

SECTION 26 22 00

LOW-VOLTAGE TRANSFORMERS

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes two-winding transformers.
- B. Related Sections:
 - 1. Section 26 05 33 - Raceway and Boxes for Electrical Systems.

1.02 REFERENCES

- A. National Electrical Manufacturers Association:
 - 1. NEMA ST 1 - Specialty Transformers (Except General Purpose Type).
 - 2. NEMA ST 20 - Dry Type Transformers for General Applications.
- B. International Electrical Testing Association:
 - 1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

1.03 SUBMITTALS

- A. Division 01 - Administrative Requirements: Submittal Procedures.
- B. Product Data: Submit outline and support point dimensions of enclosures and accessories, unit weight, voltage, kVA, and impedance ratings and characteristics, tap configurations, insulation system type, and rated temperature rise.
- C. Test Reports: Indicate loss data, efficiency at 25, 50, 75 and 100 percent rated load, and sound level.

1.04 CLOSEOUT SUBMITTALS

- A. Division 01 - Execution and Closeout Requirements: Closeout procedures.
- B. Project Record Documents: Record actual locations of transformers.

1.05 QUALIFICATIONS

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

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Division 01 - Product Requirements: Product storage and handling requirements.

- B. Store in clean, dry space. Maintain factory wrapping or provide additional canvas or plastic cover to protect units from dirt, water, construction debris, and traffic.
- C. Handle in accordance with manufacturer's written instructions. Lift only with lugs provided. Handle carefully to avoid damage to transformer internal components, enclosure, and finish.

PART 2 PRODUCTS

2.01 TWO-WINDING TRANSFORMERS

- A. Manufacturers:
 - 1. Square D.
 - 2. Cutler-Hammer.
 - 3. GE.
 - 4. Substitutions: Division 01 - Product Requirements.
- B. Product Description: NEMA ST 20, factory-assembled, air-cooled, dry type transformers, ratings as indicated on Drawings]
- C. Primary Voltage: 480 volts, 3 phase, 3 wire.
- D. Secondary Voltage: 208Y/120 volts, 3 phase, 4 wire.
- E. Insulation system and average winding temperature rise for rated kVA as follows:
 - 1. 1-15 kVA: Class 185 with 80 degrees C rise.
 - 2. 16-500 kVA: Class 220 with 80 degrees C rise.
- F. Case temperature: Do not exceed 35 degrees C rise above ambient at warmest point at full load.
- G. Winding Taps:
 - 1. Transformers Less than 15 kVA: Two 5 percent below rated voltage, full capacity taps on primary winding.
 - 2. Transformers 15 kVA and Larger: NEMA ST 20.
- H. Sound Levels: NEMA ST 20.
- I. Basic Impulse Level: 10 kV for transformers less than 300 kVA, 30 kV for transformers 300 kVA and larger.
- J. Ground core and coil assembly to enclosure by means of visible flexible copper grounding strap.
- K. Mounting:
 - 1. 16-75 kVA: Suitable for floor mounting.
 - 2. Larger than 75 kVA: Suitable for floor mounting.
- L. Coil Conductors: Continuous copper windings with terminations brazed or welded.

- M. Enclosure: NEMA ST 20, Type 1 or Type 3R ventilated. Furnish lifting eyes or brackets.
- N. Isolate core and coil from enclosure using vibration-absorbing mounts.
- O. Nameplate: Include transformer connection data and overload capacity based on rated allowable temperature rise.

2.02 SOURCE QUALITY CONTROL

- A. Production test each unit according to NEMA ST20.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Division 01 - Administrative Requirements: Coordination and project conditions.
- B. Verify mounting supports are properly sized and located including concealed bracing in walls.

3.02 INSTALLATION

- A. Set transformer plumb and level.
- B. Use flexible conduit, in accordance with Section 26 05 33, 2 feet minimum length, for connections to transformer case. Make conduit connections to side panel of enclosure.
- C. Support transformers in accordance with Section 26 05 29.
 - 1. Mount floor-mounted transformers on vibration isolating pads suitable for isolating transformer noise from building structure.
- D. Provide seismic restraints.
- E. Install grounding and bonding in accordance with Section 26 05 26.

3.03 FIELD QUALITY CONTROL

- A. Division 01 - Quality Requirements and 01 70 00 - Execution and Closeout Requirements: Field inspecting, testing, adjusting, and balancing.
- B. Inspect and test in accordance with NETA ATS, except Section 4.
- C. Perform inspections and tests listed in NETA ATS, Section 7.2.1.

3.04 ADJUSTING

- A. Division 01 - Execution and Closeout Requirements: Testing, adjusting, and balancing.
- B. Measure primary and secondary voltages and make appropriate tap adjustments.

END OF SECTION

SECTION 26 24 13

SWITCHBOARDS

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes main and distribution switchboards.
- B. Related Sections:
 - 1. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
 - 2. Section 26 05 53 - Identification for Electrical Systems.
 - 3. Section 26 28 13 - Fuses.

1.02 REFERENCES

- A. American National Standards Institute:
 - 1. ANSI C12.1 - Code for Electricity Metering.
 - 2. ANSI C39.1 - Requirements, Electrical Analog Indicating Instruments.
- B. Institute of Electrical and Electronics Engineers:
 - 1. IEEE C57.13 - Standard Requirements for Instrument Transformers.
 - 2. IEEE C62.41 - Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits.
- C. National Electrical Manufacturers Association:
 - 1. NEMA AB 1 - Molded Case Circuit Breakers and Molded Case Switches.
 - 2. NEMA FU 1 - Low Voltage Cartridge Fuses.
 - 3. NEMA KS 1 - Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).
 - 4. NEMA PB 2 - Deadfront Distribution Switchboards.
 - 5. NEMA PB 2.1 - General Instructions for Proper Handling, Installation, Operation, and Maintenance of Deadfront Distribution Switchboards Rated 600 Volts or Less.
- D. International Electrical Testing Association:
 - 1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

1.03 SUBMITTALS

- A. Division 01 - Administrative Requirements: Submittal Procedures.
- B. Shop Drawings: Indicate front and side views of enclosures with overall dimensions shown; conduit entrance locations and requirements; nameplate legends; size and number of bus bars for each phase, neutral, and ground; and switchboard instrument details.

- C. Product Data: Submit electrical characteristics including voltage, frame size and trip ratings, fault current withstand ratings, and time-current curves of equipment and components.
- D. Test Reports: Indicate results of factory production and field tests.

1.04 CLOSEOUT SUBMITTALS

- A. Division 01 - Execution and Closeout Requirements: Closeout procedures.
- B. Project Record Documents: Record actual locations, configurations, and ratings of switchboards and their components on single line diagrams and plan layouts.
- C. Operation and Maintenance Data: Submit spare parts data listing; source and current prices of replacement parts and supplies; and recommended maintenance procedures and intervals.

1.05 QUALIFICATIONS

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

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Division 01 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Deliver in 48 inch maximum width shipping splits, individually wrapped for protection and mounted on shipping skids.
- C. Accept switchboards on site. Inspect for damage.
- D. Store in clean, dry space. Maintain factory wrapping or provide additional canvas or plastic cover to protect units from dirt, water, construction debris, and traffic.
- E. Handle in accordance with NEMA PB 2.1. Lift only with lugs provided. Handle carefully to avoid damage to switchboard internal components, enclosure, and finish.

1.07 ENVIRONMENTAL REQUIREMENTS

- A. Division 01 - Product Requirements.
- B. Conform to NEMA PB 2 service conditions during and after installation of switchboards.

1.08 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

1.09 SEQUENCING

- A. Division 01 - Summary: Work sequence.
- B. Sequence Work to avoid interferences with building finishes and installation of other products.

1.10 MAINTENANCE MATERIALS

- A. Division 01 - Execution and Closeout Requirements: Spare parts and maintenance products.
- B. Furnish two of each key.
- C. Furnish two fuse pullers.

1.11 EXTRA MATERIALS

- A. Division 01 - Execution and Closeout Requirements: Spare parts and maintenance products.
- B. Furnish ten of each size and type of fuse installed.

PART 2 PRODUCTS

2.01 DISTRIBUTION SWITCHBOARDS

- A. Manufacturers:
 - 1. GE Electrical.
 - 2. Siemens.
 - 3. Square D.
 - 4. Cutler Hammer.
 - 5. Substitutions: Division 01 - Product Requirements.
- B. Product Description: NEMA PB 2, enclosed switchboard with electrical ratings and configurations as indicated on Drawings.
- C. Device Mounting:
 - 1. Main Section: Individually mounted and compartmented.
 - 2. Distribution Section: Panel mounted. Individually mounted and compartmented.
- D. Bus:
 - 1. Material: Copper, standard size.
 - 2. Connections: Bolted, accessible from front for maintenance.
 - 3. Insulation: Fully insulate bus bars. Do not reduce spacing of insulated bus.
- E. Ground Bus: Extend length of switchboard.
- F. Line and Load Terminations: Accessible from front only of switchboard, suitable for conductor materials and sizes as indicated on Drawings.
- G. Future Provisions: Fully equip spaces for future devices with bussing and bus connections, insulated and braced for short circuit currents. Furnish continuous current rating as indicated on Drawings.
- H. Enclosure: Type 1 - General Purpose (for interior); Type 3R – Weatherproof (for exterior).
- I. Align sections at front and rear.

- J. Finish: Manufacturer's standard light gray enamel over external surfaces. Coat internal surfaces with minimum one coat corrosion-resisting paint, or plate with cadmium or zinc.

2.02 MOLDED CASE CIRCUIT BREAKER

- A. Product Description: NEMA AB 1, molded-case circuit breaker.
- B. Field-Adjustable Trip Circuit Breaker: Circuit breakers with frame sizes 200 amperes and larger have mechanism for adjusting long time continuous current.
- C. Solid-State Circuit Breaker: Electronic sensing, timing, and tripping circuits for adjustable current settings; ground fault trip with integral ground fault sensing; instantaneous trip; and adjustable short time trip.
- D. Accessories: As indicated on Drawings. Conform to NEMA AB 1.
 - 1. Shunt Trip Device: 120 volts, AC.
 - 2. Undervoltage Trip Device: 120 volts, AC.
 - 3. Handle Lock: Provisions for padlocking.
 - 4. Insulated Grounding Lug: In each enclosure.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Division 01 - Administrative Requirements: Coordination and project conditions.
- B. Verify surface is suitable for switchboard installation.

3.02 INSTALLATION

- A. Install in accordance with NEMA PB 2.1.
- B. Tighten accessible bus connections and mechanical fasteners after placing switchboard.
- C. Install fuses in each switch and coordinate sizes with connected load.
- D. Install engraved plastic nameplates in accordance with Section 26 05 53.
- E. Install breaker circuit directory.
- F. Ground and bond switchboards in accordance with Section 26 05 26.

3.03 FIELD QUALITY CONTROL

- A. Division 01 - Quality Requirements 01 70 00 - Execution and Closeout Requirements: Field inspecting, testing, adjusting, and balancing.
- B. Inspect and test in accordance with NETA ATS, except Section 4.
- C. Perform inspections and tests listed in NETA ATS, Section 7.1.

3.04 ADJUSTING

- A. Division 01 - Execution and Closeout Requirements: Testing, adjusting, and balancing.
- B. Adjust operating mechanisms for free mechanical movement.
- C. Tighten bolted bus connections.
- D. Adjust circuit breaker trip and time delay settings to values recommended by the manufacturer and as approved by the Architect.
- E. Provide and perform coordination study, from main switchboard down to the branch circuit panelboards.

3.05 CLEANING

- A. Division 01 - Execution and Closeout Requirements: Final cleaning.
- B. Touch up scratched or marred surfaces to match original finish.

END OF SECTION

SECTION 26 24 16**PANELBOARDS****PART 1 GENERAL****1.01 SUMMARY**

- A. Section includes distribution and branch circuit panelboards.
- B. Related Sections:
 - 1. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
 - 2. Section 26 05 53 - Identification for Electrical Systems.

1.02 REFERENCES

- A. Institute of Electrical and Electronics Engineers:
 - 1. IEEE C62.41 - Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits.
- B. National Electrical Manufacturers Association:
 - 1. NEMA AB 1 - Molded Case Circuit Breakers and Molded Case Switches.
 - 2. NEMA FU 1 - Low Voltage Cartridge Fuses.
 - 3. NEMA ICS 2 - Industrial Control and Systems: Controllers, Contactors, and Overload Relays, Rated Not More Than 2000 Volts AC or 750 Volts DC.
 - 4. NEMA ICS 5 - Industrial Control and Systems: Control Circuit and Pilot Devices.
 - 5. NEMA KS 1 - Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).
 - 6. NEMA PB 1 - Panelboards.
 - 7. NEMA PB 1.1 - General Instructions for Proper Installation, Operation, and Maintenance of Panelboards Rated 600 Volts or Less.
- C. International Electrical Testing Association:
 - 1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.
- D. California Electrical Code (CEC):
 - 1. CEC - California Electrical Code.
- E. Underwriters Laboratories Inc.:
 - 1. UL 67 - Safety for Panelboards.
 - 2. UL 1283 - Electromagnetic Interference Filters.
 - 3. UL 1449 - Transient Voltage Surge Suppressors.

1.03 SUBMITTALS

- A. Division 01 - Administrative Requirements: Submittal Procedures.

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- B. Shop Drawings: Indicate outline and support point dimensions, voltage, main bus ampacity, integrated short circuit ampere rating, circuit breaker and fusible switch arrangement and sizes.
- C. Product Data: Submit catalog data showing specified features of standard products.

1.04 CLOSEOUT SUBMITTALS

- A. Division 01 - Execution and Closeout Requirements: Requirements for submittals.
- B. Project Record Documents: Record actual locations of panelboards and record actual circuiting arrangements.
- C. Operation and Maintenance Data: Submit spare parts listing; source and current prices of replacement parts and supplies; and recommended maintenance procedures and intervals.

1.05 QUALIFICATIONS

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

1.06 MAINTENANCE MATERIALS

- A. Division 01 - Execution and Closeout Requirements: Requirements for maintenance products.
- B. Furnish two of each panelboard key.

PART 2 PRODUCTS

2.01 DISTRIBUTION PANELBOARDS

- A. Manufacturers:
 1. Cutler-Hammer.
 2. GE Electrical.
 3. Siemens.
 4. Square D.
 5. Substitutions: Division 01 - Product Requirements.
- B. Product Description: NEMA PB 1, circuit breaker type panelboard.
- C. Panelboard Bus: Copper, current carrying components, ratings as indicated on Drawings. Furnish copper ground bus in each panelboard.
- D. Minimum integrated short circuit rating: 22,000 amperes rms symmetrical for 208 volt panelboards; 42,000 amperes rms symmetrical for 480 volt panelboards, or as indicated on Drawings.
- E. Fusible Switch Assemblies: NEMA KS 1, quick-make, quick-break, load interrupter enclosed knife switch with externally operable handle. Furnish interlock to prevent opening front cover with switch in ON position. Handle lockable in OFF position. Fuse clips: Designed to accommodate NEMA FU 1, Class R fuses.

- F. Molded Case Circuit Breakers: NEMA AB 1, circuit breakers with integral thermal and instantaneous magnetic trip in each pole. Furnish circuit breakers UL listed as Type HACR for air conditioning equipment branch circuits.
- G. Circuit Breaker Accessories: Trip units and auxiliary switches as indicated on Drawings.
- H. Enclosure: NEMA PB 1, Type 1 or 3R as indicated on drawings.
- I. Cabinet Front: Surface type, fastened with hinged door with flush lock, metal directory frame, finished in manufacturer's standard gray enamel.

2.02 BRANCH CIRCUIT PANELBOARDS

- A. Manufacturers:
 1. Cutler-Hammer.
 2. GE Electrical.
 3. Siemens.
 4. Square D.
 5. Substitutions: Division 01 - Product Requirements.
- B. Product Description: NEMA PB1, circuit breaker type, lighting and appliance branch circuit panelboard.
- C. Panelboard Bus: Copper, current carrying components, ratings as indicated on Drawings. Furnish copper ground bus in each panelboard.
- D. Minimum Integrated Short Circuit Rating: 22,000 amperes rms symmetrical for 240 volt panelboards; 14,000, 65,000 amperes rms symmetrical for 480 volt panelboards, or as indicated on Drawings.
- E. Molded Case Circuit Breakers: NEMA AB 1, bolt-on type thermal magnetic trip circuit breakers, with common trip handle for all poles, listed as Type SWD for lighting circuits, Type HACR for air conditioning equipment circuits, Class A ground fault interrupter circuit breakers as indicated on Drawings. Do not use tandem circuit breakers.
- F. Enclosure: NEMA PB 1, Type 1 or Type 3R as indicated on drawings.
- G. Cabinet Box: 6 inches deep, 20 inches wide.
- H. Cabinet Front: Flush or Surface cabinet front with concealed trim clamps, concealed hinge, metal directory frame, and flush lock keyed alike. Finish in manufacturer's standard gray enamel.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install panelboards in accordance with NEMA PB 1.1.
- B. Install panelboards plumb.
- C. Install recessed panelboards flush with wall finishes.

- D. Height: 6 feet to top of panelboard; install panelboards taller than 6 feet with bottom no more than 4 inches above floor.
- E. Install filler plates for unused spaces in panelboards.
- F. Provide typed circuit directory for each branch circuit panelboard. Revise directory to reflect circuiting changes to balance phase loads.
- G. Install engraved plastic nameplates in accordance with Section 26 05 53.
- H. Install spare conduits out of each recessed panelboard to accessible location above ceiling. Minimum spare conduits: 5 empty, 3/4 inch. Identify each as SPARE.
- I. Ground and bond panelboard enclosure according to Section 26 05 26. Connect equipment ground bars of panels in accordance with CEC.

3.02 FIELD QUALITY CONTROL

- A. Division 01 - Quality Requirements, 01 70 00 - Execution and Closeout Requirements: Field inspecting, testing, adjusting, and balancing.
- B. Inspect and test in accordance with NETA ATS, except Section 4.
- C. Perform circuit breaker inspections and tests listed in NETA ATS, Section 7.6.
- D. Perform switch inspections and tests listed in NETA ATS, Section 7.5.
- E. Perform controller inspections and tests listed in NETA ATS, Section 7.16.1.

3.03 ADJUSTING

- A. Division 01 - Execution and Closeout Requirements: Requirements for starting and adjusting.
- B. Measure steady state load currents at each panelboard feeder; rearrange circuits in panelboard to balance phase loads to within 20 percent of each other. Maintain proper phasing for multi-wire branch circuits.

END OF SECTION

SECTION 26 27 16

ELECTRICAL CABINETS AND ENCLOSURES

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes hinged cover enclosures, cabinets, terminal blocks, and accessories.
- B. Related Sections:
 - 1. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
 - 2. Section 26 05 33 - Raceway and Boxes for Electrical Systems.
 - 3. Section 27 05 33 - Conduits and Backboxes for Communications Systems.

1.02 REFERENCES

- A. National Electrical Manufacturers Association:
 - 1. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
 - 2. NEMA ICS 4 - Industrial Control and Systems: Terminal Blocks.

1.03 SUBMITTALS

- A. Division 01 - Administrative Requirements: Submittal Procedures.
- B. Product Data: Submit manufacturer's standard data for enclosures, cabinets, and terminal blocks.
- C. Manufacturer's Installation Instructions: Submit application conditions and limitations of use stipulated by product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

1.04 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years documented experience.

1.05 EXTRA MATERIALS

- A. Division 01 - Execution and Closeout Requirements: Spare parts and maintenance products.
- B. Furnish two of each key.

PART 2 PRODUCTS**2.01 HINGED COVER ENCLOSURES**

- A. Manufacturers:
 - 1. Appleton.
 - 2. Circle AW.
 - 3. Reliance Electric.
 - 4. Substitutions: Division 01 - Product Requirements.
- B. Construction: NEMA 250, Type 1 or 3R steel enclosure.
- C. Covers: Continuous hinge, held closed by flush latch operable by key.
- D. Furnish interior plywood panel for mounting terminal blocks and electrical components; finish with white enamel.
- E. Enclosure Finish: Manufacturer's standard enamel.

2.02 CABINETS

- A. Manufacturers:
 - 1. Appleton.
 - 2. Circle AW.
 - 3. Reliance Electric.
 - 4. Substitutions: Division 01 - Product Requirements.
- B. Boxes: Galvanized steel.
- C. Box Size: 24 inches wide x 30 inches high x 6 inches deep.
- D. Backboard: Furnish 3/4 inch thick plywood backboard for mounting terminal blocks. Paint matte white.
- E. Fronts: Steel, flush or surface type with door with concealed hinge, and flush lock. Finish with gray baked enamel.
- F. Furnish metal barriers to form separate compartments wiring of different systems and voltages.
- G. Furnish accessory feet for free-standing equipment.

2.03 TERMINAL BLOCKS

- A. Manufacturers:
 - 1. Carlon Electrical Products.
 - 2. Hubbell Wiring Devices.
 - 3. Reliance Electric.
 - 4. Substitutions: Division 01 - Product Requirements.

- B. Terminal Blocks: NEMA ICS 4.
- C. Power Terminals: Unit construction type with closed back and tubular pressure screw connectors, rated 600 volts.
- D. Signal and Control Terminals: Modular construction type, suitable for channel mounting, with tubular pressure screw connectors, rated 300 volts.
- E. Furnish ground bus terminal block, with each connector bonded to enclosure.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install enclosures and boxes plumb. Anchor securely to wall and structural supports at each corner in accordance with Section 26 05 29.
- B. Install cabinet fronts plumb.

3.02 CLEANING

- A. Division 01 - Execution and Closeout Requirements: Final cleaning.
- B. Clean electrical parts to remove conductive and harmful materials.
- C. Remove dirt and debris from enclosure.
- D. Clean finishes and touch up damage.

END OF SECTION

SECTION 26 27 26

WIRING DEVICES

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes wall switches; wall dimmers; receptacles; and device plates and decorative box covers.
- B. Related Sections:
 - 1. Section 26 05 33 - Raceway and Boxes for Electrical Systems: Outlet boxes for wiring devices.

1.02 REFERENCES

- A. National Electrical Manufacturers Association:
 - 1. NEMA WD 1 - General Requirements for Wiring Devices.
 - 2. NEMA WD 6 - Wiring Devices-Dimensional Requirements.

1.03 SUBMITTALS

- A. Division 01 - Administrative Requirements: Submittal Procedures.
- B. Product Data: Submit manufacturer's catalog information showing dimensions, colors, and configurations.
- C. Samples: Submit two samples of each wiring device and wall plate illustrating materials, construction, color, and finish.

1.04 QUALIFICATIONS

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

1.05 EXTRA MATERIALS

- A. Division 01 - Execution and Closeout Requirements: Spare parts and maintenance products.
- B. Furnish fifty of each style, size, and finish wall plate.

PART 2 PRODUCTS

2.01 WALL SWITCHES

- A. Manufacturers:
 - 1. Leviton.
 - 2. Hubbell.
 - 3. Pass & Seymour,

4. Substitutions: Division 01 - Product Requirements.

2.02 WALL SWITCHES

- A. Product Description: NEMA WD 1, General-Duty, AC only general-use snap switch.
- B. Body and Handle: Ivory plastic with toggle handle.
- C. Indicator Light: Lighted handle type switch.
- D. Locator Light: Lighted handle type switch.
- E. Ratings:
 - 1. Voltage: 120-277 volts, AC.
- F. Ratings: Match branch circuit and load characteristics.

2.03 WALL DIMMERS

- A. Manufacturers:
 - 1. Leviton.
 - 2. Hubbell.
 - 3. Pass & Seymour.
 - 4. Substitutions: Division 01 - Product Requirements.
- B. Product Description: NEMA WD 1, Type 1 semiconductor dimmer for incandescent or fluorescent lamps.
- C. Body and Handle: Ivory plastic with linear slide.
- D. Voltage: 120-277 volts.
- E. Power Rating: Match load shown on drawings; 600 watts minimum.
- F. Accessory Wall Switch: Match dimmer appearance.

