5) Approved equivalent.

2.03 IN-LINE DRAINS

- A. The inline drain shall be manufactured from PVC pipe stock, utilizing a thermo-molding process to reform the pipe stock to the furnished configuration. The drainage pipe connection stubs shall be manufactured from PVC pipe stock and formed to provide a watertight connection with the specified pipe system. This joint tightness shall conform to ASTM D3212 for joints for drain and sewer plastic pipe using flexible elastomeric seals. The pipe bell spigot shall be joined to the inline drain body by use of a swage mechanical joint. The pipe stock used to manufacture the inline drain body and pipe bell spigot of the surface drainage inlets shall meet the mechanical property requirements for fabricated fittings as described by ASTM D3034, Standard for Sewer PVC Pipe and Fittings; ASTM F1336, Standard for PVC Gasketed Sewer Fittings.
- B. The grates furnished for all surface drainage inlets shall be ductile iron grates for sizes 8", 10", 18", 24" and 30" (12" and 15" frames are cast iron) shall be made specifically for each fitting so as to provide a round bottom flange that closely matches the diameter of the surface

drainage inlet. Inline drain grates for traffic loading areas and turf areas shall be flat and capable of supporting H-20 wheel loading for heavy-duty traffic. Grates in shrub and planter areas shall be domed and capable of a minim H-10 loading for pedestrian traffic. Grates in 12" and 15" will be hinged to the frame using pins. Metal used in the manufacture of the castings shall conform to ASTM A536 grade 70-50-05 for ductile iron and ASTM A-48-83 Class 30B for 12" and 15" cast iron frames. Grates shall be provided painted black.

C. Acceptable Product:

1. Model ADS 27XXAG N, manufactured by Advanced Drainage Systems, 4640 Trueman Boulevard, Hilliard, OH 43026. Phone: (800) 821-6710, Fax: (614) 658-0204.
2. Drain-Rite, manufactured by Hancor, 6106 North Prospect, Fresno, CA 93711. Phone: (559) 435-6680, Fax: (559) 435-6667.
3. Approved equal.

2.04 STORM WATER TREATMENT SYSTEM

A. Filtration Requirements:

1. Storm water filtration shall meet the requirements for LEED for New Construction Version 2.2, SS Credit 6.2: Stormwater Design: Quality Control.
2. Capture and treat the stormwater runoff from 90 percent of the average annual precipitation.
 - a. The City of _____ has a mean annual rainfall of 14.4 inches and is considered an Arid Watershed.
 - b. For Arid Watersheds (less than 20 inches annual precipitation), treat 0.5 inch of precipitation.
3. Treatment flow = 0.11 cfs.
4. The system must be capable of removing 80 percent of the average annual post development total suspended solids (TSS) load.
5. The system shall address the removal of hydrocarbons.
6. Acceptable Products:
 - a. Precast 72 inch manhole StormFilter with 4 cartridges.
 - 1) Manufactured by Contech Stormwater Solutions. 12021-B NE Airport Way, Portland OR 97220. Phone: (800) 548-4667. Fax: (503) 240-9553. Email: stormwaterinc.com.
 - 2) Model PMSU20_15 storm water treatment unit.
 - 3) Manufactured by CDS Technologies. 16360 South Monterey Road, Suite 250, Morgan Hill, CA 95037. Phone: (888) 535-7559. Fax: (408) 782-0721. Email: cds@cdstech.com.
 - b. Approved equal.

B. Bypass Requirements:

1. The filtration system only treats first flush requirements. A bypass system is required to pass larger flows of up to 10 cfs.
 - a. The system shall allow for first flush drainage to pass through the filtration system.
 - b. The bypass shall be capable of passing 10 cfs through to the existing storm drain system.
2. Acceptable Products:
 - a. StormGate Manhole High Flow Bypass.
 - 1) Manufactured by Contech Stormwater Solutions. 12021-B NE Airport Way, Portland OR 97220. Phone: 800-548-4667. Fax: 800-561-1271.
 - 2) Approved equal.

2.05 BEDDING AND COVER MATERIALS

- A. Bedding: As specified in Section 31 2316.13.
- B. Cover: As specified in Section 31 2316.13.

PART 3 EXECUTION

3.01 SURFACE CONDITIONS

- A. Examine the areas and conditions under which work of this Section will be performed.
- B. Correct conditions detrimental to timely and proper completion of the work.
- C. Do not proceed until unsatisfactory conditions are corrected.