2.04 RECEPTACLES

- A. Manufacturers:
 - 1. Leviton.
 - 2. Hubbell.
 - 3. Pass & Seymour.
 - 4. Substitutions: Division 01 - Product Requirements.
- B. Product Description: NEMA WD 1, Heavy-duty general use receptacle.
- C. Device Body: Ivory nylon.
- D. Configuration: NEMA WD 6, type as indicated on Drawings.

- E. Convenience Receptacle: Type 5-20.
- F. GFCI Receptacle: Convenience receptacle with integral ground fault circuit interrupter to meet regulatory requirements.

2.05 WALL PLATES

- A. Manufacturers:
 - 1. Leviton.
 - 2. Hubbell.
 - 3. Pass & Seymour.
 - 4. Substitutions: Division 01 - Product Requirements.
- B. Coverplate: 0.035 inch thick, satin-finished stainless steel.
- C. Weatherproof Cover Plate: Gasketed cast metal plate with threaded and gasketed device cover.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Division 01 - Administrative Requirements: Coordination and project conditions.
- B. Verify outlet boxes are installed at proper height.
- C. Verify wall openings are neatly cut and completely covered by wall plates.
- D. Verify branch circuit wiring installation is completed, tested, and ready for connection to wiring devices.

3.02 PREPARATION

- A. Clean debris from outlet boxes.

3.03 INSTALLATION

- A. Install devices plumb and level.
- B. Install switches with OFF position down.
- C. Install wall dimmers to achieve full rating specified and indicated after derating for ganging as instructed by manufacturer.
- D. Do not share neutral conductor on load side of dimmers.
- E. Install receptacles with grounding pole on bottom.
- F. Connect wiring device grounding terminal to outlet box with bonding jumper and branch circuit equipment grounding conductor.

- G. Connect wiring devices by wrapping solid conductor around screw terminal. Install stranded conductor for branch circuits 10 AWG and smaller. When stranded conductors are used in lieu of solid, use crimp on fork terminals for device terminations. Do not place bare stranded conductors directly under device screws.
- H. Use jumbo size plates for outlets installed in masonry walls.
- I. Install galvanized steel plates on outlet boxes and junction boxes in unfinished areas, above accessible ceilings, and on surface mounted outlets.

3.04 INTERFACE WITH OTHER PRODUCTS

- A. Coordinate locations of outlet boxes provided under Section 26 05 33 to obtain mounting heights as specified and as indicated on drawings.
- B. Install wall switch 48 inches above finished floor.
- C. Install convenience receptacle 18 inches minimum.

3.05 FIELD QUALITY CONTROL

- A. Division 01 - Quality Requirements and 01 70 00 - Execution and Closeout Requirements: Field inspecting, testing, adjusting, and balancing.
- B. Inspect each wiring device for defects.
- C. Operate each wall switch with circuit energized and verify proper operation.
- D. Verify each receptacle device is energized.
- E. Test each receptacle device for proper polarity.
- F. Test each GFCI receptacle device for proper operation.

3.06 ADJUSTING

- A. Division 01 - Execution and Closeout Requirements: Testing, adjusting, and balancing.
- B. Adjust devices and wall plates to be flush and level.

3.07 CLEANING

- A. Division 01 - Execution and Closeout Requirements: Final cleaning.
- B. Clean exposed surfaces to remove splatters and restore finish.

END OF SECTION

SECTION 26 28 13**FUSES****PART 1 GENERAL**

1.01 SUMMARY

- A. Section includes fuses.

1.02 REFERENCES

- A. National Electrical Manufacturers Association:
 - 1. NEMA FU 1 - Low Voltage Cartridge Fuses.

1.03 DESIGN REQUIREMENTS

- A. Select fuses to provide appropriate levels of short circuit and overcurrent protection for the following components: wire, cable, bus structures, and other equipment. Design system to maintain component damage within acceptable levels during faults.
- B. Select fuses to coordinate with time current characteristics of other overcurrent protective elements, including other fuses, circuit breakers, and protective relays. Design system to maintain operation of device closest to fault operates.

1.04 FUSE PERFORMANCE REQUIREMENTS

- A. Motor Load Feeder Switches: Class RK1 (time delay).
- B. General Purpose Branch Circuits: Class RK1 (time delay).
- C. Motor Branch Circuits: Class RK1 (time delay).

1.05 SUBMITTALS

- A. Division 01 - Administrative Requirements: Submittal Procedures.
- B. Product Data: Submit data sheets showing electrical characteristics, including time-current curves.

1.06 CLOSEOUT SUBMITTALS

- A. Division 01 - Execution and Closeout Requirements: Closeout procedures.
- B. Project Record Documents: Record actual sizes, ratings, and locations of fuses.

1.07 QUALIFICATIONS

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

1.08 MAINTENANCE MATERIALS

- A. Division 01 - Execution and Closeout Requirements: Spare parts and maintenance products.
- B. Furnish two fuse pullers.

1.09 EXTRA MATERIALS

- A. Division 01 - Execution and Closeout Requirements: Requirements for extra materials.
- B. Furnish fifteen spare fuses of each Class, size, and rating installed.

PART 2 PRODUCTS

2.01 FUSES

- A. Manufacturers:
 - 1. Bussman.
 - 2. Gould Shawmut.
 - 3. Reliance.
 - 4. Substitutions: Division 01 - Product Requirements.
- B. Dimensions and Performance: NEMA FU 1, Class as specified or as indicated on Drawings.
- C. Voltage: Rating suitable for circuit phase-to-phase voltage.

2.02 CLASS RK1 (TIME DELAY) FUSES

- A. Manufacturers:
 - 1. Bussman.
 - 2. Gould Shawmut.
 - 3. Reliance.
 - 4. Substitutions: Division 01 - Product Requirements.
- B. Dimensions and Performance: NEMA FU 1.
- C. Voltage: Rating suitable for circuit phase-to-phase voltage.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install fuse with label oriented so manufacturer, type, and size are easily read.

END OF SECTION

SECTION 26 28 19
ENCLOSED SWITCHES

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes fusible and nonfusible switches.
- B. Related Sections:
 - 1. Section 26 28 13 - Fuses.

1.02 REFERENCES

- A. National Electrical Manufacturers Association:
 - 1. NEMA FU 1 - Low Voltage Cartridge Fuses.
 - 2. NEMA KS 1 - Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).
- B. International Electrical Testing Association:
 - 1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

1.03 SUBMITTALS

- A. Division 01 - Administrative Requirements: Submittal Procedures.
- B. Product Data: Submit switch ratings and enclosure dimensions.

1.04 CLOSEOUT SUBMITTALS

- A. Division 01 - Execution and Closeout Requirements: Closeout procedures.
- B. Project Record Documents: Record actual locations of enclosed switches and ratings of installed fuses.

1.05 QUALIFICATIONS

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

PART 2 PRODUCTS

2.01 FUSIBLE SWITCH ASSEMBLIES

- A. Manufacturers:
 - 1. GE Electrical.
 - 2. Hubbell Inc.

3. Square D.
 4. Cutler-Hammer
 5. Substitutions: Division 01 - Product Requirements.
- B. Product Description: NEMA KS 1, Type HD with externally operable handle interlocked to prevent opening front cover with switch in ON position, enclosed load interrupter knife switch. Handle lockable in OFF position.
- C. Fuse clips: Designed to accommodate NEMA FU 1, Class R fuses.
- D. Enclosure: NEMA KS 1, to meet conditions. Fabricate enclosure from steel finished with manufacturer's standard gray.
1. Interior Dry Locations: Type 1.
 2. Exterior Locations: Type 3R.
- E. Furnish switches with entirely copper current carrying parts.

2.02 NONFUSIBLE SWITCH ASSEMBLIES

- A. Manufacturers:
1. GE Electrical.
 2. Hubbell Inc.
 3. Square D.
 4. Cutler-Hammer
 5. Substitutions: Division 01 - Product Requirements.
- B. Product Description: NEMA KS 1, Type HD with externally operable handle interlocked to prevent opening front cover with switch in ON position]enclosed load interrupter knife switch. Handle lockable in OFF position.
- C. Enclosure: NEMA KS 1, to meet conditions. Fabricate enclosure from steel finished with manufacturer's standard gray.
1. Interior Dry Locations: Type 1.
 2. Exterior Locations: Type 3R.
- D. Furnish switches with entirely copper current carrying parts.

2.03 SWITCH RATINGS

- A. Switch Rating: Horsepower rated for AC or DC as indicated on Drawings.
- B. Short Circuit Current Rating: UL listed for 200,000 rms symmetrical amperes when used with or protected by Class R.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install enclosed switches plumb. Provide supports in accordance with Section 26 05 29.

- B. Height:5 feet to operating handle.
- C. Install fuses for fusible disconnect switches. Refer to Section 26 28 13 for product requirements.
- D. Install engraved plastic nameplates in accordance with Section 26 05 53.
- E. Apply adhesive tag on inside door of each fused switch indicating NEMA fuse class and size installed.

3.02 FIELD QUALITY CONTROL

- A. Division 01 - Quality Requirements and 01 70 00 - Execution and Closeout Requirements: Field inspecting, testing, adjusting, and balancing.
- B. Inspect and test in accordance with NETA ATS, except Section 4.
- C. Perform inspections and tests listed in NETA ATS, Section 7.5.

END OF SECTION

SECTION 26 28 23
ENCLOSED CIRCUIT BREAKERS

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes molded-case and insulated-case circuit breakers in individual enclosures.

1.02 REFERENCES

- A. National Electrical Manufacturers Association:
 - 1. NEMA AB 1 - Molded Case Circuit Breakers and Molded Case Switches.
- B. International Electrical Testing Association:
 - 1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

1.03 SUBMITTALS

- A. Division 01 - Administrative Requirements: Submittal Procedures.
- B. Product Data: Submit catalog sheets showing ratings, trip units, time current curves, dimensions, and enclosure details.

1.04 CLOSEOUT SUBMITTALS

- A. Division 01 - Execution and Closeout Requirements: Closeout procedures.
- B. Project Record Documents: Record actual locations and continuous current ratings of enclosed circuit breakers.

1.05 QUALIFICATIONS

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

1.06 EXTRA MATERIALS

- A. Division 01 - Execution and Closeout Requirements: Spare parts and maintenance products.
- B. Furnish three of each size and type of current limiter.

PART 2 PRODUCTS**2.01 MOLDED CASE CIRCUIT BREAKER**

- A. Manufacturers:
 - 1. Square D.
 - 2. General Electric.
 - 3. Siemens.
 - 4. Westinghouse.
 - 5. Challenger.
 - 6. Substitutions: Division 01 - Product Requirements.
- B. Product Description: Enclosed, molded-case circuit breaker conforming to NEMA AB 1, suitable for use as service entrance equipment where applied.
- C. Service Conditions:
 - 1. Temperature: 115 degrees F.
- D. Field-Adjustable Trip Circuit Breaker: Circuit breakers with frame sizes 200 amperes and larger have mechanism for adjusting long time and short time, continuous current and short time, and long time pickup current setting for automatic operation.
- E. Field-Changeable Ampere Rating Circuit Breaker: Circuit breakers with frame sizes 200 amperes and larger have changeable trip units.
- F. Current Limiting Circuit Breaker: Circuit breaker indicated as current-limiting have automatically-resetting current limiting elements in each pole. Let-through Current and Energy: Less than permitted for same size Class RK-5 fuse.
- G. Solid-State Circuit Breaker: Electronic sensing, timing, and tripping circuits for adjustable current settings; ground fault trip with zero sequence type ground fault sensor; instantaneous trip; and adjustable short time trip.
- H. Current Limiter: Designed for application with molded case circuit breaker.
 - 1. Coordinate limiter size with trip rating of circuit breaker to prevent nuisance tripping and to achieve interrupting current rating specified for circuit breaker.
 - 2. Interlocks trip circuit breaker and prevent closing circuit breaker when limiter compartment cover is removed or when one or more limiter is not in place or has operated.
- I. Accessories: Conform to NEMA AB 1.
 - 1. Shunt Trip Device: 120 volts, AC.
 - 2. Undervoltage Trip Device: 120 volts, AC.
 - 3. Auxiliary Switch: 120 volts, AC.
 - 4. Alarm Switch: 120 volts, AC.
 - 5. Electrical Operator: 120 volts, AC.
 - 6. Handle Lock: Provisions for padlocking.
 - 7. Insulated Grounding Lug: In each enclosure.

- J. Enclosure: NEMA AB 1, to meet conditions. Fabricate enclosure from steel finished with manufacturer's standard gray enamel.
 - 1. Interior Dry Locations: Type 1.
 - 2. Exterior Locations: Type 3R.
- K. Service Entrance: Switches identified for use as service equipment are to be labeled for this application. Furnish solid neutral assembly and equipment ground bar.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install enclosed circuit breakers plumb. Provide supports in accordance with Section 26 05 29.
- B. Height: 5 feet to operating handle.
- C. Locate and install engraved plastic nameplates in accordance with Section 26 05 53.

3.02 FIELD QUALITY CONTROL

- A. Division 01 - Execution and Closeout Requirements: Field inspecting, testing, adjusting, and balancing.
- B. Inspect and test in accordance with NETA ATS, except Section 4.
- C. Perform inspections and tests listed in NETA ATS, Section 7.6.1.1.

3.03 ADJUSTING

- A. Division 01 - Execution and Closeout Requirements: Testing, adjusting, and balancing.
- B. Adjust trip settings to coordinate circuit breakers with other overcurrent protective devices in circuit.
- C. Adjust trip settings to provide adequate protection from overcurrent and fault currents.

END OF SECTION

SECTION 26 31 00**PHOTOVOLTAICS****PART 1 GENERAL****1.01 SUMMARY**

- A. Photovoltaic system (PV System) for providing electrical power, synchronized and inter-tied with incoming utility grid power.
- B. Section Includes:
 - 1. Turnkey design of complete photovoltaic (PV) system.
 - 2. Furnish, install and wire complete photovoltaic (PV) system.
- C. Related Sections: Division 1 and Division 8.

1.02 SUBMITTALS

- A. Product Data.
- B. Shop Drawings: Provide complete system drawings with large scale details showing each components and its relationship in the system. Identify each component and quantity. Provide and schedule of parts to accompany drawings. Include product information including installation instructions for each component. Show locations of parts in relations to PV system as well as building elements to which PV system components will be attached.
- C. Engineering Analysis.
- D. Test Reports.
- E. Certificates.
- F. Qualification Statements.

1.03 SYSTEM DESIGN

- A. Calculations: Perform calculation required to provide a complete turnkey design of comprehensive operating PV system. Include system recommendation based on calculations.
- B. Manufacturer of Custom photovoltaic insulated glass units shall provide following complete services:
 - 1. System design and submittal for approval before release to manufacture.
 - 2. Manufacturing of PV laminates and delivery of final insulated glass product.
 - 3. Supply of combiner boxes and inverters to electrical contractor.
 - 4. Site training, supervision and logistics is required by General Contractor.
 - 5. System commissioning; includes testing, startup and O&M manuals.

C. Electrical Contractor:

1. Install glass to glass plug connectors.
2. Install and wire inverters and combiner boxes.
3. Complete all conduit and wire installation and terminations throughout the system.
4. Possible installation of data acquisition system.

1.04 QUALITY ASSURANCE

- A. System shall be certified by Underwriters' Laboratories.
- B. Contractor Qualification: Contractor shall be currently approved by manufacturer to install Photovoltaic systems.
- C. PV system components must be compliant with the requirements of and be listed as an approved technology for the California Energy Commissions (CEC) Emerging Technologies Buydown Program.
- D. If PV modules using Cadmium are included, then the environmental impact of the Cadmium usage must be disclosed to the District, including any special maintenance requirements, and proper disposal/recycling of the modules at the end of their useful life. Modules containing Cadmium must comply with the EPA Landfill Disposal Requirements. Any additional costs related to PV modules containing Cadmium must be clearly identified. The District may reject.
- E. PV system components and installation shall be compliant with California Electrical Code (CEC) Article 690.

1.05 QUALITY ASSURANCE

- A. Preinstallation Conference: Prior to Installation, General Contractor to organize and conduct a meeting with each subcontractor and supplier involved in installation of PV system. PV supplier will conduct training on installation of system.
- B. Qualifications: 5 years experience manufacturing and/or fabricating components of PV systems.
- C. Provide a factory trained and experienced individual to provide on-site supervision during installation of PV system.

1.06 DEFINITIONS

- A. Photovoltaics (PV): Conversion of light into direct current (DC) electricity.
- B. PV Cells: Thin, fragile wafers of silicon.
- C. PV Module: Several PV Cells connected together in series and laminated between layers of glass.
- D. Combiner Box: Provides means of collecting wiring harness from 10 to 50 PV modules together and exiting combiner box with a pair of large conductors to inverter.

- E. Data Acquisition System: Part of the inverter system. Wired with signal wire and run to exterior access point.
- F. Inverter: Converts DC power into AC power either single phase or three phase and becomes a power source wired to building electrical distribution panels.

1.07 WARRANTIES

- A. The photovoltaic panels shall be covered by the PV manufacturer's limited warranty for a minimum of 20 years from system start-up.
- B. The vendor's standard warranty coverage for the system should be at least 5 years in length and provide:
 - 1. Annual on-site system inspection, including: system testing (operating current of each electrical string), system adjustment and routing maintenance.
 - 2. Repair and/or replacement of defective parts (equipment and labor).
 - 3. System performance monitoring and historical data access for customer via secure website. Data should include: system energy and power production, ambient temperature, windspeed, and insolation.
 - 4. Daily system monitoring by vendor, including reporting of problems to customer and dispatch of resources for expeditious resolution of problems.
- C. Following the initial five year warranty period, an annual system service contract on commercially reasonable terms for years 5-10.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Photovoltaic Panels:
 - 1. Applied Solar, Inc.
 - 2. Or Equal by
 - a. Shell Solar
 - b. BP Solar
- B. Inverter Equipment:
 - 1. Xantrex: PV Series
 - 2. SMA: Sunny Boy
 - 3. Or Equal.
- C. Combiner Box:
 - 1. Xantrex
 - 2. SMA: Sunny Boy
 - 3. Or Equal.
- D. Isolation Transformer:
 - 1. Square-D

2. Cutler Hammer
3. Or Equal.

2.02 MATERIALS

- A. Photovoltaic Cells:
 1. Type of Solar Cell: Monocrystalline Silicon.
 2. Model STP 400 or STP 200.
 3. Size of Active Solar Area: 48" x 96" or 48" x 48".
- B. Technology: Building-Integrated Photovoltaic (BIPV). See Division 8 for material requirements.
- C. Cabling: 10 AWG single conductor THHW, 600 volts, module to combiner.
- D. Edge Connector: As indicated by PV module manufacturer.
 1. Method of electrical interconnection for PV laminates shall be by means of a factory supplied plug connecting cable. MC quick connects (plug and play).
 2. Cable measuring 12 to 18 inches will be supplied with a male-type connector on each end.
 3. Each laminated light for PV modules will be supplied with a female-type connector factory supplied.

2.03 ACCESSORIES

- A. Junction boxes, anchors, wiring lugs and other accessories for a complete system installation.

2.04 SYSTEM RATING

- A. System is sized to provide a minimum of 112.5 kW at full load rated power.
- B. The load voltage and bypass line voltage shall be 480 VAC, three phase, 3 wire. The utility input voltage will be 480 VAC, three phase, 3 wire.
- C. Rated PV system capacity of 112.5 kW must be specified in direct current (DC) kilowatts peak under both STC and PTC rating conditions.
 1. The STC rating, or Standard Test Conditions rating, assumes direct current, standard test conditions, referred to as "kWdc-stc". It is also referred to as kilowatts peak, or "kWp". Specific PV module manufacturer maximum and minimum power data must be specified for this rating.
 2. The PTC rating, or PV USA Test Conditions rating, is based on 1000 Watts/square meter solar irradiance, 25 degree Celsius ambient temperature and an air mass of 1.5.

2.05 ELECTRICAL CHARACTERISTICS

- A. DC Photovoltaic Panel Output:
 1. PV Module Open-Circuit Voltage: 53.3 volts.
 2. PV String Open-Circuit Voltage: 600V, or less
 3. Voltage range +10 percent, -15 percent.

B. AC Inverter System Output:

1. Voltage regulation +/- 0.5 percent balance load. +/- 2 percent for 50 percent unbalanced load.
2. Voltage adjustment range +/- 5 percent manually.
3. Frequency regulation 0.1 percent.
4. Phase Displacement:
 - a. Balanced Loads 120° +/- 1°
 - b. 50 percent unbalanced 120° +/- 3°

2.06 STRUCTURAL IMPACT AND WIND LOADING

- A. PV array will add no more than 4 pounds per square foot to the facility roof structure in the array area.
- B. The system shall be specifically designed for laying on top of single-ply membranes, built-up roofs, and most other roofing technologies used for flat or low slope (2.5:12 or less) roofs. Parts having contact with the roof shall not have sharp edges.
- C. PV array installation must comply with wind uplift requirements per the American Society of Civil Engineers Standard for Minimum Design Loads for Buildings and Other Structures (ASCE 7), and must be able to withstand design wind speeds of at least 100 mph (3-second gusts).

2.07 COMPONENTS

- A. All components of the PV systems and the installation procedures shall meet National Electrical Code requirements.
- B. Photovoltaic Panels:
 1. PV modules shall be no larger than 32 square feet in size.
 2. PV modules shall be electrically connected by "quick-connect" electrical connectors.
- C. Terminal Boxes and String Combiner Boxes:
 1. PV system will have at least one terminal box, providing the electrical strings a watertight entry to the conduit leading to the combiner box(es). The terminal box and combiner box can be one physical unit.
 2. PV system will have a combiner box(es), containing fuses and a bus to combine the outputs of the strings. A set of wires shall run from the combiner box to the inverter(s).
- D. DC/AC Inverter:
 1. PV system will have at least one inverter. Full specifications of the inverter shall be supplied as part of the system documentation and submittals.
 2. Each inverter unit shall be solid state device capable of accepting the output of the photovoltaic panels and providing rated output within specified limits.
 3. The inverter shall be able to sustain an overload across its output terminals up to 150 percent load, while supplying any load within its rating, without reducing the output voltage.

- The inverter shall current limit at 150 percent rated current at reduced voltage for any loading over 150 percent rated load. The inverter shall be capable of at least 300 percent current for short circuit conditions. If the short circuit is sustained, the inverter shall shutdown and disconnect automatically from the critical load bus.
4. The output frequency of the inverter shall be controlled by an oscillator. The oscillator shall be temperature compensated and be adjustable +/- 5 percent of rated frequency. The oscillator shall hold the inverter output frequency to +/- 0.1 percent for both steady state and transient conditions. Drift shall not exceed +/- 0.1 percent during a 24 for period. Total frequency deviation, including short time fluctuations and drift, shall not exceed +/- 0.1 percent from the rated frequency.
 5. Electronic controls shall be incorporated to provide individual phase voltage compensation to obtain phase balance under all conditions including up to 50 percent load unbalance.
 6. Each inverter unit in the system is to have fault sensing and static isolation as well as an output circuit breaker for removal of a faulted module from the system, without affecting the critical load bus beyond the stated limits.
 7. For parallel operation, all inverter units shall automatically load share at all times. The output currents of the individual PV modules shall be no more than +/- 5 percent unbalanced.
 8. Power semiconductors in the inverter shall be fused with fast acting fuses to prevent cascading failures. Each fuse shall be provided with a blown fuse indicator with an alarm light on the control panel.
- E. Isolation Transformer:
1. An isolation transformer shall be part of the system for interfacing to the building's electrical system.
 2. AC wiring shall run from the output of the inverter(s) to a disconnect, then to an isolation transformer, then to building electrical service.

PART 3 EXECUTION

3.01 EQUIPMENT DETAILS

- A. All materials and parts comprising the photovoltaic system shall be new, of current manufacturer, of a high grade and free from all defects and imperfections and shall not have been in prior service, except as required during factory testing.
- B. All active electronic devices shall be solid state. All semiconductor devices shall be hermetically sealed. Vacuum tubes shall not be used for any purposes. All relays shall be dust tight.
- C. All outdoor enclosures should be at minimum rated NEMA 3R.

3.02 WIRING

- A. All bolted connections of bus bars, lugs and cables shall be in accordance with requirements of Uniform Electrical Code and other applicable standards. All electrical power connections are to be torqued to the required value and marked.

3.03 EXAMINATION

- A. Examine curtain wall framing to verify installation tolerances for glass and locations of junction I boxes and path for routing wiring.

3.04 PREPARATION

- A. Prepare framing to receive PV modules in accordance with manufacturer's instructions and to comply with system design and accepted shop drawings.

3.05 VENTILATION

- A. Adequate ventilation shall be provided to insure that all system components are operated within their environmental ratings.
- B. Temperature sensors shall be provided to monitor temperature of indoor system components. Upon detection of temperatures in excess of any component manufacturer's recommended ambient working temperature, the sensors shall trigger audible and visual alarms.

3.06 INSTALLATION

- A. The roof shall be inspected prior to installation of PV array. Minor repairs or services, if any, will be completed prior to installation.
- B. Any loose gravel on the rooftop area designated for the system shall be removed. The collected gravel shall be either redistributed or removed from the roof. The system shall be placed on the roof within a short period of time from the removal of the gravel.
- C. Individual PV modules/tiles shall be laid out on the rooftop. PV modules shall be wired together using quick-connect electrical plugs.
- D. The terminal and combiner boxes and interconnecting conduit and wire harnesses shall then be installed.
- E. The inverter shall then be installed. After inspectors from all jurisdictions having authority, including the electrical utility, have verified the work, the inverter shall be connected to AC service.
- F. Install PV modules by qualified glazing subcontractor in accordance with the system design criteria and in accordance with accepted shop drawings.
- G. Install components and wired complete system by qualified licensed electrician and connect to building electrical system as shown or indicated on Electrical Drawing or Specifications.
- H. After the PV glass is installed by glazing contractor, electrical contractor must place each connector into gap between glass lights, complete plug connections and test for proper voltage.
- I. Upon completion of connection and testing, glazing contractor to install mullions.

3.07 MONITORING AND TESTING

- A. Monitoring:
 - 1. A Data Acquisition System (DAS) shall be provided. The DAS shall allow measurement of:
 - a. Ambient temperature
 - b. Wind speed
 - c. Solar irradiation
 - d. System power output

2. The DAS shall include a data logger, modem for data retrieval, NEMA 4 enclosure, dry bulb measuring device, anemometer, solar sensor and radiation shield.

B. Testing and Commissioning:

1. Photovoltaic modules shall be tested in factory for design performance.
2. Inverter shall be factory tested for performance, and results shall be included in the O & M manual.
3. System testing of installed photovoltaic array shall be performed in the field on all system strings and reported to the Owner.
4. PV module manufacturer who has provided design, preinstallation instructions and onsite construction supervision shall provide commissioning and startup testing services to assist subcontractors in starting up and commissioning system.
5. Provide training of Owner and Owner's facilities operations staff at completion of entire system installation after startup, testing and commissioning of system and coordination with other applicable building systems.

END OF SECTION

SECTION 26 33 53**STATIC UNINTERRUPTIBLE POWER SUPPLY****PART 1 GENERAL**

1.01 SUMMARY

- A. Section includes static uninterruptible power supply.

1.02 REFERENCES

- A. Institute of Electrical and Electronics Engineers:
 - 1. IEEE 1184 - Guide for the Selection and Sizing of Batteries for Uninterruptible Power Systems.
- B. National Electrical Manufacturers Association:
 - 1. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
 - 2. NEMA PE 1 - Uninterruptible Power Systems.
- C. International Electrical Testing Association:
 - 1. NETA ATS - Acceptance Testing Specifications for Electrical Power. Distribution Equipment and Systems.

1.03 SUBMITTALS

- A. Division 01 - Administrative Requirements: Submittal Procedures.
- B. Shop Drawings: Indicate electrical characteristics and connection requirements. Indicate battery rack dimensions; battery type, size, dimensions, and weight; detailed equipment outlines, weight, and dimensions; location of conduit entry and exit; single-line diagram indicating metering, control, and external wiring requirements; heat rejection and air flow requirements.
- C. Product Data: Submit catalog sheets and technical data sheets to indicate physical data and electrical performance, electrical characteristics, and connection requirements.
- D. Manufacturer's Field Reports: Indicate inspections, findings, and recommendations.

1.04 CLOSEOUT SUBMITTALS

- A. Division 01 - Execution and Closeout Requirements: Closeout procedures.
- B. Operation and Maintenance Data: Submit description of operating procedures; servicing procedures; list of major components; recommended remedial and preventive maintenance procedures; and spare parts list.

1.05 QUALIFICATIONS

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

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Division 01 - Product Requirements: Product storage and handling requirements.
- B. Protect equipment from extreme temperature and humidity by storing in conditioned space.
- C. Protect equipment from dust and debris by wrapping unit in dust tight cover and storing away from construction activity.
- D. Deliver batteries no sooner than 30 days before charging.

1.07 ENVIRONMENTAL REQUIREMENTS

- A. Division 01 - Product Requirements.
- B. Do not store or install unless temperature is maintained between 32 degrees F and 104 degrees F, at relative humidity less than 95 percent (non-condensing).

1.08 WARRANTY

- A. Division 01 - Execution and Closeout Requirements: Product warranties and product bonds.
- B. Furnish five year manufacturer warranty.

1.09 MAINTENANCE SERVICE

- A. Division 01 - Execution and Closeout Requirements: Maintenance service.
- B. Furnish service and maintenance of uninterruptible power supply for one year from Date of Substantial Completion.

PART 2 PRODUCTS**2.01 STATIC UNINTERRUPTIBLE POWER SUPPLY**

- A. Manufacturers:
 - 1. Best Power Technology.
 - 2. Liebert Corp.
 - 3. Square D.
 - 4. Substitutions: Division 01 - Product Requirements.
- B. Product Description: Nonredundant uninterruptible power supply with reverse transfer.
- C. System Ratings and Operating Characteristics:
 - 1. System Continuous Rating: As indicated on Drawings, over entire battery voltage range at specified power factor. Maintain output voltage within specified limits at load from full load to no-load.
 - 2. Battery Capacity: Capable of operating at full load for 2 hours.
 - 3. Voltage Rating: 120/208 volts, 1 phase.
 - 4. Input Voltage Operating Range: Plus or minus 10 percent.
 - 5. Input Frequency Operating Range: 60 Hz. plus or minus 3 Hz.

6. Input Current Limit: Adjustable to maximum of 125 percent required to operate at full load with battery bank on float charge.
 7. Current Walk-in: 25 to 100 percent in fifteen seconds.
 8. UPS Power Factor Over Full Range of Loads and Input Voltages: 74 to 100 percent, lagging.
 9. Harmonic Distortion of Input Current Wave Form: 5 percent maximum at full load.
 10. Output Voltage Regulation:
 - a. Plus or minus 10 percent for balanced load, full range of DC input and no load to full load variations.
 - b. Plus or minus 5 percent for 50 percent unbalanced load, full range of DC input and no load to full load variations.
 - c. Plus or minus 3 percent during maximum overload of system.
 11. Output Voltage Adjustment: Plus or minus 10 percent.
 12. Output Free Running Frequency: 60 Hz Plus or minus 0.5 percent.
 13. Frequency Adjustment: Plus or minus 5 Hz.
 14. Output Harmonic Distortion: Maximum 5 percent rms total harmonic distortion (THD) and maximum 3 percent any single harmonic, at rated frequency and voltage, from 10 percent load to full load and over battery voltage range, measured into linear load.
 15. Voltage Transient Response for Application of 0 to 50 Percent, 50 to 100 Percent, 100 to 50 Percent, and 50 to 0 Percent Step Loads, and Transfer To and From Bypass Line:
 - a. Plus 8, minus 10 percent for maximum of 8.3 milliseconds.
 - b. Plus or minus 5 percent for maximum of 25 milliseconds.
 - c. Plus or minus 3 percent for maximum of 50 milliseconds.
 - d. Recovery to steady state within 100 milliseconds after out-of-tolerance variation.
 16. Phase Displacement:
 - a. 120 plus or minus 1 degrees for balanced loads.
 - b. 120 plus or minus 4 degrees for 50 percent unbalanced loads.
 17. Three-phase Overload Ratings:
 - a. 1000 percent for 5 cycles; via static switch.
 - b. 150 percent for 10 seconds.
 - c. 125 percent for 10 minutes.
 18. Output Current Limit: 150 percent of rated output current.
 19. Voltage Unbalance: 3 percent maximum line-line with 100 percent load unbalance.
 20. Efficiency: 98 percent at full load, 95 percent at 50 percent load, minimum. Measure efficiency of unit including battery and isolation transformer losses.
- D. Design:
1. Inverter Type: Pulse-width modulated.
 2. Designed for capacity expansion by addition of parallel modules in field with minimum downtime.
 3. Rectifier/Charger Capacity: Sufficient to supply full load to inverter while recharging fully-discharged battery to 95 percent of full capacity in four hours or less; and within input current limits specified.
 4. Furnish means for on-line testing of UPS, including test points to allow adjusting and servicing. Furnish means for testing static switch while load is bypassed to utility.
 5. Mean Time Between Failures: 60,000 hours, minimum.
 6. Cooling: Natural convection.
 7. Operate battery floating, isolated from UPS AC input and AC output. Furnish battery resistance grounded through 5,000 - 10,000 ohms for purpose of ground fault sensing.

8. Do not use continuous moving parts or electron tubes. Accomplish power switching using semiconductor devices.
9. Construct equipment so each power component capable of replacement without soldering iron or special tools.
10. Use front-panel removable plug-in control modules.

E. Controls:

1. AC input circuit breaker.
2. "Inverter operate" switch to initiate inverter operation.
3. "Inverter standby" switch to cause inverter to cease operation
4. "Static switch transfer" switch to permit manual actuation of static transfer switch.
5. "Static switch lock-out" switch to inhibit automatic retransfer of load to inverter.
6. Battery charge timer.
7. "Indicator test" switch.
8. Static switch preferred input circuit breaker
9. Static switch output circuit breaker
10. Static switch bypass circuit breaker.
11. Controls for maintenance bypass switch.

F. Indicators:

1. "Inverter synchronized to utility."
2. "Load connected to utility."
3. "Static transfer switch inhibited."
4. "High/low DC voltage."
5. "Overtemperature."
6. "Inverter output overload."

G. Meters: Use 1 percent accuracy meters to indicate the following:

1. Rectifier/charger DC voltage and current.
2. Utility, inverter output, and load AC voltage.
3. Load AC current.
4. Inverter output and utility frequency.
5. UPS output watts.

H. Fabrication:

1. Electroplate brackets and securing hardware with corrosion resistant material. Secure bolts, studs and nuts with lock washers.
2. Identify internal wiring at each end of conductor. Furnish cabinet grounding lug.
3. Conversion Equipment Enclosure: NEMA 250, Type 1 enclosure allowing access from front for servicing adjustments and connections. Access through hinged door equipped with tumbler lock and latch handle. Equip cabinet for fork truck lifting.
4. Equip air inlet with permanent type filters and pressurize cabinet, or use gaskets around door and panel openings to prevent entry of dirt.
5. Cabinet finish: Primed and painted inside and outside with suitable semi-gloss enamel.

2.02 BATTERY

- A. Storage Battery: Lead calcium heavy duty industrial battery, designed for auxiliary power service. Furnish battery with impact resistant plastic case. Furnish cells with explosion proof

vents, clear containers, and ample space for plate growth without stressing container and cover.

- B. Ampere-Hour Rating: Sized in accordance with IEEE 1184.
- C. Battery Racks: Maximum of three tier, entirely steel construction, with plastic insulating rails at points of contact with battery case. Paint racks with acid resistant paint.

2.03 SOURCE QUALITY CONTROL

- A. Furnish shop inspection and testing of components and completed UPS assembly.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Division 01 - Administrative Requirements: Coordination and project conditions.
- B. Verify HVAC Systems are operational to maintain specified environmental conditions.

3.02 FIELD QUALITY CONTROL

- A. Division 01 - Quality Requirements.
- B. Inspect and test in accordance with NETA ATS, except Section 4.
- C. Perform inspections and tests listed in NETA ATS, Section 7.22.
- D. Verify specification performance criteria.
- E. Measure battery discharge and recharge times.
- F. Simulate fault in each system component and utility power.
- G. Operate unit at 77 degrees F for eight hours.
- H. Perform other tests as recommended by manufacturer.

3.03 MANUFACTURER'S FIELD SERVICES

- A. Division 01 - Quality Requirements: Manufacturer's field services.
- B. Prepare and start up UPS.

3.04 ADJUSTING

- A. Division 01 - Execution and Closeout Requirements: Testing, adjusting, and balancing.
- B. Adjust output voltage to within 1 percent of nominal.
- C. Adjust output frequency to within 0.6 percent of nominal.

3.05 DEMONSTRATION AND TRAINING

- A. Furnish 2 hours of instruction each for two persons, to be conducted at project site with manufacturer's representative.

3.06 PROTECTION OF INSTALLED CONSTRUCTION

- A. Division 01 - Execution and Closeout Requirements: Protecting installed construction.

END OF SECTION

SECTION 26 51 00
INTERIOR LIGHTING

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes interior luminaires, lamps, ballasts, and accessories.
- B. Related Sections:
 - 1. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
 - 2. Section 26 05 33 - Raceway and Boxes for Electrical Systems.

1.02 REFERENCES

- A. American National Standards Institute:
 - 1. ANSI C82.1 - American National Standard for Lamp Ballast-Line Frequency Fluorescent Lamp Ballast.
 - 2. ANSI C82.4 - American National Standard for Ballasts-for High-Intensity-Discharge and Low-Pressure Sodium Lamps (Multiple-Supply Type).

1.03 SUBMITTALS

- A. Division 01 - Administrative Requirements: Submittal Procedures.
- B. Shop Drawings: Indicate dimensions and components for each luminaire not standard product of manufacturer.
- C. Product Data: Submit dimensions, ratings, and performance data.

1.04 QUALIFICATIONS

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

1.05 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

1.06 MAINTENANCE MATERIALS

- A. Division 01 - Execution and Closeout Requirements: Spare parts and maintenance products.
- B. Furnish twenty of each plastic lens type.
- C. Furnish one replacement lamps for each lamp installed.
- D. Furnish twenty of each ballast type.

PART 2 PRODUCTS**2.01 INTERIOR LUMINAIRES**

- A. Product Description: Complete interior luminaire assemblies, with features, options, and accessories as scheduled.
- B. Refer to Division 01 - Product Requirements for product options. Substitutions are not permitted.

2.02 FLUORESCENT BALLASTS

- A. Manufacturers:
 - 1. General Electric Co.
 - 2. Hubbell Lighting.
 - 3. Magnetek Inc.
 - 4. Philips Electronic North America.
 - 5. Substitutions: Division 01 - Product Requirements.
- B. Product Description: Electronic ballast, suitable for lamps specified, with voltage to match luminaire voltage.

2.03 HIGH INTENSITY DISCHARGE (HID) BALLASTS

- A. Manufacturers:
 - 1. General Electric Co.
 - 2. Philips Electronics North America.
 - 3. Siemens Corp.
 - 4. Venture Lighting International Inc.
 - 5. Substitutions: Division 01 - Product Requirements.
- B. Product Description: ANSI C82.4, metal halide lamp ballast, suitable for lamp specified, with voltage to match luminaire voltage.

2.04 FLUORESCENT DIMMING BALLASTS AND CONTROLS

- A. Manufacturers:
 - 1. Lutron.
 - 2. Magnetek.
 - 3. Hubbell Inc.
 - 4. Pass & Seymour.
 - 5. Thomas Industries.
 - 6. Substitutions: Division 01 - Product Requirements.
- B. Product Description: Electrical assembly of control unit and ballast to furnish smooth dimming of fluorescent lamps.
- C. Control Unit: Linear slide type, rated 1500 watts at 277 volts.

- D. Ballast: Selected by dimming system manufacturer as suitable for operation with control unit and suitable for lamp type and quantity specified for luminaire.

2.05 INCANDESCENT LAMPS

A. Manufacturers:

1. General Electric Co.
2. Philips Electronics North America.
3. RCS Industries Co.
4. Substitutions: Division 01 - Product Requirements.

2.06 FLUORESCENT LAMPS

A. Manufacturers:

1. General Electric Co.
2. Hubbell Inc.
3. Philips Electronics.
4. Substitutions: Division 01 - Product Requirements.

2.07 HID LAMPS

A. Manufacturers:

1. Duro-Test Corp.
2. General Electric Co.
3. Philips Electronic North America.
4. RCS Industries North America.
5. Siemens Corp.
6. Substitutions: Division 01 - Product Requirements.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install suspended luminaires using pendants supported from swivel hangers. Install pendant length required to suspend luminaire at indicated height.
- B. Support luminaires 2 x 4 foot size and larger independent of ceiling framing.
- C. Locate recessed ceiling luminaires as indicated on Drawings.
- D. Install surface mounted luminaires plumb and adjust to align with building lines and with each other. Secure to prevent movement.
- E. Exposed Grid Ceilings: Support surface-mounted luminaires on grid ceiling directly from building structure. Fasten surface mounted luminaires to ceiling grid members using bolts, screws, rivets, or suitable clips.
- F. Install recessed luminaires to permit removal from below.

- G. Install recessed luminaires using accessories and firestopping materials to meet regulatory requirements for fire rating.
- H. Install clips to secure recessed grid-supported luminaires in place.
- I. Install wall-mounted luminaires at height as indicated on Drawings as scheduled.
- J. Install accessories furnished with each luminaire.
- K. Connect luminaires to branch circuit outlets provided under Section 26 05 33.
- L. Make wiring connections to branch circuit using building wire with insulation suitable for temperature conditions within luminaire.
- M. Install specified lamps in each luminaire.
- N. Ground and bond interior luminaires in accordance with Section 26 05 26.

3.02 FIELD QUALITY CONTROL

- A. Division 01 - Quality Requirements - Execution and Closeout Requirements: Field inspecting, testing, adjusting, and balancing.
- B. Operate each luminaire after installation and connection. Inspect for proper connection and operation.

3.03 ADJUSTING

- A. Division 01 - Execution and Closeout Requirements: Testing, adjusting, and balancing.
- B. Aim and adjust luminaires as indicated on Drawings.

3.04 CLEANING

- A. Division 01 - Execution and Closeout Requirements: Final cleaning.
- B. Remove dirt and debris from enclosures.
- C. Clean photometric control surfaces as recommended by manufacturer.
- D. Clean finishes and touch up damage.

3.05 PROTECTION OF FINISHED WORK

- A. Division 01 - Execution and Closeout Requirements: Protecting finished work.
- B. Relamp luminaires having failed lamps at Substantial Completion.

END OF SECTION

SECTION 26 52 00
EMERGENCY LIGHTING

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes emergency lighting units and exit signs.
- B. Related Sections:
 - 1. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
 - 2. Section 26 05 33 - Raceway and Boxes for Electrical Systems.
 - 3. Section 26 51 00 - Interior Lighting: Exit signs.

1.02 REFERENCES

- A. National Electrical Manufacturers Association:
 - 1. NEMA WD 6 - Wiring Devices-Dimensional Requirements.

1.03 SYSTEM DESCRIPTION

- A. Emergency lighting to comply with requirements.

1.04 SUBMITTALS

- A. Division 01 - Administrative Requirements: Submittal Procedures.
- B. Product Data: Submit dimensions, ratings, and performance data.

1.05 QUALIFICATIONS

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

1.06 MAINTENANCE MATERIALS

- A. Division 01 - Execution and Closeout Requirements: Spare parts and maintenance products.
- B. Furnish twelve replacement battery for each battery type and size.

PART 2 PRODUCTS

2.01 EMERGENCY LIGHTING UNITS

- A. Manufacturers:
 - 1. Dual-Lite.
 - 2. Prescolite.

3. McPhilben.
4. Substitutions: Division 01 - Product Requirements.

- B. Product Description: Self-contained incandescent emergency lighting unit.
- C. Battery: 12 volt, nickel-cadmium type, with 1.5 hour capacity.
- D. Battery Charger: Dual-rate type, with sufficient capacity to recharge discharged battery to full charge within twelve hours.
- E. Indicators: Lamps to indicate AC ON and RECHARGING. Voltmeter to indicate battery voltage.
- F. TEST switch: Transfers unit from external power supply to integral battery supply.
- G. Input Voltage: 120-277 volts.
- H. Performance of systems shall comply with CBC 1006.4.

2.02 EXIT SIGNS

- A. Product Description: Exit sign fixture suitable for use as emergency lighting unit.
- B. Directional Arrows: As indicated on Drawings.
- C. Mounting: As indicated on Drawings.
- D. Battery: 12 volt, nickel-cadmium type, with 1.5 hour capacity.
- E. Battery Charger: Dual-rate type, with sufficient capacity to recharge discharged battery to full charge within twelve hours.
- F. Input Voltage: 120-277 volts.
- G. Placement of signs shall comply with CBC 1011.1.

2.03 FLUORESCENT LAMP EMERGENCY POWER SUPPLY

- A. Manufacturers:
 1. Bodine.
 2. Cooper.
 3. Substitutions: Division 01 - Product Requirements.
- B. Product Description: Emergency battery power supply suitable for installation in ballast compartment of fluorescent luminaire.
- C. Lamp Ratings: One F32CW lamp providing 600 lumens, minimum.
- D. Battery: Sealed lead calcium type, rated for 10 year life.
- E. Include TEST switch and AC ON indicator light, installed to be operable and visible from outside of assembled luminaire.

PART 3 EXECUTION**3.01 INSTALLATION**

- A. Install suspended exit signs using pendants supported from swivel hangers. Install pendant length required to suspend sign at indicated height.
- B. Install surface-mounted emergency lighting units and exit signs plumb and adjust to align with building lines and with each other. Secure to prevent movement.
- C. Install wall-mounted emergency lighting units and exit signs at height as indicated on Drawings.
- D. Install accessories furnished with each emergency lighting unit and exit sign.
- E. Connect emergency lighting units and exit signs to branch circuit outlets provided in Section 26 05 33.
- F. Make wiring connections to branch circuit using building wire with insulation suitable for temperature conditions within unit.
- G. Install specified lamps in each emergency lighting unit and exit sign.
- H. Ground and bond emergency lighting units and exit signs in accordance with Section 26 05 26.

3.02 FIELD QUALITY CONTROL

- A. Division 01 - Quality Requirements and 01 70 00 - Execution and Closeout Requirements: Field inspecting, testing, adjusting, and balancing.
- B. Operate each unit after installation and connection. Inspect for proper connection and operation.

3.03 ADJUSTING

- A. Division 01 - Execution and Closeout Requirements: Testing, adjusting, and balancing.
- B. Aim and adjust lamp fixtures.
- C. Position exit sign directional arrows as indicated on Drawings.

3.04 PROTECTION OF FINISHED WORK

- A. Division 01 - Execution and Closeout Requirements: Protecting finished work.
- B. Relamp emergency lighting units and exit signs having failed lamps at Substantial Completion.

END OF SECTION

SECTION 27 05 26

GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Wire.
2. Mechanical connectors.