3.02 TRENCHING

- A. See Section 31 2316.13 for additional requirements.
- B. Excavate, trench, and bed for site drains as follows:
- C. Movement of construction machinery:
 - 1. Use means necessary to avoid displacement of, and injury to, pipe and structure while compacting by rolling or operating equipment parallel to the pipe.
 - 2. Movement of construction machinery over a culvert or storm drain at any stage of construction is solely at the Contractor's risk.
- D. Bedding:
 - 1. Provide a bedding surface for the pipe with a firm foundation of uniform density throughout the entire length of the pipe.
 - 2. Bed the pipe carefully in a soil foundation accurately shaped and rounded to conform to the lower $\frac{1}{4}$ of the outside perimeter of circular pipe, or set the pipe in a bed of sand.
 - 3. Tamp bedding where necessary.
 - 4. Provide bell holes and depressions for pipe joints of only the length, depth, and width required for making the particular pipe joint properly.
 - 5. Where plastic pipe is used, provide a minimum of 4" of sand bedding over the top and under the pipe.

3.03 INSTALLATION

- A. Verify that trench cut is ready to receive work and excavations, dimensions, and elevations are as indicated on layout drawings.
- B. General:
 - 1. Carefully examine each pipe prior to placing.
 - a. Promptly set aside defective pipe and damaged pipe.
 - b. Clearly identify defects.
 - c. Do not install defective pipe or damaged pipe.
 - 2. Place pipe to the grades and alignment indicated, with a tolerance of one in 1000 vertical and one in 500 horizontal, unless otherwise directed by the Architect.
 - 3. Provide adequate facilities for lowering pipe safely into the trenches.
 - 4. Do not place pipe in water, nor place pipe when trench or weather is unsuitable for such work.
- C. Polyvinyl chloride pipe joints: Install with the specified materials and in accordance with the manufacturer's recommendations as approved by the Engineer, applying solvent cement to pipe and fitting as recommended in ASTM D285.

- D. High Density Polyethylene: Installation shall be in accordance with ASTM D2321 and as recommended by the pipe manufacturer. Backfill shall be ASTM D2321 Class I, II, or III soils, or USCS material corresponding to these ASTM designations. Backfill material shall be placed in 6-inch lifts and compacted to 90 percent minimum density per AASHTO T99.
- E. Joining pipes of different materials: Provide fittings or couplings made for the pipe material jointing, or provide a concrete collar as approved by the Engineer.
- F. Joining pipe of different sizes:
 - 1. Provide reducer fittings to the larger pipe.
 - 2. Where pipes are different materials as well as different sizes, use the same material for reducer fittings as in the larger pipe.
 - 3. Use saddle connection when branch lines join a main or collector main.
 - 4. Use eccentric collar joint when the slope of the pipe is less than 1%.
- G. Lay pipe to slope gradients noted on layout drawings; with maximum variation from true slope of 1/8 inch in 10 feet.
- H. Connect to building storm drainage system, foundation drainage system, and utility/municipal system.

3.04 INSTALLATION - CATCH BASINS, TRENCH DRAINS AND CLEANOUTS

- A. Form bottom of excavation clean and smooth to correct elevation.
- B. Form and place cast-in-place concrete base pad, with provision for sanitary sewer pipe end sections.
- C. Establish elevations and pipe inverts for inlets and outlets as indicated.
- D. Mount lid and frame level in grout, secured to top cone section to elevation indicated.

3.05 FIELD QUALITY CONTROL

- A. Perform field inspection in accordance with Division 01 - General Requirements.
- B. Visually inspect the pipe for deflection.
 - 1. Deflection is limited to 7.5% of the base diameter.
 - 2. If the visual inspection determines the pipe may have deflection problems, the engineer can direct a mandrel test be performed.
 - 3. Such test will be performed at the contractor's expense.
 - 4. If required, the procedure can be conducted within the first 30 days after installation. Recommended madrel settings reflectin 7.5% of the base diameter for piper are shown in the table below:

NOMINAL DIAMETER INCHES	PIPE MEETING ASTM AND AASHTO STANDARDS		PIPE MEETING CSA STANDARDS	
	BASE DIAMETER INCHES	MANDREL SETTING INCHES	BASE DIAMETER MM	MANDREL SETTING MM
4	3.87	3.58	96.92	89.7
6	5.80	5.36	145.42	134.5
8	7.73	7.15	193.84	179.3
10	9.66	8.94	242.34	224.2
12	11.60	10.73	290.83	269.0

15	14.50	13.41	363.65	336.4
18	17.40	16.09	436.18	403.5
21	20.30	18.78	508.86	470.7
24	23.20	21.46	581.67	538.0

Pipe size greater than 24" is tested by visual inspection

- C. If tests indicate Work does not meet specified requirements, remove Work, replace and retest at no cost to CRPD.

3.06 PROTECTION

- A. Protect pipe and bedding cover from damage or displacement until backfilling operation is in progress.

End of Section 33 4211