B. Related Sections:

1. Section 26 05 26 - Grounding and Bonding for Electrical Systems.

1.02 REFERENCES

A. Building Industry Consulting Service International, Inc.

1. BICSI TDM Manual - Telecommunications Distribution Methods Manual.

B. California Electrical Code:

1. CEC - California Electrical Code.

C. Telecommunication Industry Association/Electronic Industries Alliance:

1. TIA/EIA 607 - Commercial Building Grounding and Bonding Requirements for Telecommunications.

1.03 SYSTEM DESCRIPTION

A. Communications grounding systems use the following elements as grounding electrodes:

1. Building grounding electrode.

B. Do not use the following elements as grounding electrodes:

1. Building plumbing system.
2. Building gas system.

1.04 PERFORMANCE REQUIREMENTS

A. Grounding System Resistance: 25 ohms maximum.

1.05 SUBMITTALS

A. Division 01 - Administrative Requirements: Submittal Procedures.

B. Product Data: Submit data on grounding electrodes and connections.

- C. Test Reports: Indicate overall resistance to ground.
- D. Manufacturer's Installation Instructions: Submit for active electrodes.
- E. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.

1.06 CLOSEOUT SUBMITTALS

- A. Division 01 - Execution and Closeout Requirements: Requirements for submittals.
- B. Project Record Documents: Record actual locations of components and grounding electrodes.

1.07 QUALITY ASSURANCE

- A. Provide grounding and surge protection of telecommunications system in accordance with latest version of Grounding, Bonding and Electrical Protection chapter of the BICSI TDM Manual, TIA/EIA 607, and CEC.

1.08 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years documented experience.
- B. Installer: Company specializing in performing work of this section with minimum 3 years documented experience.

1.09 PRE-INSTALLATION MEETINGS

- A. Division 01 - Administrative Requirements: Pre-installation meeting.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Division 01 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Accept materials on site in original factory packaging, labeled with manufacturer's identification.
- C. Protect from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original packaging.

1.11 COORDINATION

- A. Division 01 - Administrative Requirements: Requirements for coordination.
- B. Complete grounding and bonding of building power system ground.

PART 2 PRODUCTS

2.01 WIRE

- A. Material: Stranded copper.
- B. Grounding Conductor: Copper conductor bare.

- C. Bonding Conductor: Copper conductor bare.

2.02 MECHANICAL CONNECTORS

- A. Manufacturers:

1. Apache Grounding/Erico Inc.
2. Copperweld, Inc.
3. Erico, Inc.
4. ILSCO Corporation.
5. O-Z Gedney Co.
6. Thomas & Betts, Electrical.
7. Substitutions: Division 01 - Product Requirements.

- B. Description: Bronze connectors, suitable for grounding and bonding applications, in configurations required for particular installation.

PART 3 EXECUTION

3.01 PREPARATION

- A. Remove paint at connection points.

3.02 INSTALLATION

- A. Install in accordance with BICSI TDM Manual, TIA/EIA 607, and CEC.
- B. Install grounding and bonding conductors concealed from view.
- C. Install grounding for each rack using 6 AWG THHN, rated for 90 degrees C, insulated, copper stranded conductor to copper communication grounding bus bar located in main telecommunications room.
- D. Bond main telecommunications grounding system to building grounding electrode system at main electrical service entrance location with 6 AWG THHN, rated for 90 degrees C, insulated, copper stranded conductor.
- E. Install routing for grounding conductor as short and direct as practical.
- F. Install routing of bonding conductors with minimum number of bends and splices. Use sweeping bends.
- G. Install bonding connections with listed bolts, crimp pressure connectors, clamps, or lugs.
- H. Between each telecommunications/signal room, install multiple busbars directly bonded with 6 AWG copper conductor.
- I. Position busbars near associated equipment and insulate from supports.
- J. Construct busbars of copper, 4 inches x 8 inches by 1/4 inch thick with pilot holes for ground lug.
- K. Bond backbone cabling at each sheath opening.

- L. Ground data cabinets, racks, cable trays, and mounting hardware located in MDF Room and IDF Rooms.
- M. Install ground from each piece of equipment to MDF Room grounding bar via an insulated cable no smaller than 6 AWG stranded copper wire. Install proper grounding lug on cable where connecting to racks and grounding bar.
- N. Label grounding conductors and grounding bus bars in accordance with Section 27 05 53.
- O. Permanently attach equipment and grounding conductors prior to energizing equipment.

3.03 FIELD QUALITY CONTROL

- A. Division 01 - Quality Requirements - Execution and Closeout Requirements: Field inspecting, testing, adjusting, and balancing.
- B. Visually inspect from each bus bar to main grounding electrode service location.
- C. Test in accordance with BICSI TDM Manual, TIA/EIA 607, and CEC.
- D. When improper grounding is found, check entire project and correct. Perform retest.

END OF SECTION

SECTION 27 05 29**HANGERS AND SUPPORTS FOR COMMUNICATIONS SYSTEMS****PART 1 GENERAL**

1.01 SUMMARY

A. Section Includes:

1. Conduit supports.
2. Formed steel channel.
3. Sleeves.
4. Mechanical sleeve seals.
5. Firestopping relating to electrical work.
6. Firestopping accessories.
7. Equipment bases and supports.

B. Related Sections:

1. Division 03 - Cast-In-Place Concrete: Product requirements for concrete for placement by this section.
2. Section 26 05 29 - Hangers and Supports for Electrical Systems.

1.02 REFERENCES

A. ASTM International:

1. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
2. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials.
3. ASTM E814 - Standard Test Method for Fire Tests of Through-Penetration Fire Stops.
4. ASTM E1966 - Standard Test Method for Fire-Resistive Joint Systems.

B. FM Global:

1. FM - Approval Guide, A Guide to Equipment, Materials & Services Approved By Factory Mutual Research For Property Conservation.

C. California Electrical Code:

1. CEC - California Electrical Code.

D. Underwriters Laboratories Inc.:

1. UL 263 - Fire Tests of Building Construction and Materials.
2. UL 723 - Tests for Surface Burning Characteristics of Building Materials.
3. UL 1479 - Fire Tests of Through-Penetration Firestops.
4. UL 2079 - Tests for Fire Resistance of Building Joint Systems.
5. UL - Fire Resistance Directory.

E. Intertek Testing Services (Warnock Hersey Listed):

1. WH - Certification Listings.

1.03 DEFINITIONS

- A. Firestopping (Through-Penetration Protection System): Sealing or stuffing material or assembly placed in spaces between and penetrations through building materials to arrest movement of fire, smoke, heat, and hot gases through fire rated construction.

1.04 SYSTEM DESCRIPTION

- A. Firestopping Materials: ASTM E119, UL 1479 to achieve fire ratings as noted on Drawings for adjacent construction, but not less than 1 hour fire rating.
- B. Firestop interruptions to fire rated assemblies, materials, and components.

1.05 PERFORMANCE REQUIREMENTS

- A. Firestopping: Conform to FM and UL for fire resistance ratings and surface burning characteristics.
- B. Firestopping: Provide certificate of compliance from authority having jurisdiction indicating approval of materials used.

1.06 SUBMITTALS

- A. Division 01 - Administrative Requirements: Submittal Procedures.
- B. Shop Drawings: Indicate system layout with location and detail of trapeze hangers.
- C. Product Data:
1. Hangers and Supports: Submit manufacturers catalog data including load capacity.
 2. Firestopping: Submit data on product characteristics, performance and limitation criteria.
- D. Firestopping Schedule: Submit schedule of opening locations and sizes, penetrating items, and required listed design numbers to seal openings to maintain fire resistance rating of adjacent assembly.
- E. Manufacturer's Installation Instructions:
1. Hangers and Supports: Submit special procedures and assembly of components.
 2. Firestopping: Submit preparation and installation instructions.
- F. Manufacturer's Certificate: Certify products meet or exceed specified requirements.
- G. Engineering Judgements: For conditions not covered by UL or WH listed designs, submit judgements by licensed professional engineer suitable for presentation to authority having jurisdiction for acceptance as meeting code fire protection requirements.

1.07 QUALITY ASSURANCE

- A. Through Penetration Firestopping of Fire Rated Assemblies: UL 1479 or ASTM E814 with 0.10 inch water gage minimum positive pressure differential to achieve fire F-Ratings and temperature T-Ratings as indicated on Drawings, but not less than 1-hour.
 - 1. Wall Penetrations: Fire F-Ratings as indicated on Drawings, but not less than 1-hour.
 - 2. Floor and Roof Penetrations: Fire F-Ratings and temperature T-Ratings as indicated on Drawings, but not less than 1-hour.
 - a. Floor Penetrations Within Wall Cavities: T-Rating is not required.
- B. Through Penetration Firestopping of Non-Fire Rated Floor and Roof Assemblies: Materials to resist free passage of flame and products of combustion.
 - 1. Noncombustible Penetrating Items: Noncombustible materials for penetrating items connecting maximum of three stories.
 - 2. Penetrating Items: Materials approved by authorities having jurisdiction for penetrating items connecting maximum of two stories.
- C. Fire Resistant Joints in Fire Rated Floor, Roof, and Wall Assemblies: ASTM E1966 or UL 2079 to achieve fire resistant rating as indicated on Drawings for assembly in which joint is installed.
- D. Fire Resistant Joints Between Floor Slabs and Exterior Walls: ASTM E119 with 0.10 inch water gage minimum positive pressure differential to achieve fire resistant rating as indicated on Drawings for floor assembly.
- E. Surface Burning Characteristics: 25/450 flame spread/smoke developed index when tested in accordance with ASTM E84.

1.08 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years documented experience.
- B. Installer: Company specializing in performing work of this section with minimum 3 years documented experience.

1.09 DELIVERY, STORAGE, AND HANDLING

- A. Division 01 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Accept materials on site in original factory packaging, labeled with manufacturer's identification.
- C. Protect from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original packaging.

1.10 ENVIRONMENTAL REQUIREMENTS

- A. Division 01 - Product Requirements: Environmental conditions affecting products on site.
- B. Do not apply firestopping materials when temperature of substrate material and ambient air is below 60 degrees F.

- C. Maintain this minimum temperature before, during, and for minimum 3 days after installation of firestopping materials.
- D. Provide ventilation in areas to receive solvent cured materials.

PART 2 PRODUCTS

2.01 CONDUIT SUPPORTS

- A. Manufacturers:
 - 1. Allied Tube & Conduit Corp.
 - 2. Electroline Manufacturing Company.
 - 3. O-Z Gedney Co.
 - 4. Substitutions: Division 01 - Product Requirements.
- B. Hanger Rods: Threaded high tensile strength galvanized carbon steel with free running threads.
- C. Beam Clamps: Malleable Iron, with tapered hole in base and back to accept either bolt or hanger rod. Set screw: hardened steel.
- D. Conduit clamps for trapeze hangers: Galvanized steel, notched to fit trapeze with single bolt to tighten.
- E. Conduit clamps - general purpose: One hole malleable iron for surface mounted conduits.
- F. Cable Ties: High strength nylon temperature rated to 185 degrees F. Self locking.

2.02 FORMED STEEL CHANNEL

- A. Manufacturers:
 - 1. Allied Tube & Conduit Corp.
 - 2. B-Line Systems.
 - 3. Midland Ross Corporation, Electrical Products Division.
 - 4. Unistrut Corp.
 - 5. Substitutions: Division 01 - Product Requirements.
- B. Product Description: Galvanized 12 gage) thick steel. With holes 1-1/2 inches on center.

2.03 SLEEVES

- A. Sleeves for Through Non-fire Rated Floors: 18 gage thick galvanized steel.
- B. Sleeves for Through Fire Rated and Fire Resistive Floors and Walls, and Fire Proofing: Prefabricated fire rated sleeves including seals, UL listed.
- C. Fire-stopping Insulation: Glass fiber type, non-combustible.

2.04 MECHANICAL SLEEVE SEALS

A. Manufacturers:

1. Thunderline Link-Seal, Inc.
2. NMP Corporation.
3. Substitutions: Division 01 - Product Requirements.

- B. Product Description: Modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between object and sleeve, connected with bolts and pressure plates causing rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.

2.05 FIRESTOPPING

A. Manufacturers:

1. Dow Corning Corp.
2. Fire Trak Corp.
3. Hilti Corp.
4. International Protective Coating Corp.
5. 3M fire Protection Products.
6. Specified Technology, Inc.
7. Substitutions: Division 01 - Product Requirements.

2.06 FIRESTOPPING ACCESSORIES

- A. Primer: Type recommended by firestopping manufacturer for specific substrate surfaces and suitable for required fire ratings.
- B. Dam Material: Permanent:
1. Sheet metal.
- C. Installation Accessories: Provide clips, collars, fasteners, temporary stops or dams, and other devices required to position and retain materials in place.
- D. General:
1. Furnish UL listed products.
 2. Select products with rating not less than rating of wall or floor being penetrated.
- E. Non-Rated Surfaces:
1. Stamped steel, chrome plated, hinged, split ring escutcheons or floor plates or ceiling plates for covering openings in occupied areas where conduit is exposed.
 2. For exterior wall openings below grade, furnish modular mechanical type seal consisting of interlocking synthetic rubber links shaped to continuously fill annular space between conduit and cored opening or water-stop type wall sleeve.

PART 3 EXECUTION**3.01 EXAMINATION**

- A. Division 01 - Administrative Requirements: Verification of existing conditions before starting work.
- B. Verify openings are ready to receive sleeves.
- C. Verify openings are ready to receive firestopping.

3.02 PREPARATION

- A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other matter affecting bond of firestopping material.
- B. Remove incompatible materials affecting bond.
- C. Install backing materials to arrest liquid material leakage.
- D. Do not drill or cut structural members.

3.03 INSTALLATION - HANGERS AND SUPPORTS

- A. Anchors and Fasteners:
 - 1. Concrete Structural Elements: Provide precast inserts, expansion anchors.
 - 2. Steel Structural Elements: Provide beam clamps.
 - 3. Concrete Surfaces: Provide self-drilling anchors and expansion anchors.
 - 4. Hollow Masonry, Plaster, and Gypsum Board Partitions: Provide toggle bolts.
 - 5. Sheet Metal: Provide sheet metal screws.
 - 6. Wood Elements: Provide wood screws.
- B. Inserts:
 - 1. Install inserts for placement in concrete forms.
 - 2. Install inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
 - 3. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches.
 - 4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
- C. Install conduit and raceway support and spacing in accordance with CEC.
- D. Do not fasten supports to pipes, ducts, mechanical equipment, or conduit.
- E. Install multiple conduit runs on common hangers.
- F. Supports:
 - 1. Fabricate supports from structural steel or formed steel channel. Install hexagon head bolts to present neat appearance with adequate strength and rigidity. Install spring lock washers under nuts.

2. Install surface mounted cabinets and panelboards with minimum of four anchors.
3. In wet and damp locations install steel channel supports to stand cabinets and panelboards 1 inch off wall.

3.04 INSTALLATION - FIRESTOPPING

- A. Install material at fire rated construction perimeters and openings containing penetrating sleeves, piping, ductwork, conduit and other items, requiring firestopping.
- B. Apply primer where recommended by manufacturer for type of firestopping material and substrate involved, and as required for compliance with required fire ratings.
- C. Apply firestopping material in sufficient thickness to achieve required fire and smoke rating, to uniform density and texture.

3.05 INSTALLATION - SLEEVES

- A. Exterior watertight entries: Seal with adjustable interlocking rubber links.
- B. Conduit penetrations not required to be watertight: Sleeve and fill with silicon foam.
- C. Set sleeves in position in forms. Provide reinforcing around sleeves.
- D. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.
- E. Extend sleeves through floors 1 inch above finished floor level. Caulk sleeves.
- F. Where conduit or raceway penetrates floor, ceiling, or wall, close off space between conduit or raceway and adjacent work with fire stopping insulation and caulk. Provide close fitting metal collar or escutcheon covers at both sides of penetration.
- G. Install chrome plated steel escutcheons at finished surfaces.

3.06 FIELD QUALITY CONTROL

- A. Division 01 - Quality Requirements and 01 70 00 - Execution and Closeout Requirements: Field inspecting, testing, adjusting, and balancing.
- B. Inspect installed firestopping for compliance with specifications and submitted schedule.

3.07 CLEANING

- A. Division 01 - Execution and Closeout Requirements: Requirements for cleaning.
- B. Clean adjacent surfaces of firestopping materials.

3.08 PROTECTION OF FINISHED WORK

- A. Division 01 - Execution and Closeout Requirements: Requirements for protecting finished Work.

- B. Protect adjacent surfaces from damage by material installation.

END OF SECTION

SECTION 27 05 33**CONDUITS AND BACKBOXES FOR COMMUNICATIONS SYSTEMS****PART 1 GENERAL**

1.01 SUMMARY

- A. Section includes conduit and tubing, surface raceways, wireways, outlet boxes, pull and junction boxes, and handholes.
- B. Related Sections:
 - 1. Section 26 05 03 - Equipment Wiring Connections.
 - 2. Section 26 05 33 - Raceway and Boxes for Electrical Systems.
 - 3. Section 26 27 16 - Electrical Cabinets and Enclosures.
 - 4. Section 26 27 26 - Wiring Devices.
 - 5. Section 27 05 26 - Grounding and Bonding for Communications Systems.
 - 6. Section 27 05 29 - Hangers and Supports for Communications Systems.
 - 7. Section 27 05 53 - Identification for Communications Systems.

1.02 REFERENCES

- A. American National Standards Institute:
 - 1. ANSI C80.1 - Rigid Steel Conduit, Zinc Coated.
 - 2. ANSI C80.3 - Specification for Electrical Metallic Tubing, Zinc Coated.
 - 3. ANSI C80.5 - Aluminum Rigid Conduit - (ARC).
- B. National Electrical Manufacturers Association:
 - 1. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
 - 2. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and Cable Assemblies.
 - 3. NEMA OS 1 - Sheet Steel Outlet Boxes, Device Boxes, Covers, and Box Supports.
 - 4. NEMA OS 2 - Nonmetallic Outlet Boxes, Device Boxes, Covers, and Box Supports.
 - 5. NEMA RN 1 - Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit.
 - 6. NEMA TC 2 - Electrical Polyvinyl Chloride (PVC) Tubing and Conduit.
 - 7. NEMA TC 3 - PVC Fittings for Use with Rigid PVC Conduit and Tubing.

1.03 SYSTEM DESCRIPTION

- A. Raceway and boxes located as indicated on Drawings, and at other locations required for splices, taps, wire pulling, equipment connections, and compliance with regulatory requirements. Raceway and boxes are shown in approximate locations unless dimensioned. Provide raceway to complete wiring system.
- B. Underground More than 5 feet outside Foundation Wall: Provide thickwall nonmetallic conduit. Provide cast metal boxes or nonmetallic handhole.
- C. Underground Within 5 feet from Foundation Wall: Provide rigid steel conduit. Provide cast metal or nonmetallic boxes.

- D. Outdoor Locations, Above Grade: Provide rigid conduit. Provide cast metal or nonmetallic outlet, pull, and junction boxes.
- E. Wet and Damp Locations: Provide rigid steel. Provide cast metal or nonmetallic outlet, junction, and pull boxes. Provide flush mounting outlet box in finished areas.
- F. Concealed Dry Locations: Provide electrical metallic tubing. Provide sheet-metal boxes. Provide flush mounting outlet box in finished areas. Provide hinged enclosure for large pull boxes.
- G. Exposed Dry Locations: Provide electrical metallic tubing. Provide sheet-metal boxes. Provide flush mounting outlet box in finished areas. Provide hinged enclosure for large pull boxes.

1.04 DESIGN REQUIREMENTS

- A. Minimum Raceway Size: 3/4 inch unless otherwise specified.

1.05 SUBMITTALS

- A. Division 01 - Administrative Requirements: Submittal Procedures.
- B. Manufacturer's Installation Instructions: Submit application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, and installation of Product.

1.06 CLOSEOUT SUBMITTALS

- A. Division 01 - Execution and Closeout Requirements: Requirements for submittals.
- B. Project Record Documents:
 1. Record actual routing of conduits larger than 2 inches.
 2. Record actual locations and mounting heights of outlet, pull, and junction boxes.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Division 01 - Product Requirements: Product storage and handling requirements.
- B. Protect conduit from corrosion and entrance of debris by storing above grade. Provide appropriate covering.
- C. Protect PVC conduit from sunlight.

1.08 COORDINATION

- A. Division 01 - Administrative Requirements: Coordination and project conditions.
- B. Coordinate installation of outlet boxes for equipment connected under Section 26 05 03.
- C. Coordinate mounting heights, orientation and locations of outlets mounted above counters, benches, and backsplashes.

PART 2 PRODUCTS

2.01 METAL CONDUIT

- A. Manufacturers:
 - 1. Allied Tube.
 - 2. Hubbell Wiring Devices.
 - 3. Thomas & Betts Corp.
 - 4. Walker Systems Inc.
 - 5. The Wiremold Co.
 - 6. Substitutions: Division 01 - Product Requirements.
- B. Rigid Steel Conduit: ANSI C80.1.
- C. Rigid Aluminum Conduit: ANSI C80.5.
- D. Intermediate Metal Conduit (IMC): Rigid steel.
- E. Fittings and Conduit Bodies: NEMA FB 1; material to match conduit.

2.02 FLEXIBLE METAL CONDUIT

- A. Manufacturers:
 - 1. Carlon Electrical Products.
 - 2. Hubbell Wiring Devices.
 - 3. Thomas & Betts Corp.
 - 4. Walker Systems Inc.
 - 5. The Wiremold Co.
 - 6. Substitutions: Division 01 - Product Requirements.
- B. Product Description: Interlocked aluminum construction.
- C. Fittings: NEMA FB 1.

2.03 LIQUIDTIGHT FLEXIBLE METAL CONDUIT

- A. Manufacturers:
 - 1. Carlon Electrical Products.
 - 2. Hubbell Wiring Devices.
 - 3. Thomas & Betts Corp.
 - 4. Walker Systems Inc.
 - 5. The Wiremold Co.
 - 6. Substitutions: Division 01 - Product Requirements.
- B. Product Description: Interlocked aluminum construction with PVC jacket.
- C. Fittings: NEMA FB 1.

2.04 ELECTRICAL METALLIC TUBING (EMT)

- A. Manufacturers:
 - 1. Allied Tube.
 - 2. Hubbell Wiring Devices.
 - 3. Thomas & Betts Corp.
 - 4. Walker Systems Inc.
 - 5. The Wiremold Co.
 - 6. Substitutions: Division 01 - Product Requirements.
- B. Product Description: ANSI C80.3; galvanized tubing.
- C. Fittings and Conduit Bodies: NEMA FB 1; steel compression type.

2.05 NONMETALLIC CONDUIT

- A. Manufacturers:
 - 1. Carlon Electrical Products.
 - 2. Hubbell Wiring Devices.
 - 3. Thomas & Betts Corp.
 - 4. Walker Systems Inc.
 - 5. The Wiremold Co.
 - 6. Substitutions: Division 01 - Product Requirements.
- B. Product Description: NEMA TC 2; Schedule 80 PVC.
- C. Fittings and Conduit Bodies: NEMA TC 3.

2.06 OUTLET BOXES

- A. Manufacturers:
 - 1. Carlon Electrical Products.
 - 2. Hubbell Wiring Devices.
 - 3. Thomas & Betts Corp.
 - 4. Walker Systems Inc.
 - 5. The Wiremold Co.
 - 6. Substitutions: Division 01 - Product Requirements.
- B. Sheet Metal Outlet Boxes: NEMA OS 1, galvanized steel.
 - 1. Luminaire and Equipment Supporting Boxes: Rated for weight of equipment supported; furnish 1/2 inch male fixture studs where required.
 - 2. Concrete Ceiling Boxes: Concrete type.
- C. Nonmetallic Outlet Boxes: NEMA OS 2.
- D. Cast Boxes: NEMA FB 1, Type FD, aluminum. Furnish gasketed cover by box manufacturer.
- E. Wall Plates for Finished Areas: As specified in Section 26 27 26.

- F. Wall Plates for Unfinished Areas: Furnish gasketed cover.

2.07 PULL AND JUNCTION BOXES

A. Manufacturers:

1. Carlon Electrical Products.
2. Hubbell Wiring Devices.
3. Thomas & Betts Corp.
4. Walker Systems Inc.
5. The Wiremold Co.
6. Substitutions: Division 01 - Product Requirements.

- B. Sheet Metal Boxes: NEMA OS 1, galvanized steel.

- C. Hinged Enclosures: As specified in Section 26 27 16.

- D. Surface Mounted Cast Metal Box: NEMA 250, Type 4; flat-flanged, surface mounted junction box:

1. Material: Galvanized cast iron.
2. Cover: Furnish with ground flange, neoprene gasket, and stainless steel cover screws.

- E. In-Ground Cast Metal Box: NEMA 250, Type 6, outside flanged, recessed cover box for flush mounting:

1. Material: Galvanized cast iron.
2. Cover: Smooth cover with neoprene gasket and stainless steel cover screws.
3. Cover Legend: "COMMUNICATION".

PART 3 EXECUTION

3.01 EXAMINATION

- A. Division 01 - Administrative Requirements: Coordination and project conditions.
- B. Verify outlet locations and routing and termination locations of raceway prior to rough-in.

3.02 INSTALLATION

- A. Ground and bond raceway and boxes in accordance with Section 26 05 26.
- B. Fasten raceway and box supports to structure and finishes in accordance with Section 26 05 29.
- C. Identify raceway and boxes in accordance with Section 26 05 53.
- D. Arrange raceway and boxes to maintain headroom and present neat appearance.

3.03 INSTALLATION - RACEWAY

- A. Raceway routing is shown in approximate locations unless dimensioned. Route to complete wiring system.

- B. Arrange raceway supports to prevent misalignment during wiring installation.
- C. Support raceway using coated steel or malleable iron straps, lay-in adjustable hangers, clevis hangers, and split hangers.
- D. Group related raceway; support using conduit rack. Construct rack using steel channel specified in Section 26 05 29 provide space on each for 25 percent additional raceways.
- E. Do not support raceway with wire or perforated pipe straps. Remove wire used for temporary supports
- F. Do not attach raceway to ceiling support wires or other piping systems.
- G. Construct wireway supports from steel channel specified in Section 26 05 29.
- H. Route exposed raceway parallel and perpendicular to walls.
- I. Route raceway installed above accessible ceilings parallel and perpendicular to walls.
- J. Route conduit in and under slab from point-to-point.
- K. Maintain clearance between raceway and piping for maintenance purposes.
- L. Maintain 12 inch clearance between raceway and surfaces with temperatures exceeding 104 degrees F.
- M. Cut conduit square using saw or pipe cutter; de-burr cut ends.
- N. Bring conduit to shoulder of fittings; fasten securely.
- O. Join nonmetallic conduit using cement as recommended by manufacturer. Wipe nonmetallic conduit dry and clean before joining. Apply full even coat of cement to entire area inserted in fitting. Allow joint to cure for minimum 20 minutes.
- P. Install conduit hubs to fasten conduit to sheet metal boxes in damp and wet locations to cast boxes.
- Q. Install no more than equivalent of three 90 degree bends between boxes. Install conduit bodies to make sharp changes in direction, as around beams. Install factory elbows for bends in metal conduit larger than 2 inch size.
- R. Avoid moisture traps; install junction box with drain fitting at low points in conduit system.
- S. Install fittings to accommodate expansion and deflection where raceway crosses seismic and expansion joints.
- T. Install suitable pull string or cord in each empty raceway except sleeves and nipples.
- U. Install suitable caps to protect installed conduit against entrance of dirt and moisture.

3.04 INSTALLATION - BOXES

- A. Install wall mounted boxes at elevations to accommodate mounting heights.

- B. Adjust box location up to 10 feet prior to rough-in to accommodate intended purpose.
- C. Orient boxes to accommodate wiring devices oriented as specified in Section 26 27 26.
- D. Install pull boxes and junction boxes above accessible ceilings and in unfinished areas only.
- E. In Accessible Ceiling Areas: Install outlet and junction boxes no more than 6 inches from ceiling access panel or from removable recessed luminaire.
- F. Locate flush mounting box in masonry wall to require cutting of masonry unit corner only. Coordinate masonry cutting to achieve neat opening.
- G. Do not install flush mounting box back-to-back in walls; install with minimum 6 inches separation. Install with minimum 24 inches separation in acoustic rated walls.
- H. Secure flush mounting box to interior wall and partition studs. Accurately position to allow for surface finish thickness.
- I. Install stamped steel bridges to fasten flush mounting outlet box between studs.
- J. Install flush mounting box without damaging wall insulation or reducing its effectiveness.
- K. Install adjustable steel channel fasteners for hung ceiling outlet box.
- L. Do not fasten boxes to ceiling support wires or other piping systems.
- M. Support boxes independently of conduit.
- N. Install gang box where more than one device is mounted together. Do not use sectional box.
- O. Install gang box with plaster ring for single device outlets.

3.05 INTERFACE WITH OTHER PRODUCTS

- A. Install conduit to preserve fire resistance rating of partitions and other elements, using materials and methods in accordance with Division 07.
- B. Route conduit through roof openings for piping and ductwork or through suitable roof jack with pitch pocket.
- C. Locate outlet boxes to allow luminaires positioned as indicated on Drawings.
- D. Align adjacent wall mounted outlet boxes for switches, thermostats, and similar devices.

3.06 ADJUSTING

- A. Division 01 - Execution and Closeout Requirements: Testing, adjusting, and balancing.
- B. Adjust flush-mounting outlets to make front flush with finished wall material.
- C. Install knockout closures in unused openings in boxes.

3.07 CLEANING

- A. Division 01 - Execution and Closeout Requirements: Final cleaning.
- B. Clean interior of boxes to remove dust, debris, and other material.
- C. Clean exposed surfaces and restore finish.

END OF SECTION

SECTION 27 05 36

CABLE TRAY FOR COMMUNICATION SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Ladder rack and accessories.

1.02 REFERENCES

- A. CEC – California Electrical Code.
- B. ASTM A 123 - Specification for Zinc (Hot-Galvanized) Coatings on Products Fabricated from Rolled, Pressed, and Forged Steel Shapes, Plates, Bars, and Strip.
- C. ASTM A 525 - General Requirements for Steel Sheet, Zinc-Coated Galvanized by the Hot-Dip Process.
- D. NEMA VE 1 - Metallic Cable Tray Systems.

1.03 SUBMITTALS

- A. Division 01 - Administrative Requirements: Submittal Procedures.
- B. Shop Drawings: Indicate tray type, dimensions, support points, and finishes.
- C. Product Data: Provide data for fittings and accessories.
- D. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of Product.

1.04 PROJECT RECORD DOCUMENTS

- A. Submit under provisions of Division 01.
- B. Record actual routing of ladder rack and locations of supports.

1.05 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing Products specified in this Section with minimum five years documented experience.

1.06 REGULATORY REQUIREMENTS

- A. Conform to requirements of ANSI/NFPA 70.
- B. Furnish products listed and classified by Underwriters Laboratories, Inc. or testing firm acceptable to authority having jurisdiction as suitable for purpose specified and shown.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. P.W. Industries
- B. B-line.
- C. Erico.
- D. Approved equal.

2.02 LADDER RACK

- A. Description: NEMA VE 1, Class 20C ladder type tray.
- B. Material: Steel.
- C. Finish: ASTM A 123, hot dipped galvanized after fabrication.
- D. Inside Width: 18 inches. As indicated on drawings.
- E. Inside Depth: 4 inches. As indicated on drawings.
- F. Straight Section Rung Spacing: 9 inches on center. As indicated on drawings.
- G. Inside Radius of Fittings: 24 inches or as indicated on drawings.
- H. Provide manufacturer's standard clamps, hangers, brackets, splice plates, reducer plates, blind ends, barrier strips, connectors, and grounding straps.

2.03 WARNING SIGNS

- A. Engraved Nameplates: 3/4-inch high black letters on yellow laminated plastic nameplate, engraved with the following wording:

WARNING! DO NOT USE CABLE TRAY AS WALKWAY, LADDER, OR SUPPORT. USE ONLY AS MECHANICAL SUPPORT FOR CABLES AND TUBING!

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install metallic cable tray in accordance with NEMA VE 1.
- C. Support trays in accordance with Section 26 05 29. Provide supports at each connection point, at the end of each run, and at other points to maintain spacing between supports of 8 feet maximum.
- D. Use expansion connectors where required.

- E. Ground and bond cable tray under provisions of Section 26 05 26.
 - 1. Provide continuity between tray components.
 - 2. Use anti-oxidant compound to prepare aluminum contact surfaces before assembly.
 - 3. Provide 2 AWG bare copper equipment grounding conductor through entire length of tray; bond to each component.
 - 4. Connections to tray may be made using mechanical or exothermic connectors.

- F. Install warning signs at 20-ft centers along cable tray, located to be visible.

END OF SECTION

SECTION 27 05 53**IDENTIFICATION FOR COMMUNICATIONS SYSTEMS****PART 1 GENERAL****1.01 SUMMARY****A. Section Includes:**

1. Nameplates.
2. Wire markers.
3. Conduit markers.
4. Stencils.
5. Underground Warning Tape.

B. Related Sections:

1. Division 09 - Painting and Coating: Execution requirements for painting specified by this section.
2. Section 27 05 53 - Identification for Communications Systems.

1.02 SUBMITTALS**A. Division 01 - Administrative Requirements: Submittal Procedures.****B. Product Data:**

1. Submit manufacturer's catalog literature for each product required.
2. Submit electrical identification schedule including list of wording, symbols, letter size, color coding, tag number, location, and function.

C. Manufacturer's Installation Instructions: Indicate installation instructions, special procedures, and installation.**1.03 CLOSEOUT SUBMITTALS****A. Division 01 - Execution and Closeout Requirements: Requirements for submittals.****B. Project Record Documents: Record actual locations of tagged devices; include tag numbers.****1.04 DELIVERY, STORAGE, AND HANDLING****A. Division 01 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.****B. Accept identification products on site in original containers. Inspect for damage.****C. Accept materials on site in original factory packaging, labeled with manufacturer's identification, including product density and thickness.****D. Protect insulation from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original wrapping.**

1.05 ENVIRONMENTAL REQUIREMENTS

- A. Division 01 - Product Requirements: Environmental conditions affecting products on site.
- B. Install nameplates only when ambient temperature and humidity conditions for adhesive are within range recommended by manufacturer.

1.06 EXTRA MATERIALS

- A. Division 01 - Execution and Closeout Requirements: Requirements for extra materials.

PART 2 PRODUCTS

2.01 NAMEPLATES

- A. Product Description: Laminated three-layer plastic with engraved black letters on white contrasting background color.
- B. Letter Size:
 - 1. 1/8 inch high letters for identifying individual equipment and loads.
 - 2. 1/4 inch high letters for identifying grouped equipment and loads.
- C. Minimum nameplate thickness: 1/8 inch.

2.02 WIRE MARKERS

- A. Description: Split sleeve type wire markers.
- B. Legend:
 - 1. Power and Lighting Circuits: Branch circuit or feeder number as indicated on Drawings.
 - 2. Low Voltage Circuits: Wire number as indicated on shop drawings.

2.03 UNDERGROUND WARNING TAPE

- A. Description: 4 inch wide plastic tape, detectable type, colored yellow with suitable warning legend describing buried electrical lines.

PART 3 EXECUTION

3.01 PREPARATION

- A. Degrease and clean surfaces to receive adhesive for identification materials.
- B. Prepare surfaces in accordance with Division 09 for stencil painting.

3.02 EXISTING WORK

- A. Install identification on all equipment.
- B. Replace lost nameplates.

3.03 INSTALLATION

- A. Install identifying devices after completion of painting.
- B. Nameplate Installation:
 - 1. Install nameplate parallel to equipment lines.
 - 2. Install nameplate for each electrical distribution and control equipment enclosure with corrosive-resistant mechanical fasteners, or adhesive.
 - 3. Install nameplates for each control panel and major control components located outside panel with corrosive-resistant mechanical fasteners, or adhesive.
 - 4. Secure nameplate to equipment front using adhesive.
 - 5. Secure nameplate to inside surface of door on recessed panelboard in finished locations.
 - 6. Install nameplates for the following:
 - a. Switchboards.
 - b. Panelboards.
 - c. Transformers.
 - d. Service Disconnects.
- C. Underground Warning Tape Installation: Install underground warning tape along length of each underground conduit, raceway, or cable 6 to 8 inches minimum below finished grade or as indicated on drawings, and directly above buried conduit, raceway, or cable.

END OF SECTION

SECTION 28 16 00**INTRUSION DETECTION SYSTEM****PART 1 GENERAL****1.01 SCOPE OF WORK**

- A. All applicable portions of Section 26 05 03 shall apply to this section as though written herein completely.
- B. The County has decided to standardize on using Bosch security equipment throughout the County. Equal-in-all-respects substitutions must be reviewed and approved.

1.02 RELATED WORK

- A. Document affecting work of this section include, but are not necessarily limited to, General Conditions, Supplementary Conditions and sections of Division 1 and 26 of these specifications.
- B. The work described by this part includes the furnishing of all materials, equipment, supplies, labor and the performing of all operations necessary for the installation of complete and operating systems
- C. All conduits, outlet boxes, back boxes, junction boxes, terminal cabinets, backboards, wiring, cables, equipment, devices, etc., shall be furnished and installed complete under this section. Conduit and junction box sizes shall be determined by the Installing Communications Contractor for the particular wire and cable fills required for the systems installed. (Conduit sizes shall comply with the National Electrical Code). The entire responsibility of the system, including the installation, operation, function, testing and maintenance for one (1) year after final acceptance under this section shall be the responsibility of the communications contractor.
- D. The Installing Electronic Systems Contractor shall furnish and install all equipment, cables, devices, and other materials even though not specifically mentioned herein, which are necessary for the proper integration of the system so that the system shall perform the functions listed herein in compliance with all specified requirements.

1.03 GENERAL REQUIREMENTS

- A. The Installing Electronic Systems Contractor shall hold a valid State of California C-10 License, shall have completed at least 20 projects of equal scope, shall have been in business of furnishing and installing communication systems of this type for at least five years, and capable of being bonded to assure the owner of performance and satisfactory service during the guarantee period.
- B. The Installing Electronic Systems Contractor shall be a factory authorized distributor and warrantee station for the brand of equipment offered and shall maintain a fully equipped service organization capable of furnishing adequate repair service to the equipment. The Contractor shall maintain a spare set of all major parts for the system at all times. All circuit boards, amplifiers and control sub systems shall be 100% backed up with stock at contractor's shop.
- C. The vendor shall allow enough time in the bid to do a needs assessment process to ensure the database programming and features of all the systems will meet the desired functions of the facility administrative staff.

1.04 SUBMITTAL AND MANUALS

- A. Comply with all requirements of the General Conditions, Supplementary Conditions and applicable sections of Divisions 1 and 26 of these specifications.
- B. Additional requirements of this section are:
 - 1. Within thirty-five (35) calendar days after the date of award of the Contract, the Contractor shall submit to the Architect for review, eight copies of a complete submission.
 - 2. The submission shall consist of five major sections with each section separated with index tabs. Each page in the submission shall be numbered chronologically and shall be summarized in the index.
 - 3. The first section shall be the "Index" which shall include the project title and address, name of the firm submitting the proposal and name of the Architect.
 - 4. The second section shall include a copy of the Installing Communication Contractors valid C-10 California State Contractors License, letters of factory authorization and guaranteed service, list of 20 projects of equal scope and list of proposed instrumentation to be used by the Contractor.
 - 5. The third section shall contain the comparative specification listing, including a complete listing of the characteristics of the equipment to be furnished next to all of the specified equipment's features and functions as stated in the specifications and data sheets.
 - 6. The fourth section shall contain an original factory data sheet for every piece of equipment in the specifications.
 - 7. The fifth section shall contain a wiring designation schedule for each circuit leaving each piece of equipment and drawings showing system wiring plans.
- C. The Contractor shall provide two copies of an "Operating and Servicing Manual" for the system. The manuals shall be bound in flexible binders. All data shall be printed material or typewritten. Each manual shall include the following: Instructions necessary for the proper operation and servicing of the system; complete as-built installation drawings of the system; a wiring destination schedule for each circuit leaving for each piece of equipment; a schematic diagram of major components with all transistor and IC complements and replacement number.

PART 2 PRODUCTS

2.01 INTRUSION ALARM SYSTEM

- A. Description:
 - 1. The system shall consist of door switches and motion detection devices connected to detect intrusion into the covered areas. The system shall be zoned or as indicated on the drawings and have a control panel capable of providing alarm and trouble signals, by zone, for connection to the County equipment or transmitted as per County requirements. System on-off and access control from remote equipment furnished by the County or by a remote push button key pads.
 - 2. Each zone shall be a separate compartment and can have a key pad mounted as shown. A master key pad position shall be provided as shown in the administrative area.
- B. Products:
 - 1. Provide Radionics 9412 control panels with annunciation of each zone separately. Provide D1260 alpha remote controls as shown on plans.
 - 2. Provide Radionics D8129 module to interface with CCTV Security System, as required.

3. Wall-mounted PIR/Microwave motion detectors shall be Bosch ISM-BLD1-P-F1 with B328 mounting plate. Use DSC BV500 if shown ceiling mounted. Provide each device with a D9127U POPIT module to be located in the Signal IDFs.
 4. Door Switches: Sentrol 1078 series with mounting as necessary to adapt to doors furnished. Provide each device with a D9127U POPIT module to be located in the Signal IDFs.
 5. Motion Sensor Cable shall be Thompson 393U22BE or equal, 4-conductor 22AWG solid cable with a beige jacket. Door Contact Cable shall be Thompson 393T22BR or equal, 2-conductor 22AWG solid with a brown jacket. Keypad Cable shall be Thompson 393L18OR or equal, 2-pair 18AWG with an orange jacket. Home-run each device to the nearest Signal IDF.
 6. Power supplies for motion detectors shall be Altronix SMP3PM-CTX, 12vdc located in Signal Rooms. Provide a minimum of one (1) power supply per building.
 7. Protect the roof hatches (if there are any) in the building with Sentrol 2505A magnetic contacts and annunciate separately as a day zone to indicate opening and closing of all hatches during the day and alarm at night.
 8. Provide all necessary hardware and software for a complete and working system.
- C. Testing: System shall detect the entry through a door switched door and/or the motion of a body taking not more than four steps in an area secured with motion detection equipment where entry doors or windows are possible access. System shall be complete and properly operating prior to calling for the test. The inspector, contractor and engineer shall walk test system at County's option and contractor shall make minor satisfactory adjustments to the system in the presence of the inspector. Contractor shall coordinate the time of test with the County inspector. This test shall be performed during a time when there is no other person(s) on the site.

PART 3 EXECUTION

3.01 INSTALLATION

- A. The wiring of the system shall be executed in accordance with the drawings and the equipment manufacturer's wiring diagrams. Should any variations in these requirements occur, the contractor shall notify the Architect before making any changes. It shall be the responsibility of the factory authorized distributor of the approved equipment to install the equipment and guarantee the system to operate as per plans and specifications.
- B. Furnish all conductors, equipment plugs, terminal strips, etc., and labor to install a complete and operable system.
- C. The cables within the rack or cabinets shall be carefully cabled and laced with No. 12 Cord waxed linen lacing twine or t&b model ty-rap Series 500 cable straps. All cables numbered for identification.
- D. Splices of conductors in underground pull boxes are not permitted.
- E. The labor employed by the contractor shall be regularly employed in the installation and repair of communication systems and shall be acceptable to the owner and architect to engage in the installation and service of this system.
- F. The contractor shall thoroughly clean all equipment and materials. All exposed parts of the equipment, cabinets, and other equipment shall be left in a clean condition, unblemished and

free of all dirt, dust, smudges, spots, fingerprints, etc., the contractor shall remove all debris and rubbish occasioned by the electronic systems work from the site. The contractor shall thoroughly clean all buildings of any dirt, debris, rubbish, marks, etc. caused by the performance of this work.

- G. The contractor shall provide not less than eight (8) hours for instruction of personnel in the operation and maintenance of the systems. This instruction time shall be divided a directed by the Owner.

3.02 WARRANTY

- A. The entire system shall be warranted free of mechanical or electrical defects for a period of one (1) year after final acceptance of the installation. Any material showing mechanical or electrical defects shall be replaced promptly at no expense to the purchaser.
- B. The contractor shall maintain a competent service organization and shall, if requested, submit a service maintenance agreement to the owner after the end of the guarantee period.
- C. A typewritten notice shall be posted at the equipment rack which shall indicate the firm, address and telephone number to call when service is necessary. The notice shall be mounted in a neatly finished metal frame with a clear plastic window and securely attached to the inside of the door.

3.03 TESTING

- A. Provide all instruments for testing and demonstrating in the presence of the Owner's inspector that the frequency response is as stated in the factory data sheets. Check all circuits and wiring to verify they are free of shorts and grounds.
- B. The Owner reserves the right to make independent tests of all equipment furnished to determine whether or not the equipment complies with the requirements specified herein and to accept or reject any or all of the equipment on the basis of the results thereby obtained.

END OF SECTION

SECTION 28 31 00**ANALOG ADDRESSABLE FIRE ALARM****PART 1 GENERAL****1.01 SCOPE**

- A. The complete installation of fire alarm devices and accessories shall be Silent Knight 5820XL Series 24VDC analog addressable fire alarm system with SpectrAlert synchronized notification. The Fire Alarm Control Panels (FACP) is a microprocessor-based, network capable and complete with an integral DACT that is UL listed for Remote Station, Proprietary and Central Station fire alarm systems. The FA System shall be compliant with UL 864, 9th edition.
1. The fire alarm system shall be provided and installed by a Silent Knight Certified Installer. Systems provided and/or installed by anyone other than a Silent Knight Certified Installer shall be considered in non-compliance with this specification and subject to replacement at the expense of the Division 26 contractor.
 - a. The Silent Knight Certified Installer shall furnish all labor, materials, appliances, cabling, tools, equipment, facilities transportation and services necessary for and incidental to performing all operations in connection with furnishing, delivery and installation of all equipment, wiring, programming, configuration, testing, training required by this Section, complete as shown on the applicable Contract Drawings and/or specified herein.
 - 1) This specification provides the requirements for the installation, programming, configuration, testing and maintenance of a complete analog addressable fire alarm system. This system shall include, but not be limited to:
 - a) Fire Alarm Control Panel (FACP)
 - (1) Modules as required.
 - b) Annunciator/keypad bus
 - c) Wiring
 - d) Conduit
 - e) Associated peripheral devices
 - f) Other relevant components and accessories required to provide a complete and operational analog addressable reporting Life Safety System.
- B. The fire alarm system shall be capable of providing, at a minimum, the following:
1. Fire Alarm Control Panel (FACP):
 - a. Integral Digital Alarm Communications Transmitter (DACT).
 - b. Network Interface capability via copper and/or fiber optic network.
 2. Analog addressable initiation devices.
 3. Analog addressable control modules.
 4. Notification appliances:
 - a. Compatible with combination horn/strobe two wire circuit.
 5. Notification Appliance Circuit (NAC) remote power supply.
 - a. Combination horn/strobe two wire circuit.
 - b. Built-in synchronization capabilities.
 6. Internet Protocol (IP) connectivity for remote access capability via LAN/WAN network.

- C. Any material and/or equipment necessary for the proper operation of the system, which is not specified or described herein, shall be deemed part of this Specification.
- D. Contractor shall offer code required fire alarm system inspection and maintenance contract.

1.02 QUALIFICATIONS

A. Equipment:

1. This specification is based on the equipment of manufacturer(s) who have been approved by the Owner and the Manufacturer(s) herein named shall be considered as meeting the requirements of this specification.
2. The equipment manufacturer shall be a United States manufacturer, who has been regularly engaged in the manufacture of fire alarm systems for at least thirty (30) years.
3. Equipment provided for this project shall be the product of Silent Knight. No substitutions shall be approved.
4. It is the Contractor's responsibility to meet the entire intent of these specifications. Deviations from the specified items shall be at the risk of the Contractor until the date of final acceptance by the Architect, Engineer and the Owner's representative. All costs for removal, relocation or replacement of a substituted item shall be at the risk of the Division 26 Contractor.
5. All equipment shall conform to applicable codes and ordinances.
6. All equipment shall be California State Fire Marshal (CSFM) listed.
7. All equipment shall bear the label of a Nationally Recognized Testing Laboratory (NRTL) such as Intertek Testing Services NA, Inc. (ITSNA - formerly ETL) or Underwriters Laboratories Inc. (UL) and be listed by their re-examination service.

B. System Supplier/Installer:

1. The system shall be provided and installed by a Silent Knight Certified Installer who is trained and certified by the Manufacturer in the proper installation, programming, configuration, testing, service and maintenance of the system.
2. Subsequent to a successful bid the System Supplier/Installer shall submit a qualification documentation package which shall include the following:
 - a. Underwriters Laboratories (UL) Listing indicating current status as a UL Listed Central Station Fire Service – Local Service (UUFX-L) installation company.
 - b. Evidence of current status as the Silent Knight Certified Installer.
 - c. Certificates indicating that a minimum of four (4) technicians have attended and completed all requirements and received certification from the manufacturer's installation and service school.
 - d. A list of twenty (20) completed projects of equal scope, with associated Owners Representative contact names and telephone numbers.
 - e. Evidence of current State of California Contractor's License, C-10.
 - f. Evidence of current State of California Alarm Company Operator License, ACO.
 - g. A minimum of four (4) National Institute for Certification in Engineering Technologies (NICET) certificates in "Fire Protection Engineering Technology – Fire Alarm Systems". NICET certificates shall include at a minimum (1) Level 3 and (2) Level 2.
3. Per California codes all individuals involved in the installation of the fire alarm system shall hold a valid State of California, Division of Apprenticeship Standards (DAS), Fire/Life Safety Technician Certification.
 - a. Evidence of DAS certification shall be provided immediately upon request at the project site.

4. The System Supplier/Installer shall show satisfactory evidence, upon request, that he maintains a fully equipped service organization capable of furnishing adequate inspection, service and maintenance of the system.
 - a. The System Supplier/Installer shall maintain at his facility the necessary spare parts in the proper proportion as recommended by the manufacturer to maintain and service the equipment being supplied.
5. The System Supplier/Installer shall be prepared to offer a service contract for the maintenance of the system beyond the warranty period.
6. The System Supplier/Installer shall be an established fire alarm systems contractor that has and currently maintains a locally run (within 100 miles of the job site) and operated business for at least twenty (20) years.
7. The System Supplier/Installer shall employ a minimum of four (4) Silent Knight factory trained technicians and a 24 hour emergency service department.
8. The System Supplier/Installer shall designate one person to act as the project manager having total responsibility for coordination, communications and project technical integrity. This project manager shall have a minimum of three (3) years experience as a supervisor and installer of the systems specified herein.

1.03 RELATED SPECIFICATIONS

- A. The conditions of the General Contract (General, Supplementary, and other Conditions) and the Division 1 - General Requirements specifications are hereby made a part of this Section.
 1. Section 26 05 00 – Common Work Results on Electrical
 2. Section 26 05 03 – Equipment Wiring Connections
 3. Section 26 05 19 – Low-Voltage Electrical Power Conductors and Cables
 4. Section 26 05 33 – Raceway and Boxes for Electrical Systems
 5. Section 26 27 16 – Electrical Cabinets and Enclosures
- B. Related Work by Others:
 1. Reference Part 3, sub-section 3.1B of this specification.

1.04 RELATED DOCUMENTS

- A. In the event of a conflict between this specification and the construction drawings this specification shall take precedence.

1.05 APPLICABLE CODES & STANDARDS

- A. 2010 Building Standards Administrative Code, Part 1, Title 24, California Code of Regulations
- B. 2010 California Building Code (CBC) Part 2, Title 24, California Code of Regulations (2009 International Building Code)
- C. 2010 California Electrical Code (CEC) Part 3, Title 24, California Code of Regulations (2008 National Electrical Code)
- D. 2010 California Mechanical Code (CMC) Part 4, Title 24, California Code of Regulations (2009 Uniform Mechanical Code)
- E. 2010 California Plumbing Code (CPC) Part 5, Title 24, California Code of Regulations (2009 Uniform Plumbing Code)

F. 2010 California Fire Code (CFC) Part 9, Title 24, California Code of Regulations (2009 International Fire Code)

G. NFPA Standards

1. The fire alarm system shall comply with the applicable provisions of the following current National Fire Protection Association (NFPA) standards:
 - a. NFPA 12 Carbon Dioxide Extinguishing Systems
 - b. NFPA 72, National Fire Alarm Code 2002
 - c. Central Station Fire Alarm Systems
 - d. Local Fire Alarm Systems
 - e. Auxiliary Fire Alarm Systems
 - f. Remote Station Fire Alarm Systems
 - g. Proprietary Fire Alarm Systems
 - h. NFPA 90A, Installation of Air Conditioning and Ventilating Systems
 - i. NFPA 101, Life Safety Code - Safety to Life from Fire in Buildings and Structures
 - j. NFPA 750 Water Mist Fire Protection Systems
 - k. NFPA 2001 clean Agent Fire Extinguishing Systems

H. ADA - Americans with Disabilities Act

I. CAC – California Administrative Code, Title 24

J. U.L. Standards

1. The system shall comply with the applicable provisions of the following U.L. Standards and Classifications:
 - a. UL 268, Smoke Detectors for Fire Alarm Signaling Systems
 - b. UL 464, Audible Signal Appliances
 - c. UL 521, Heat Detectors for Fire Protective Signaling Systems
 - d. UL 864, Control Units for Fire Protective Signaling Systems
 - e. UL 1481 Power Supplies for Fire Alarm Systems
 - f. UL 1971, Emergency Devices for the Hearing Impaired
 - g. UOJZ, Control Units, System
 - h. SYZV Control Units, Releasing Device
 - i. UOXX, Control Unit Accessories, System
 - j. SYSW Accessories, Releasing Device Service

1.06 SUBSTITUTIONS

A. The Fire Alarm System shall be Silent Knight. Substitutions shall be per Division 01.

1.07 SUBMITTALS

A. Within thirty-five (35) calendar days after the date of the award of the contract, the Contractor shall submit to the Architect for review, eight (8) copies of a complete Submittal Package. The Submittal Package shall consist of the following sections, with each section separated with index tabs.

1. Title Page:
 - a. Project Title
 - b. Project address

- c. Architect's name and address
 - d. Contractor's name and address
2. Index of Submittal Contents:
 - a. Each Section of the Submittal Package shall be numbered chronologically and shall be summarized in the Index.
 3. Certifications:
 - a. Index of Certification Section Contents
 - b. Valid State of California Contractors License
 - c. Manufacturer's Certifications
 - 1) Authorized Distributor
 - 2) Factory Trained Technician
 - d. UL (Underwriters Laboratories Inc.) Listing
 - e. NICET Certifications
 - f. California DAS, Fire/Life Safety Technician Certifications
 4. Project List:
 - a. A substantial list (minimum of 20) of completed projects equal in scope to that specified herein.
 - 1) Contact information shall be made available upon request.
 5. Product Data:
 - a. Index of Equipment Data Sheets
 - b. Manufacturer's Data Sheets including cable types
 - c. Applicable Listings and Approvals

PART 2 PRODUCTS

2.01 SYSTEM REQUIREMENTS

A. Basic Performance:

1. The fire detection and alarm system shall continually supervise and monitor the integrity of conductors: initiating device circuits (IDC); notification appliance circuits (NAC); and signaling line circuits (SLC); per the requirements of NFPA 72.
 - a. Loss of signal from any of these circuits will activate a trouble indication, both audible and visual, at the local FACP.
2. System shall be fully programmable and configurable on site to accommodate system expansions and facilitate changes in operation.
3. All software programs shall be stored in non-volatile programmable memory within the FACP.
 - a. Loss of primary and secondary power shall not erase the instructions stored in the memory.
 - b. System programming shall be password protected.
4. Alarm, supervisory and trouble signals from analog addressable devices shall be encoded onto NFPA Style 4 (Class B) signaling line circuits (SLC).
5. Initiation device circuits (IDC) shall be wired NFPA Style B (Class B)
6. Notification appliance circuits shall be wired NFPA Style Y (Class B).
7. A single ground or open on any system SLC, IDC or NAC shall not cause a system malfunction, loss of operating power or the ability to report an alarm.
8. Alarm signals arriving at the main FACP shall not be lost due to a power failure.

9. The system shall be provided with sufficient battery capacity to operate the entire system upon loss of 120 VAC power in a normal supervisory mode for a period of twenty four (24) hours with five (5) minutes of alarm indication at the end of this period. The system shall automatically transfer to the standby batteries upon power failure. All battery charging and recharging operations shall be automatic. Batteries, once discharged, shall recharge at a rate to provide a minimum of 70% capacity in twelve (12) hours.

B. System Functional Operation:

1. The actuation of any approved alarm initiating device shall automatically initiate the following functions:
 - a. Alarm LED on the FACP shall flash.
 - b. Local audible piezo electronic signal in the FACP shall sound.
 - c. The alarm condition description, including the type of point and the location within the protected premises, shall be displayed on the LCD display at the FACP and, where applicable, the remote annunciator(s).
 - d. System shall transmit the condition to an off-site supervising station. Supervising station shall be approved per 2007 CFC 907.2.3.5.
 - e. Printing and history storage equipment shall log the information associated with the condition, including the time and date of the alarm occurrence.
 - f. System output programs configured via control-by-event (CBE) programming to be activated by the particular point in alarm shall be executed, and the associated system output (alarm notification appliances and relays) shall be activated on either local outputs or points located on other network nodes.
2. The actuation of any approved supervisory alarm initiating device shall automatically initiate the following functions:
 - a. Supervisory LED on the FACP shall flash.
 - b. Local audible piezo electronic signal in the FACP shall sound.
 - c. The supervisory condition description, including the type of point and the location within the protected premises, shall be displayed on the LCD display at the FACP and, where applicable, the remote annunciator(s).
 - d. System shall transmit the condition to an off-site supervising station. Supervising station shall be approved per 2007 CFC 907.2.3.5.
 - e. Printing and history storage equipment shall log the information associated with the condition, including the time and date of the alarm occurrence.
 - f. System output programs configured via control-by-event (CBE) programming to be activated by the particular point in alarm shall be executed, and the associated system output (alarm notification appliances and relays) shall be activated on either local outputs or points located on other network nodes.
3. Whenever a trouble condition is detected and reported the FACP shall automatically initiate the following functions:
 - a. Trouble LED on the FACP shall flash.
 - b. Local audible piezo electronic signal in the FACP shall sound.
 - c. The trouble condition description, including the type of point and the location within the protected premises, shall be displayed on the LCD display at the FACP and, where applicable, the remote annunciator(s).
 - d. System shall transmit the condition to an off-site supervising station. Supervising station shall be approved per 2007 CFC 907.2.3.5.
 - e. Printing and history storage equipment shall log the information associated with the condition, including the time and date of the alarm occurrence.

- f. System output programs configured via control-by-event (CBE) programming to be activated by the particular point in alarm shall be executed, and the associated system output (alarm notification appliances and relays) shall be activated on either local outputs or points located on other network nodes.

C. Remote Monitoring Connection:

1. The fire alarm system shall be connected via Digital Alarm Communicator Transmitter (DACT) over telephone lines to a UL Listed Central Station Monitoring Company.
 - a. The fire alarm control panel shall provide an integral Digital Alarm Communicator Transmitter (DACT) for signaling to a UL Listed Central Station Monitoring Company. The DACT shall contain a "Dialer-Runaway" feature preventing unnecessary transmissions as the result of intermittent faults in the system and shall be Carrier Access Code (CAC) compliant, accepting up to 20-digit central station telephone numbers.
 - b. The fire alarm system shall transmit alarm, supervisory alarm and trouble signals with the alarms having priority over the trouble signal.

D. Internet Protocol (IP) Connectivity for Remote Access:

1. The system shall be capable of remote access via LAN/WAN network.
 - a. Remote access features and functions shall include the following:
 - 1) Perform programming of the main processor including all system features and functions noted elsewhere in this specification.
 - 2) The capability to perform system diagnostics and access integral system report software regarding the current system status.
 - b. External Device Server:
 - 1) Shall support RS-232, RS-422 and RS-485 serial connections
 - 2) Shall configure via HTTP, DHCP, Telnet or serial
 - 3) Shall be capable of Flash ROM upgrades
 - 4) Network Interface – (10Base-T or 10Base-T/100Base-TX) Ethernet
 - 5) Serial Interface – DB25F, RS-232/RS-422/RS-485 serial port with DCE configuration.
 - 6) Shall be capable of modem emulation and accept modem AT commands on the serial port to establish a network connection to the system.
2. The contractor shall provide all active electronics, software and peripheral equipment for a complete and operable system.
3. Systems not capable of remote access requirements of this specification will not be considered acceptable.

2.02 SYSTEM COMPONENTS

A. Fire Alarm Control Panel (FACP):

1. Silent Knight 5820XL.

B. Initiating Devices:

1. Addressable Sensors:
 - a. Analog Photoelectric Smoke Sensors:
 - 1) Silent Knight Model #SD505-APS.
 - a) California State Fire Marshal (CSFM) Listing No. 7270-0559:129

- b) Analog photoelectronic sensors shall have a low profile and be capable of being set at four sensitivity settings of: "LOW, LOW MEDIUM, MEDIUM, MEDIUM HIGH, and HIGH" levels.
- c) Automatic and manual functional sensitivity and performance tests shall be possible without the necessity of generating smoke. This method shall test all sensor circuitry and a "Failed Test" indication shall display for any failed test.
- d) Two LEDs providing 360-degree visibility of operating status and alarm indication shall be provided on each sensor. The LEDs shall pulse periodically indicating that the sensor is receiving power and communication is taking place. This feature shall be field programmable. Upon alarm, these LEDs shall light continuously. An alarm output shall be available for remote annunciation.
- e) The system shall check the sensitivity of each sensor periodically. If a sensor alarm threshold sensitivity has changed, due to aging and/or dust accumulation, the system shall automatically compensate for this change (drift compensation).
- f) Each sensor shall allow for the setting of two sensitivity levels. These levels may be programmed so that when the building is occupied, a sensor will be less sensitive than when the building is unoccupied. This feature permits sensors to be more reliable and at the same time reduces/minimizes unwanted alarms. This feature shall also provide for programmable weekend days, where the sensor will remain at an unoccupied sensitivity level.
- g) The sensor screen and cover assembly shall be removable for field cleaning.
- h) Each sensor shall be interchangeable via adapter and twistlock mounting base, to ensure matching the proper sensor to the potential hazards of the areas being protected. In all cases the system shall recognize when an improper sensor type has been installed in a previously programmed sensor type location.
- i) The sensor shall contain, in addition to the above, a 135o FT thermal sensor.

2. Conventional Detectors:

- a. Combination Fixed Temperature/Rate of Rise Heat Detectors:
 - 1) Silent Knight - Model No. SD505-AHS.
 - 2) California State Fire Marshal (CSFM) Listing No. 7270-0559:127..
 - 3) Combination fixed temperature and rate-of-rise thermal detectors.
 - 4) 194°F. temperature rating.
 - 5) Maximum UL spacing of 50' x 50' on 10' high ceiling.
 - 6) The detectors shall be installed where indicated on the plans.
- b. Addressable High Temperature Detector:
 - 1) Silent Knight Model No. IDP-HEAT-HT.
 - 2) California State Fire Marshal (CSFM) Listing No. 7272-0559:147
 - 3) Variable high temperature detector.
 - 4) Temperature detection at 135°F – 190°F.
 - 5) Shall be installed where indicated on plans.

C. Notification Devices:

- 1. Programmable Electronic Horn – Outdoor Weatherproof:
 - a. System Sensor Model No. H12-24K:
 - 1) California State Fire Marshal (CSFM) Listing No. 7135-1653:116.

- 2) Electronic horns shall operate on 24 VDC nominal.
 - 3) Shall be suitable for mounting on the wall.
 - 4) Shall be surface mounted.
 - 5) Finish shall be red.
 - 6) All exterior mounted horns shall be weatherproof.
2. Visual Strobe Appliance:
- a. System Sensor Model No. S2415/30/75/110:
 - 1) California State Fire Marshal (CSFM) Listing No. 7320-1653:183.
 - 2) Shall operate on 24 VDC nominal.
 - 3) Shall be single-candela rating devices.
 - a) Candela ratings shall be 15, 30, 75 or 110.
 - b) Intensity shall be as specified on the drawings.
 - 4) Shall meet the requirements of the ADA and UL 1971.
 - a) The maximum pulse duration shall be 2/10ths of one second.
 - b) The flash rate shall be one flash per every second.
 - 5) Finish shall be red.
3. Combination Audible/Visual Horn/Strobe Appliance – Indoor Wall Mount:
- a. System Sensor Model No. P2415/30/75/110:
 - 1) California State Fire Marshal (CSFM) Listing No. 7135-1653:147.
 - 2) Shall meet the requirements of Section 3 listed above for visibility.
 - 3) Audible (horn) and visual (strobe) devices shall operate on the same two wire circuit and shall be capable of audible silencing.
 - 4) Finish shall be red.
4. Ceiling mount devices shall be of the same manufacturer as the devices indicated above and shall be approved for the application required.

D. Accessory Equipment:

1. Notification Appliance Circuit (NAC) Remote Power Supply:
 - a. Silent Knight Model No. RPS 5496:
 - 1) California State Fire Marshal (CSFM) Listing No. 7170-0559:143.
 - 2) The Remote Power Supply is a device designed for use as either a remote 24 volt power supply or used to power Notification Appliances.
 - 3) The Remote Power Supply shall offer up to 8.0 amps of regulated 24-volt power. It shall include an integral charger designed to charge sealed lead-acid storage batteries and to support 60-hour standby.
 - 4) The Remote Power Supply input trigger shall be a Signaling Line Circuit from the fire alarm control panel. Four outputs shall be available for connection to the Notification devices. All four outputs shall be capable of accommodating both Class B and Class A Notification Appliance Circuits.
 - 5) The Remote Power Supply shall include the ability to delay the AC fail delay per 1993 NFPA requirements.
 - 6) The Remote Power Supply shall provide integral synchronization and shall be capable of accommodating Audible and Visual devices, combined on each individual Notification Appliance Circuit, with the capability of silencing of Audible devices while Visual Devices remain in operation.

2.03 CABLE/WIRE

- A. All fire alarm system cable and/or wire shall be run in conduit or raceways.

- B. Signaling Line Circuit (SLC) and Annunciator Data Cable:
1. Indoor dry location:
 - a. Belden Model No. 5220UJ or approved equal.
 - 1) California State Fire Marshal (CSFM) Listing No. 7161-0060:103.
 - 2) 16/2 conductor cable, FPL rated, non-plenum, complete with red PVC jacket.
 2. Outdoor wet location:
 - a. Burton Cable Model No. 18JE2-0 or approved equal
 - 1) California State Fire Marshal (CSFM) Listing No. 7161-1495:101.
 - 2) 16/2 conductor cable, FPL rated, complete with black underground/direct burial, sunlight resistant rated PVC jacket.
- C. Initiating Device Circuit (IDC), Notification Appliance Circuit (NAC) and 24 volt DC auxiliary power.
1. Speaker circuits:
 - a. Belden Model No. 5320FJ or approved equal.
 - 1) California State Fire Marshal (CSFM) Listing No. 7161-0060:103.
 - 2) 18/2 conductor cable, FPL rated, shielded, non-plenum, complete with red PVC jacket.
 2. All other locations:
 - a. #12 AWG THHN/THWN.
 - 1) California State Fire Marshal (CSFM) Listing not applicable.

PART 3 EXECUTION

3.01 DIVISION OF WORK

- A. All equipment shall be installed in strict accordance with the manufacturer's installation documentation. Any deviation shall require the Contractor to correct the installation without impact to the construction schedule and at no additional cost to the Owner.
- B. While all work included under this specification is the complete responsibility of the contractor, the division of actual work listed following shall occur.
1. All conduits with pull cords, all electrical pull boxes, grounding rods, all outlet boxes, terminal cabinets, backboards, etc., which form part of the rough-in work shall be provided and installed completely by the Division 26 Contractor. Coordinate as required for proper installation.
 2. The balance of the system, including installation of initiating devices, notification appliances, cabling and equipment, making all connections, etc., shall be performed by the System Supplier/Installer (reference Part 1, Section 1.2B of this specification).
 3. All 120VAC power conductors and conduits associated with power circuits to all low voltage system equipment locations shall be provided and installed by the Division 26 Contractor.
 4. An insulated stranded copper ground wire shall be provided from each equipment rack to the building grounding system, in compliance with CEC Article 250, by the Division 26 Contractor.
 5. Labeling of pullboxes and terminal cabinets shall be provided and installed by the Division 26 Contractor.

3.02 INSTALLATION

- A. All work shall be completed in strict accordance with all applicable codes and ordinances, by a Silent Knight Platinum Distributor.
1. Per California codes all individuals involved in the installation of the fire alarm system shall hold a valid State of California, Division of Apprenticeship Standards (DAS), Fire/Life Safety Technician Certification.
 - a. Evidence of DAS certification shall be provided immediately upon request at the project site.
 - 1) Failure to provide evidence of DAS certification shall mandate immediate removal of said individual from the project site.
- B. Cable/Wire:
1. All cable/wire for the fire alarm system shall be new, unless otherwise noted on plans.
 2. Raceways containing conductors serving the fire alarm system shall not contain any other conductors. No AC current carrying conductors shall be allowed in the same raceway with DC fire alarm system conductors.
 3. System cable/wire and equipment installation shall be in accordance with good engineering practices and in accordance with the California Electrical Code (CEC). All cable/wire shall test free from all grounds and shorts.
 4. All fire alarm system cable/wire shall be labeled at all points of termination. All labeling shall be based on the room numbers as provided by the Owner or his representative.
 5. Protection and Dressing of Cables:
 - a. Cables mounted on backboards and within equipment racks, etc., shall be grouped and securely attached to the backboard or enclosure in horizontal and vertical bundles in a neat workmanlike manner using Thomas & Betts "Ty-Rap", Panduit cable mounts and Allen-Tel cable management or equal. Edge protection material ("cat-track") shall be installed on edges of holes, lips of ducts or any other point where cables or harnesses cross metallic edge.
 6. Underground Cables:
 - a. Any cable/wire pulled through manholes or pullboxes located below grade shall be continuous with no splices. The cable/wire shall be intact with no cuts in the protective outer jacket.
 - b. Shall be approved for use in underground applications.

3.03 SYSTEM START-UP

- A. All start-up programming and system commissioning shall be performed by a Silent Knight Certified Installer.

3.04 SYSTEM VERIFICATION

- A. Subsequent to system start-up the system installer shall perform a pre-test to verify that the following features are functioning properly.
1. All notification appliances
 2. All initiation devices
 3. All control modules
 4. All monitor modules
 5. Communication link to monitoring service

3.05 ACCEPTANCE TESTING

- A. The system installer shall, in the presence of the Owner's representative and the Inspector of Record (IOR), perform 100% testing as noted in System Verification above.
- B. References:
 - 1. CFC 907.17 – Acceptance Tests and CFC 907.18 – Record of Completion.
 - 2. NFPA 72 Chapter 10 – Inspection Testing and Maintenance.

3.06 IN SERVICE TRAINING

- A. The Contractor shall instruct personnel designated by the Owner in the proper use, basic care and maintenance of the system beyond the warranty period. Contractor shall provide up to eight hours of in-service training with this system.

3.07 FACTORY TRAINING & CERTIFICATION

- A. The manufacturer shall provide factory certified training to two (2) technicians from the County. These technicians shall be trained and certified as manufacturers certified technicians capable of performing any work on the system after the installation of the system.
- B. All cost for training including travel, lodging, meals and per diem shall be included in the Fire Alarm Contractor's bid for this project.

3.08 CONTRACT CLOSE-OUT DOCUMENTATION

- A. Contractor shall provide the following:
 - 1. One reproducible hard copy of project record drawings.
 - 2. One copy of manufacturer's maintenance and operation manuals.
 - 3. One copy of system warranty

3.09 WARRANTY

- A. The Contractor shall warrant the equipment to be new and free from defects in material and workmanship, and will, within one year from the date of installation, repair or replace any equipment found to be defective. This warranty shall not apply to any equipment that has been subject to misuse, abuse, negligence or unauthorized modification.

3.10 MANUFACTURER'S FIELD SERVICES

- A. The contractor shall, at the owner's request, make available a service contract offering continuing factory authorized service of this system upon expiration of the initial warranty period.
- B. The system manufacturer shall maintain engineering and service departments capable of rendering advice regarding installation and final adjustment of the system.

END OF SECTION

SECTION 31 10 00

SITE CLEARING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. The Work of this Section includes all labor, materials, equipment and services necessary to complete all clearing and grubbing together with the removal and disposal of items, as shown on the drawings and as specified herein, complete.
 - 1. Remove all trees, plants and site materials that have been designated for demolition, after receiving approval from Owner's Representative.

1.02 SAFETY AND PROTECTION

- A. Traffic: Conduct demolition operations and removal of debris to ensure minimum interference with existing or Contractor installed temporary roads, streets and other adjacent occupied or used facilities. Do not close or obstruct streets without written permission from Owner. Provide temporary barricades, fences, canopies, railings and other safeguards to eliminate hazards to persons and property without interference to use of adjacent property, public rights-of-way, utilities and structures. Provide any signs or lights deemed necessary by the Owner.
- B. Dust: Prevent the spread of dust and flying particles. Sprinkle rubbish and debris with water and keep dust to minimum. Meet the requirements of the South Coast Air Quality Management District and applicable City, County, and State Laws.
- C. Fire Protection: Maintain adequate fire protection, including extinguishers and operative water hose lines during demolition.
- D. Materials and debris shall not be disposed of by burning at the demolition sites
- E. Explosives: The use of explosives is not permitted.
- F. Demolition operations shall be conducted in conformance with the applicable requirements of Article 31, Demolition, of the Construction Safety Orders of the Occupational Health and Safety.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.01 CLEARING AND GRUBBING

- A. Verify all trees and shrubs to be removed with Owner's Representative prior to starting any demolition work.

- B. Clearing: Fell trees, dispose of the trees and other vegetation designated for remove together with the downed timber, snags, brush and rubbish, occurring within the construction limits. All limbs, branches, and roots damaged during construction, together with those required to be trimmed, shall be neatly cut next to the bole of the tree or main branch or root under the direction of a certified Arborist.
- C. Grubbing: Remove and dispose of all stumps above grade, all matted roots and all roots larger than 3 inches in diameter to a depth of 12".
- D. Removal: All cleared and grubbed plants and construction debris shall be promptly removed completely away from the Project site. Do not store or permit materials to accumulate on the Project site.
 - 1. Do not burn materials or debris on the premises.
 - 2. Remove all debris from the Project site to a legal dumping area.

3.02 TREE AND TREE STUMP REMOVAL

- A. Trees and tree stumps designated for removal shall be removed to 2 feet below finish grade minimum.

END OF SECTION

SECTION 31 22 00**GRADING****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Work in this section includes, but is not necessarily limited to providing grading consisting of excavating and removing from the site unsuitable material; excavating; preparing areas to be filled; placing and compacting fill materials; and all other work necessary to conform with lines, grades, and slopes shown on the Drawings, as specified herein, and as needed for complete and proper excavation and grading operations.

1.02 REFERENCES

- A. Standards and Organization – Referenced American Society for Testing and Materials (ASTM) Standards
- B. Standard Specifications for Public Works Construction (Greenbook) latest Edition
- C. Caltrans Standard Plans Latest Edition
- D. California Manual on Uniform Traffic Control Devices (CA MUTCD, as amended for use in California) Latest Edition

1.03 DEFINITIONS

- A. Fill: Fill materials placed to raise the natural grade of the site or to backfill excavation.
- B. On-Site Material: Soil material which is obtained from the required excavation on the site.
- C. Imported Material: Soil material which is imported in from off-site areas.
- D. Select Material: On-site or imported material which is approved for use as structural fill.
- E. Subgrade: The uppermost surface of an excavation.
- F. Structures: Buildings, footings, foundations, retaining walls, tanks, mechanical and electrical appurtenances, or any other man-made stationary features constructed above or below ground surface.

1.04 QUALITY ASSURANCE

- A. Require continuous inspection for fill placement and compaction observations will be made by the Owner's Soil Engineer during the excavating, filling and compacting operations.
- B. Require continuous inspection for fill placement and compaction by Soil Engineer will make field density tests in accordance with ASTM D 1556-90. Density tests shall be made in the compacted materials below the surface where the surface is disturbed. When these tests indicate that the density of any layer of fill or portion thereof is below

the specified density, the particular layer or portions shall be reworked until the specified density has been obtained.

- C. Required inspection and testing will be paid for by the Owner.

1.05 SOILS REPORT

- A. A soils report for the project entitled, "Geotechnical Exploration Proposed Mead Valley Library" prepared by Leighton Consulting, Inc., and dated October 4, 2010 is available at the Architect's Office. The information is not intended as representations or warranties of the continuity of such conditions between soil borings. The Owner will not be responsible for interpretations or conclusions drawn there from. The data are made available for the convenience of the Contractor.
- B. Contractor shall examine aforementioned soils report and familiarize himself with its contents.
- C. Additional test borings and other exploratory operations may be made by Contractor at no cost to the Owner.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Provide approved borrow soil materials from off-site when sufficient approved soil materials are not available from excavations.
- B. Satisfactory Soil Materials: Excavated or imported soil material free of rock or gravel larger than 3-inches (50mm) in any dimension, debris, waste, frozen materials, vegetation and other deleterious matter; and suitable for fill as determined by the Soils Engineer.
- C. Backfill and Fill Materials: Satisfactory soil materials.
- D. Topsoil: Sandy loam material with 100% passing through a 1" sieve.
- E. Concrete: Structural concrete with a compressive strength of 2,000psi for fill to correct unauthorized excavation. Structural strength of 3,000psi for existing concrete hardscape areas impacted by the work.

PART 3 EXECUTION

3.01 STAKING AND GRADES

- A. Lay out work; establish necessary markers, benchmarks grading stakes, and other stakes as required.
- B. Existing and finish elevations are shown on the drawings, and unless inconsistencies therein are brought to the attention of the Engineer in writing prior to commencement of construction, the Contractor will be held responsible for the proper location and elevation of all work.

- C. The contractor shall replace all existing concrete within the trenched concrete areas from nearest existing score line to score line. This same requirement applies for existing Portland Cement Concrete slab removals.

3.02 PROTECTION OF EXISTING

- A. Protect shrubs, lawn, and other features remaining as portion of final landscape.
- B. Protect benchmarks, fences, roads, sidewalks, pavements, and curbs which are to remain.
- C. Protect above or below grade utilities which are to remain.
- D. Protect facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by demolition and construction operations.
- E. Repair or replace all damage.

3.03 PREPARATION

- A. Over-excavate areas to receive structures or pavement as by the soils report, bring to a near optimum moisture content, scarify and recompact to at least 90 percent relative compaction (ASTM D 1557-91) prior to refilling the excavation to grade with properly compacted fill.
 - 1. No clearing or grading operations shall be performed without the presence of the Soils Engineer.
 - 2. All areas to be graded shall be stripped of significant vegetation and other deleterious materials.
 - 3. The proposed building area shall be over-excavated per soils report and Soils engineer.
 - 4. Imported fill shall be inorganic, granular soils, free from rocks or lumps greater than three-inch maximum dimension. Sources for import fill shall be inspected and approved by the Soils Engineer prior to their use.

3.04 EXCAVATION

- A. Excavate for foundations, pits, trenches, footings, floor slabs, concrete walks, curbs, paving, to the lines and levels required, indicated, and specified herein, and provide shoring, bracing, cribbing, pumping, and planking required. The bottoms of trenches shall be level, tamped firm, clean and free from debris or foreign matter. Include the watering of footing trenches for settlement as may be directed by the Geotechnical Engineer. Keep excavations free from standing water at all times.
- B. Should excavations for footings, through error, be excavated to a greater depth than indicated or directed, such additional depth shall be filled with "lean-mix" concrete.
- C. Excavated earth material which is suitable for structural fill or backfill, as determined by the Soil Engineer, shall be conditioned for re-use and properly stockpiled for later filling and backfilling operations. Condition by spreading in layers not to exceed 6 inches, each lift brought to near optimum moisture content, and compacted to a relative compaction of at least 90 percent (ASTM D 1557-91). Remove and dispose of off site rocks and aggregate, exceeding 3 inches in the largest dimension, and deleterious material.

- D. Remove abandoned sewers, piping, and other utilities encountered in the progress of the excavation and plug the ends in an approved manner. Stage on-site connections to maintain continuous utility service conveyance.
- E. Immediately report to the Engineer, and authorities having jurisdiction, active sewers, water and gas pipes, electric power, light or telephone poles, conduits, or wires, and other active utility lines encountered, which conflict with the Work. Allow the Owner and proper authorities free access to take what measures they deem necessary to repair relocate or remove the obstruction as determined by the Engineer.

3.05 COMPACTED FILLS

A. Preparing Areas to be Filled:

1. Remove objectionable material from the surface upon which the fill is to be placed and remove or compact loose and porous soils to the depths specified. Plow or scarify the surface to depths specified.
2. After the foundation for the fill has been cleared, plowed or scarified, disc or blade until it is uniform and free from clods, bring to the proper moisture content and compact as specified for fill.

B. Placing, spreading, and Compacting Fill Material:

1. Place the fill material in layers that when compacted to not exceed 6 inches. Spread each layer evenly and thoroughly mix during the spreading to obtain uniformity of material in each layer.
2. Aerate the fill material when the moisture content is above that specified by the Soils Engineer, by blading, mixing or other satisfactory methods until the moisture content is as specified.
3. Add water to the fill material when the moisture content is below that specified by the Soils Engineer, until the moisture content is as specified.
4. Thoroughly compact each layer to the specified density after it has been placed, mixed and spread evenly. Accomplish compaction by sheepsfoot rollers, vibratory roller, multiple-wheel pneumatic-tired rollers or other types of acceptable compacting equipment. Use equipment of such design that it will be able to compact the fill to the specified density. Compaction shall be continuous over the entire area and the equipment shall make sufficient trips to insure that the desired density has been obtained throughout the entire fill.
5. Reshape the surface as indicated after the subgrade for the slabs on ground has been compacted and trenches backfilled, and prior to placement of under floor granular base. Eliminate high or low spots. Thoroughly compact the finish subgrade by rolling, vibrating and tamping to a uniform dense surface. Protect the subgrade from displacement by equipment or other operations.
6. Apply landscaping protection on graded slopes such as wildflower, jute mesh or other approved method.

3.06 TRENCHING AND BACKFILLING

- A. Backfill trenching within the pipe trench with structural fill meeting the requirements. Place backfill material in lift thickness appropriate to the type compaction equipment utilized and compact to a minimum degree of compaction of 90% by mechanical means. Utility trenches extending below 1:1 (horizontal: vertical) projection from the outer edge of

a foundation should be backfilled with lean concrete (3-sack) within the influence zone of the foundation.

- B. Place backfill in 8-inch layers, level and tamp in place. Jetting will not be permitted; excessive puddling will not be permitted. Compact all layers as specified herein.

3.07 PROTECTION OF WORK

- A. During construction properly grade excavated surfaces to provide positive drainage and prevent ponding of water. Do not permit water to accumulate in excavations. Control surface water to avoid damage to adjoining properties, or to finished work on the site. Take remedial measures to prevent erosion of freshly graded areas and slopes, until such time as permanent drainage and erosion control measures have been installed.
- B. Protect open excavations, trenches, and the like with fences, covers, and railings as required to maintain safe pedestrian and vehicular traffic passage. Prevent erosion of freshly graded areas during construction and until such time as permanent drainage and erosion control measures have been installed.
- C. After completion of grading and the Soils Engineer has finished his observations of the work, no further excavation or filling shall be done except under the observation of the Soils Engineer.

3.08 FINISH GRADING

- A. Fine grade to bring areas to required lines and grades. The subgrade elevation within the building area for slabs on grade (without a base course) shall be within 0.10 feet along a 10 foot straight edge.
- B. Slope finish grades to drain surface water away from buildings, walks, paving, and other structures. Generally, grade with uniform slope between points where elevations are given, or between such points and existing grades.

3.09 STORAGE OF SOIL MATERIALS

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

3.10 COMPLETION REQUIREMENTS

- A. Cleanup: Leave entire graded portions of the site "rake-clean" and ready to for utility and landscaping improvements. All other areas adjacent to existing hardscape improvements shall be broom swept, light pressure washed, and left clean with no visual evidence of construction operations.
- B. Disposal: Pick up and transport unsuitable, deleterious excess material and debris to an off- site legal disposal area.

END OF SECTION

SECTION 32 11 00

BASE COURSE

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Work in this section includes, but is not necessarily limited to Installation of base material and improvements as indicated, specified, and required.

1.02 REFERENCES

- A. Standards and Organization – Referenced American Society for Testing and Materials (ASTM) Standards
- B. Standard Specifications for Public Works Construction (Greenbook) Latest Edition
- C. Caltrans Standard Plans Latest Edition
- D. California Manual on Uniform Traffic Control Devices (CA MUTCD, as amended for use in California) Latest Edition

PART 2 PRODUCTS

2.01 MATERIALS

- A. Untreated Base Materials
 - 1. Crushed Aggregate Base.
 - 2. Water: Clean, fresh and potable.
- B. Materials generated on site shall not be used as a base course material.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Base material shall be inspected for gradation and material content prior to installation. The owner may choose to have additional tests performed by a geotechnical engineer, retained by the Owner, before installation.

3.02 INSTALLATION

- A. Install base course material in layers not exceeding 4 inches in thickness, unless required otherwise. Grade and compact to indicated levels or grades, cut and fill, water and roll until the surface is hard and true to line, grade and required section. Provide a relative compaction of at least 95 percent, unless otherwise required.
- B. Grade base course to elevations indicated on Drawings, ready to receive surfacing, in accordance with Section 30 22 00: Grading.

3.03 PROTECTION OF WORK

- A. Protect the Work of this section until Substantial Completion.

END OF SECTION

SECTION 32 12 00

FLEXIBLE PAVING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Work in this section includes, but is not necessarily limited to paving for playground, parking areas, areas, between buildings, synthetic track surfacing adjacent to planting and turf areas as indicated and related paved improvements as indicated, specified, and required.

1.02 REFERENCES

- A. Standards and Organization – Referenced American Society for Testing and Materials (ASTM) Standards
- B. Standard Specifications for Public Works Construction (Greenbook) Latest Edition
- C. Caltrans Standard Plans Latest Edition
- D. California Manual on Uniform Traffic Control Devices (CA MUTCD, as amended for use in California) Latest Edition

PART 2 PRODUCTS

2.01 MATERIALS

- A. Provide materials of the class, grade, or type indicated on the Drawings, conforming to relevant provisions of the Standard Specifications for Public Works Construction.

PART 3 EXECUTION

3.01 ON-SITE ASPHALT CONCRETE PAVEMENT WORK

- A. Thickness of Surfacing: Unless otherwise indicated on Drawings or specified, install bituminous surfacing to a compacted thickness of 2 inches.
- B. Provide surfacing material over base course as specified in Section 32 11 00: Base Course.
- C. Surfaces of walls, concrete, masonry, or existing bituminous surfacing indicated to be in direct contact with installed bituminous surfacing shall be cleaned, dried and uniformly coated with an asphaltic emulsion film.
- D. Thicken edges of bituminous surfacing that do not abut walls, concrete, or masonry, and edges joining existing bituminous surfaces. Remove headers at existing bituminous surfacing where new bituminous surfacing is to be installed. Thicken edges an additional 2 inches and taper to the indicated or specified thickness 6 inches back from such edges.

- E. Provide adequate protection for concrete, planting areas, and other finish Work adjacent to areas indicated to receive bituminous surfacing.
- F. Placement
1. Do not install bituminous surfacing when atmospheric temperature is below 40 degrees F; or when fog or other unsuitable weather conditions are present. Temperature of mixture at time of installation shall not be lower than 260 degrees F in warm weather or higher than 320 degrees F in cold weather.
 2. Where 2-inch or 3-inch thick surfacing is indicated or specified, install surfacing in one course. Where surfacing is indicated or specified 4 inches or more in thickness, except for thickened edges, install bituminous surfacing in courses of approximately equal thickness, each course not exceeding 2-1/2 inches in thickness unless otherwise required by the Architect.
- G. Spreading
1. Install bituminous surfacing in a manner to cause least possible handling of mixture. In open areas and wherever practicable, install by mechanical means with a self-propelled mechanical spreader. In confined or restricted areas, install mixture with hot shovels and rakes, and smooth with lutes.
- H. Rolling
1. Finish roll with a self-propelled tandem roller weighing at least 8 tons. Break down roll with a self-propelled roller weighing between 1-1/2 tons and 8 tons.
 2. Roll in a manner that preserves flow lines and the established finished grades. Break down roll in areas adjacent to flow lines parallel to flow lines. Break down roll after bituminous surfacing is installed without shoving or cracking of mixture under roller. Continue finish rolling until surfacing is unyielding, true to grade, and meets requirements for specified smoothness. Areas inaccessible to finish roller may be finish rolled with breakdown roller or tamped with hot tamping irons and smoothed with hot smoothing irons or hand roller.
 3. Where bituminous surfacing abuts concrete, masonry, walks or concrete paving, tamp joint smooth, if necessary, as described above to obtain a uniformly even joint, true to line and grade. Tamp and smooth to properly compact.
 4. Compacted bituminous surfacing shall be provided with a bulk specific gravity of at least 2.31 when tested in accordance with ASTM D 1188.

3.02 TOLERANCE

- A. Smoothness: Surface of bituminous surfacing after rolling, shall be even, smooth and uniform in texture with no voids or rock pockets, free of roller marks or other irregularities, and not varying by more than 0.03 foot, except at local depressions or raised areas as indicated, when a 10 foot straightedge is placed on surface.
- B. Grade: Finished grade shall not vary more than 0.02 foot above or below required grade. Variations within prescribed tolerance shall be compensating so that average grade and cross-section are provided.

3.03 FINISH

- A. Surface Sealing

1. Surface Preparation
 - a. Thoroughly wash surfaces with water to remove dirt, debris, excessive oil and grease, or other foreign matter.

2. Application
 - a. Install seal coat in strict accordance with manufacturer's written directions and recommendations.
 - b. Install 2 coats of surface seal to new bituminous surfacing. First coat shall be installed before flood testing. Clean surface and allow to dry before installing second coat. Second coat shall be installed after bituminous surfacing has passed flood test.
 - c. Where new bituminous surfacing is installed adjacent to existing bituminous surfacing, overlap surface seal a minimum of 12 inches onto existing bituminous surfacing.
 - d. Where existing bituminous surfacing is indicated to be patched and sealed, install 2 coats of surface seal after patching

3.04 PROTECTION OF SURFACES

- A. Protect sealed and unsealed surfaces from damage and traffic during performance of the Work of this section and until surface seal has thoroughly set and cured. Do not permit traffic of any kind for at least 24 hours after completion of installation.

- B. Protect the Work of this section until Substantial Completion.

END OF SECTION

SECTION 32 13 00**RIGID PAVING****PART 1 GENERAL**

1.01 SECTION INCLUDES

- A. Work in this section includes, but is not necessarily limited to concrete paving, driveway aprons, curbing/gutters, and related concrete improvements as indicated, specified, and required.

1.02 REFERENCES

- A. Standards and Organization – Referenced American Society for Testing and Materials (ASTM) Standards
- B. Standard Specifications for Public Works Construction (Greenbook) Latest Edition
- C. Caltrans Standard Plans Latest Edition
- D. California Manual on Uniform Traffic Control Devices (CA MUTCD, as amended for use in California) Latest Edition

PART 2 PRODUCTS

2.01 MATERIALS

- A. Concrete
 - 1. Portland cement.
 - 2. Aggregates from approved source to insure uniform quality and grading. Deliver so that moisture content variations will not decrease production of reasonably uniform concrete.
 - 3. Water: Clean, fresh and potable.
- B. Expansion and Control Joints
 - 1. Curbs and gutters: Asphalt impregnated fiber filler material, 1/2 inch thick.
 - 2. Control joints for concrete walks and exterior concrete pavement: As shown on site plan. Control joints shall be a formed joint. Tops of joints shall be installed flush with the concrete surface. Depth of joint shall be a minimum of 1/4 the thickness of slab. Use control joints on all curbs, curbs and gutters, and cross gutters at maximum intervals of 16 feet on center. Sawed joints may be used in lieu of the above, providing they are at least one inch deep.
- C. Concrete Wheel Stops
 - 1. Precast concrete using smooth metal forms, 2,000 psi concrete, with one No. 3 horizontal reinforcement bar; 6 inches high, sides battered, 6 inch top, 8 inch bottom, ends vertical, with edges rounded (3/4 inch radius).

- D. Striping and Markings
 - 1. Accessible parking spaces shall be marked in accordance with CBC Section 129B.5.
 - 2. Truncated Dome Tactile Warnings shall be in accordance with CBC Section 1133B.8.5.

PART 3 EXECUTION

3.01 ON-SITE CONCRETE WORK

- A. Construct all site concrete of 2,500psi concrete unless otherwise indicated or specified. Provide reinforcing bars or mesh where indicated. Form accurately to profiles shown, using wood, metal or plastic forms as approved. Place and handle concrete in manner that will avoid segregation of ingredients.
- B. Concrete Curbs: Provide 1/2" thick expansion joints at beginning and at end of curves, intersections, and 20-foot intervals between, set plumb, square, and to same profile as the curbs. Edge curb tops to 1/2" radius and vertical joints to 1/4" radius.
- C. Concrete Gutters: Provide 1/2" thick expansion joints as above for curbs.
- D. Combination Curb and Gutter: As above for curbs and gutters, including expansion joints.
- E. Concrete Walks: Provide 1/2" expansion joints as specified for curbs and where walks abut rigid structures, aligned with joints in curbs where adjoining.
- F. Control Joints: Provide for concrete walks and exterior concrete pavement as indicated. Install tops of the joints flush with the concrete surface and depth of joint a minimum of 1/4 the thickness of slab.

3.02 FINISH

- A. Walks and Pavement: Finish concrete as noted on drawings. Score walks and or pavement in direction and pattern indicated on drawings.
- B. Gutters: Light broom finish with 3 inch wide steel trowel finish at flow line.
- C. Curbs: Steel trowel finish, followed by fine hair brush finish.
- D. Ramps, Stair Tread and Landings: Medium broom finish on surfaces < 6% slope. Heavy broom finish on surfaces > 6% slopes.
- E. 'Smooth Finish' concrete means that the concrete is to be steel troweled to a smooth finish.

3.03 CURING

- A. Concrete work shall be properly cured and protected against injury and defacement of any nature during construction operations. If weather is hot or surface has dried out, spray surface with fine mist of water, starting not later than 2 hours after final troweling. Surface of finish shall be kept continuously wet for at least 10 days. Wetting is considered emergency work and shall be performed on weekends and holidays if necessary.

- B. In lieu of water curing, within 24 hours after finishing, the concrete may be cured with an approved clear liquid curing compound, applied in accordance with the manufacturer's recommendations.

3.04 FLOOD TEST

- A. All concrete gutters and concrete pavement shall be given a flood test. All concrete work, where water ponds and does not run off, shall be removed by the Contractor to the nearest score or joint line and replaced to provide proper drainage.

END OF SECTION

SECTION 32 84 00**IRRIGATION SYSTEM****PART 1 - GENERAL REQUIREMENTS****1.1 RELATED DOCUMENTS**

The provisions of the "Standard Specifications for Public Works Construction, (SSPWC)" latest edition, shall apply except as modified herein.

1.2 DESCRIPTION

- A. **Work Included:** Unless otherwise specified, the construction of irrigation systems shall include the furnishing, installing and testing of mains, laterals, risers and fittings, quick couplers, ball/gate valves, back flow preventers, furnishing and installing of irrigation controllers, booster pumps, excavation and backfill, protection or rerouting and maintenance of existing irrigation main lines and control wires that cross this phase area of work and are necessary to service other parts of the site, assuring existing irrigation systems to remain fully operational, and all other work in accordance with the plans and specifications for a complete operating system.
1. The intent of the drawings and specification is to indicate and specify a complete and efficient irrigation system ready for use in accordance with the manufacturer's recommendations and meeting the recommended approval of the Landscape Architect. All work shall be in accordance with applicable City and County codes, and these plans/specifications.
 2. Irrigation systems shall be constructed to the sizes and grades and at the location shown on the drawings. Lines shown on the plans are essentially diagrammatic. Locations of all heads, valves, etc., shall be reviewed by the Landscape Architect at the time of construction. Do not exceed spacing of the heads as shown on plans.
 3. The applicable provisions of the General Conditions and the Special Conditions of these specifications shall govern the work of this section as if herein written in full.
 4. The Contractor shall maintain, continuously, a competent superintendent or foreman, satisfactory to the Owner, during the progress of work, with authority to act for him in all matters pertaining to the work.
 5. Work noted as "N.I.C.", "existing" or "to be supplied and/or installed by others" is not a part of this section.
 6. The work in this section shall be coordinated with all underground utilities and trades responsible for their installation.
- B. **Field Conditions:** Verify drawing dimensions with actual field conditions. Inspect related work and adjacent surfaces. Report to the Landscape Architect all conditions which prevent proper execution of this work.
- C. **Permits and Fees:** The contractor shall apply and pay for all necessary fees and permits required in the pursuit of his work as required by governing codes.
- D. All assemblies specified herein shall be installed in accordance with the respective details. In the absence of detail drawings or specifications pertaining to the specific items required to complete the

work, the Contractor shall perform such work in accordance with the best standard practice and to the satisfaction of the Landscape Architect.

- E. Irrigation Contractor is responsible for replacing or repairing any acts of theft or vandalism during construction and the maintenance period.
- F. Permission to shut off any water lines must be obtained from the Owner. Disruption of existing systems shall be kept to a minimum.
- G. Contractor shall maintain irrigation system throughout plant establishment and maintenance period.
- H. Contractor shall provide one year guarantee.
- I. Contractor shall have foreman from plant establishment period train onsite staff in regards to equipment operation, watering schedules, fertilization schedule, and plant material care/ maintenance prior to turn over. Contractor is responsible for setting up the training session and to notify Landscape Architect as to date and time of the meeting.

1.3 RELATED WORK DESCRIBED ELSEWHERE

- A. Landscaping: Section 32 93 00

1.4 QUALITY ASSURANCE

- A. Codes and Standards: In addition to complying with all pertinent codes and regulations, comply with the latest rules of the National Electrical Code and the Electrical Safety Orders of the State of California, Division of Industrial Safety, for all electrical work and materials.
- B. Qualifications of Installers: 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 and the materials manufacturer's recommended methods of installation, and who shall direct all work performed under this Section.

1.5 SUBMITTALS

- A. General: Comply with the provisions of Section 01 33 00.
- B. Product Data: Within 45 days after award of the Contract, and before any materials of this Section have been delivered to the job site, submit to the Architect:
 1. A complete materials list of all items proposed to be furnished and installed under this Section.
 2. The manufacturer's recommended methods of installation which, when recommended for approval by the Architect, shall become the basis for review and accepting or rejecting actual installation methods used on the work when not otherwise specified or detailed.
- C. Materials and Samples: If materials are to be employed, other than designated on the plans, the Contractor shall, prior to the installation of any irrigation work, submit for recommended approval by the Landscape Architect, a list of materials and equipment he proposes to use. The material and equipment list shall include, but not be limited to, polyvinyl chloride pipe, automatic controllers and control valves, quick coupling valves and irrigation heads.

1. Should the Contractor propose to use materials or equipment other than those listed on the plans, he shall submit samples of the make and type proposed. Samples shall be submitted a sufficient time in advance of the start of construction to allow a period of not less than seven (7) days for testing and recommended approval.
 2. Recommended approval of irrigation equipment and materials shall depend on the following:
 - a. Conformance to specification requirements.
 - b. Acceptable test results and/or field performance.
 - c. Durability and low maintenance.
 - d. Availability of parts and service.
 - e. Compatibility with owner's materials inventories.
- D. Project Record Drawings: Provide separate and complete Project Record Drawings prepared in accordance with the provisions of these Specifications, Sub-section 3.9, following.

1.6 PRODUCT HANDLE

- A. Protection: Use all means necessary to protect the materials of this Section before, during, and after installation and to protect the work and materials of all other trades.
- B. Delivery: Polyvinyl chloride pipe shall be delivered to the work site in unbroken bundles or rolls packaged in such a manner as to provide adequate protection for the pipe ends, threaded or plain.
- C. Replacements: In the event of damage, immediately make all repairs and replacements necessary to the recommended approval of the Architect and at no additional cost to the Owner.

PART 2 - PRODUCTS

2.1 PIPE

- A. Plastic Pipe:
 1. Unless otherwise specified, the construction of lateral lines and main lines shall include excavation and backfill, the furnishing, installing and testing of pipe, tube and fittings, the furnishing and installing of anchors, thrust blocks and location wire, the improvements, line flushing and testing, and all other work in accordance with the plans and specifications.
 2. Main supply pressure lines shall be PVC; 4" and larger Class 200, 2" - 3" Class 315, 1 1/2" and smaller Schedule 40, as manufactured by JM Eagle, or approved equal.
 3. Lateral non-pressure lines shall be PVC. Schedule 200 polyvinyl chloride, as manufactured by JM Eagle, or approved equal.
 4. Irrigation Lines Sleeves shall be PVC. Schedule 40 polyvinyl chloride, as manufactured by JM Eagle, or approved equal.
 5. Low Voltage Control Wire Sleeves (valve wires) shall be PVC Schedule 40 polyvinyl chloride, as manufactured by JM Eagle, or approved equal. All exposed wires shall be sleeved in PVC Schedule 40 ULV electrical conduit with ULV Schedule 40 fittings.
 - a. Identification: All pipe shall be continuously and permanently marked with the following information: The normal pipe size, the type and schedule or class of material, the

working pressure or pressure rating at 73.4 degrees F., the manufacturer's name or trade mark, and the National Sanitation Foundation (N.S.F.) seal of approval.

6. All plastic pipe shall be guaranteed by its manufacturer to have passed, or be capable of passing, the Anhydrous Acetone Immersion Test and to be free from manufacturing defects.

B. Polyvinyl Chloride Pipe Fittings and Connections:

1. Polyvinyl chloride pipe fittings and connections approved for irrigation systems shall be polyvinyl chloride, Type II, Grade I, Schedule 40, high impact molded fittings, manufactured from virgin compounds.
2. The Schedule 40 fittings shall be tapered socket type, or molded thread type, suitable for either solvent weld or screwed connections.
3. Machine threaded fittings will be acceptable only if thread-stripping resistance test results are submitted and approved.
4. In line fittings, such as couplings, unions and bushings may be machined from extruded stock.
5. Plastic saddle and flange fittings will not be acceptable.
6. All fittings shall be permanently marked with the following information: The normal pipe size, the type and schedule of material, and the National Sanitation Foundation (N.S.F.) seal of approval.

C. Galvanized Pipe and Fittings:

1. All galvanized steel pipe shall be Schedule 40, threaded, coupled and hot-dip galvanized, and shall comply with ASTM A120 and A53.
2. All fittings for galvanized steel pipe shall be 150 PSI rated galvanized malleable iron, banded pattern.
3. Pipe sizes indicated on the drawings are nominal inside diameter unless otherwise noted.

2.2 VALVES

A. Gate Valves:

1. All gate valves shall be all bronze construction full port; 1/2" thru 2", Nibco T113.
2. Working Pressure Rated: 200 PSI non rising stem, screw in bonnet, solid wedge.
3. Gate valves installed underground shall be housed in a Christy plastic box.

B. Automatic Control Valves (Electric):

1. All automatic control valves (electric) shall be as called for on plans, electrically controlled, hydraulically operated, single seat, normally closed no equivalents or equals.
2. The valves shall be actuated by a normally closed solenoid valve operator using 24 volts, 60 cycle alternating current. The wires in the coil of the solenoid shall be embedded in an epoxy resin. The entire solenoid shall be enclosed in Spears dry splice DS-400 water proof connectors. Valves shall automatically close in event of electrical power failure.
3. All automatic control valves shall have a flow control device for manually adjusting the amount of flow of water through the valve. The flow control device shall be adjusted so that the pressure at the nozzle of the irrigation head farthest from the automatic control valve shall be that as specified in the irrigation legend per plan. The pressure at the irrigation head shall be measured by means of a pilot pressure gauge while the irrigation head is operating.

4. Automatic control valves shall be constructed of brass or stainless steel springs and screens, and composition material (neoprene) seals and seat washers.
5. Valve stems shall have a manual handle.
6. All automatic control valves shall be equipped with an petcock valve for manual operation control.
7. The Contractor shall furnish one valve box key for each six or less valve boxes installed.
8. All valves shall have a T.C. Christie valve marking plastic tag.
9. Approved Manufacturers: Hunter, Rainbird

2.3 QUICK COUPLERS

- A. Quick couplers shall be as called out for on plans.
- B. Approved Manufacturer: Rainbird

2.4 CONTROLLERS AND WIRE

- A. Automatic Controllers (Electric):
 1. Controller shall as called for on plans.
 2. All automatic controllers treated in this specification shall be for use with solenoid operated (24-volt electric), normally closed, control valves.
 3. Automatic controllers shall meet the following requirements:
 - a. Be completely automatic in operation with remote control.
 - b. Shall electrically start the sprinkling cycle.
 - c. Shall electrically time the individual stations.
 - d. Shall operate on single phase, 120 volt, 60 cycle, and alternating current.
 - e. Shall contain electrical circuits for pump and master valve operations.
 - f. Shall have complete operating instructions and charts indicating controller station to valve locations mounted inside the controller in full view when controller is open.
 - g. Smart irrigation controller which automatically adjusts frequency and/or duration of irrigation events in response to changing weather conditions.
- B. Control Wire:
 1. All control wire shall be of the Underwriter's Laboratory type UF (underground feeder), single conductor, solid copper, plastic insulated, 600 volt rated, for direct burial applications. Maximum conductor operating temperature, 60 degrees C. for both wet and dry locations. Wire composition is as follows:
 - a. Conductor - The conductors shall be solid annealed uncoated copper meeting the applicable requirements of the latest revisions of A.S.T.M. B-3.
 - b. Insulation - The insulation shall be colored plastic which meets the test requirements of I.P.C.E.A. (The Insulated Power Cable Engineer's Association) Pub. No. S-61-402, dated July 1961, Section 3.7 for 60 degrees C. polyvinyl chloride insulation. The insulation shall be flame retardant, resistant to fungus, resistant to corrosive fumes, suitable for wet locations and furnish some degree of inherent protections against

mechanical abuse. Insulation thickness shall be 47 mils for AWG #14, 12 & 10, and 62 mils for AWG #8.

c. Color Coding - The conductor insulation shall be color coded as follows:

- 1) All common ground wire shall be white.
- 2) All pilot (valve control) wire shall be black.

2.5 VALVE BOXES

A. Valve Boxes: Remote control valve boxes shall be rectangular plastic boxes with non-hinged locking covers. Valve station number shall be heat branded in two-inch-high (2") numerals on cover. Gate valve boxes shall be round plastic boxes with non-hinged covers marked by heat branding either "Gate Valve" or "G. V." on cover.

2.6 SPRINKLER/BUBBLER HEADS

A. Sprinkler/Bubbler Heads:

1. Sprinkler/Bubbler heads shall be as called for on plans. Sprinkler/Bubbler heads shall be of the types and sizes, with the diameter (or radius) of throw, pressure, discharge and any other designations necessary to determine the types and sizes, as indicated on the plans.
2. All sprinkler/bubbler heads of a particular type of function in the system shall be of the same manufacturer and shall be marked with the manufacturer's name and model number. This identification shall be visible without having to remove the sprinkler/bubbler head from the system.
3. Unless otherwise specified, all irrigation heads & body shall be constructed of cyclac with the following exceptions: bearings, washers, gaskets, seals, spray pins and rocker arms.

2.7 DRIP IRRIGATION SPECIALTIES

- A. All drip irrigation equipment shall be as called out for on plans.
- B. Approved manufacturer: Rainbird, KISS

PART 3 - EXECUTION

3.1 SURFACE CONDITIONS

A. Inspection:

1. 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.
2. Verify that irrigation system may be installed in strict accordance with all pertinent codes and regulations, the original design, the reference standards and the manufacturer's recommendations.

B. Discrepancies:

1. In the event of discrepancy, immediately notify the Landscape Architect.

2. Do not proceed with installation in areas of discrepancy until all such discrepancies have been fully resolved.

3.2 FIELD MEASUREMENTS

A. General:

1. Trenches and other excavations for irrigation pipe and appurtenances shall be excavated true to alignment and grade, and shall be of ample size for the proper performance of installation work, review, testing and backfill.
2. Where it is necessary to excavate adjacent to existing trees, the Contractor shall use all possible care to avoid injury to trees and tree roots.
3. Protect all existing utilities and repair any damage to existing utilities with matching new materials, at no increase in contract price.
4. Generally, piping under concrete shall be installed by jacking, boring or hydraulic driving. Where any cutting or breaking of sidewalks and/or concrete work is necessary, it shall be removed and replaced by the Contractor. Permission to cut or break sidewalks and/or concrete shall be obtained from the Architect. No hydraulic driving will be permitted under asphaltic concrete paving.
5. Coordinate with planting operations, as 10" deep cross-ripping is required prior to irrigation systems installation. (cross-ripping is part of the planting work).

B. Plastic Pipe Trenches:

1. Minimum trench width shall be six (6) inches.
2. Minimum trench depth below bottom of pipe shall be two (2) inches.
3. Minimum cover shall be based on finished grades, unless otherwise noted on Drawings.
 - a. Lateral Line minimum cover shall be twelve (12) inches.
 - b. Main Line minimum cover shall be eighteen (18) inches.
 - c. Pipe and Wire Sleeves minimum cover shall be twenty-four (24) inches.

C. Backfill Material:

1. All plastic pipe shall be bedded and encased with approved backfill material free of rocks and clods as indicated in the following table and/or shown on the plans.
 - a. Thickness Under Pipe Minimum Two (2) inches
 - b. Thickness Above Pipe Minimum Four (4) inches
 - c. Thickness at Side of Pipe Minimum Two (2) inches
2. The balance of backfill material shall be approved soil. Unsuitable material, including clods and rocks over 2 to 2-1/2 inches in size, shall be removed from the premises and disposed of legally at no cost to the Owner.
3. Backfill material shall be sufficiently compacted under and on each side of the pipe to provide support free of voids. On slope areas over 3:1 gradient compaction shall be 85% (min) or equal to the requirements of the grading plans, whichever is greater. Pipe joints shall remain exposed until the completion of pressure and leakage test, unless authorized by the Architect. The top six (6) inches of backfill shall be free of rocks over one (1) inch, subsoil, rubbish and debris.
4. The remainder of the backfill material shall contain no lumps or rocks larger than two and one-half (2-1/2) inches, nor contain rubbish and debris.

5. Backfill shall be tamped or puddled to the dry density of adjacent soil. Backfill within areas of structurally compacted soils shall be returned to the original relative density as before trenching.

D. Location Wire:

1. Location wire shall be placed on top of the four-inch select backfill over all mainline (pressure bearing) pipes, except copper pipe. Wire shall be No. 12 gauge copper, new or used or an approved substitute, and shall provide a continuous electrical conductor between gate valves and control valves. Each end shall be brought to the valve sleeve and two feet of wire looped free in the trench beside the valve body. This location wire may be omitted where copper hydraulic control tubing or electric control wire follows the water main.

3.3 INSTALLATION OF POLYVINYL CHLORIDE PIPE

- A. Polyvinyl chloride pipe shall be installed in such a manner so as to provide for expansion and contraction as recommended by the manufacturer.
- B. All polyvinyl chloride pipe shall lay free in the trench with no induced strain. Where there is evidence of induced pipe strain, the Contractor shall be required to make pipe cuts and install angle fittings as necessary to eliminate the strain.
- C. When a connection is plastic to metal, a female adapter shall be used. The metal nipple shall be hand-tightened, plus one turn with a strap wrench. Joint compound shall be Permatex, Type 2, or Teflon Tape.
- D. The Contractor will be required to remove and replace any fitting which induces a torque strain to the pipe.
- E. Polyvinyl chloride pipe shall be cut with a PVC pipe cutter, hand saw or hack saw with the assistance of a square and sawing vise or in a manner so as to ensure square ends. Burrs at cut ends shall be removed prior to installation so that a smooth unobstructed flow will be obtained.
- F. All plastic to plastic joints shall be solvent-weld joints. Only the solvent recommended by the pipe manufacturer shall be used.
- G. The solvent-weld joints shall be made in the following manner:
 1. Thoroughly clean the mating pipe and fitting with a clean dry cloth.
 2. Try the parts for fit. The parts should "dry-mate" between one-third and two-thirds the depth of the socket. If adequate insertion is not obtained, or bottoming occurs, try another part until a satisfactory "dry-fit" is obtained.
 3. Apply a uniform coat of solvent to the outside of the pipe with a non-synthetic bristle brush.

NOTE: For PVC, Type I, 1120-1220, pipe mating surface shall first be cleaned with the application of Methyl Isobutyl Ketone (MIBK) solvent. This cleaning shall be accomplished by applying MIBK solvent to the full mating surface area and wiping off with a clean cloth, repeating the process, if necessary, until no trace of shine remains (neither streaks nor spots). The use of commercial PVC solvent-cement thinners as a substitute of MIBK is not allowed.
 4. Apply a uniform coat of solvent-weld to the fitting socket.
 5. Re-apply a light coat of solvent-weld to the pipe and quickly insert it into the fitting.

6. Give the pipe or fitting a quarter turn to ensure even distribution of the solvents and make sure that the pipe is inserted to the full depth of the fitting socket.
7. Hold in position for at least 15 seconds.
8. Wipe off excess solvent that appears at the outer shoulder of the fitting.

3.4 INSTALLATION OF CONTROL WIRE

- A. Unless otherwise specified, the installation of control wire shall include excavation and backfill, the furnishing, installing and testing of the wires, the removal and/or restoration of existing improvements and all other work in accordance with the plans and specifications.
- B. Unless otherwise specified all neutral (common ground) wire shall be AWG #12 and all pilot (valve control) wire shall be AWG #14.
- C. At least one spare wire shall be installed from the controller clock to the most distant valve. When wire runs go in different directions from the controller clock, a separate spare wire shall be installed from the controller clock to the most distant valve in each different wire run direction.
- D. Tape and bundle all control wires at 10' o/c maximum; place wiring with 18" minimum cover. When wiring is placed in common trenches with piping, set wiring 2" from any piping.
- E. All wire splicing shall take place in the valve boxes and/or pull boxes. All splices shall be made with a mechanical connector encased in a self-curing epoxy resin which provides a permanent watertight connection.
- F. All direct burial control wires shall be identified as to their respective valve number and controller clock letter in all pull boxes and at all wire termination. Spare wires and "future valve" wires, if any, shall also be identified. Labels and tags shall be used for identification which are not affected by moisture or temperatures between minus 30 degrees F. and plus 200 degrees F. The labels and tags shall be resistant to abrasion, dirt, grease, and chemicals used in lawn fertilizers and conditioners. The labels and tags shall be firmly attached to the wire in every case. The Contractor shall submit samples of the labels or tags to be used, to the Architect for recommended approval, prior to the installation of the control wire. Examples of nomenclature of tags or labels are as follows:
 1. Neutral (common ground) wire = "Neutral" Clock "A"
 2. Pilot (valve control) wire = "A.V. #1." Clock "A"
 3. Spare Wire = "Spare" Clock "A"
- G. The final operating sequence of the remote control valves, within each individual controller clock, shall be as called out on drawings.
- H. Testing:
 1. All direct burial control wire installed shall be tested in the following manner.
 - a. Before any backfill material is placed over the control wires in the trench, the wires shall be tested with a meter for insulation resistance. Minimum insulation resistance to ground shall be fifty (50) megohms. Any conductor not meeting this requirement shall be replaced.
 - b. After backfill encasement, the wires shall again be tested with a meter. The minimum acceptable insulation resistance to ground on this test shall be one (1) megohm. Any conductor not meeting this requirement shall be replaced.
 2. Provide separate common wire for each controller installed.

3.5 INSTALLATION OF VALVES

- A. General: Unless otherwise specified, the installation of the valves shall include excavation and backfill, the furnishing, installing and testing of risers, fittings and valves, the furnishing and installing of appurtenances, accessories, anchors and thrust blocks, the removal and/or restoration of existing improvements and all other work in accordance with the plans and specifications.
- B. Gate Valves: Valves installed underground shall be housed in a Christy plastic valve box, no equivalents or equals.
- C. Automatic Control Valves: Automatic control valves shall be set upright and housed in Christy plastic valve box. The Contractor shall brand, the identification number of the valve and controller the outside cover of the box. Per 2.5- Valve Box section.

3.6 INSTALLATION OF AUTOMATIC CONTROLLERS

- A. Unless otherwise specified, the installation of automatic controllers shall include the furnishing, the installing, making necessary electrical connections, the testing of controllers and connection, and all other work as called for on the plans and/or in the specifications.
- B. All electrical conduit shall be P.V.C. Sunstop ULV Schedule 40 pipe & fittings.
- C. Install controllers at 5' min. away from 3 phase power.
- D. Unless otherwise specified the installation of controllers shall be as detailed on plan.
- E. Controllers shall be tested for fourteen (14) calendar days after complete installation of the irrigation system. System shall operate automatically in the manner shown on the drawings and/or specified herein.

3.7 INSTALLATION OF IRRIGATION HEADS

- A. Unless otherwise specified, the installation of irrigation heads shall include excavation and backfill, the furnishing, installing and testing of risers, fittings and heads, the furnishing and installing of anchors and thrust blocks, the furnishing and installing of cone shaped screens at base of each head, the removal and/or restoration of existing improvements and all other work shall be in accordance with the plans and specifications.
- B. Flushing: All water lines shall be thoroughly out before heads are installed.
- C. Location and arc of heads shall be adjusted, if required to eliminate any dry spots, over water or spillage on adjacent areas.
- D. All shrubbery heads to be installed within three (3) feet of curbs shall be set to a maximum height of six (6) inches above the grade of the curb. Shrubby heads installed in all other areas shall be twelve (12) inches above finished grades unless otherwise indicated on the plans. Pop-up shrub heads shall be installed as detailed.

3.8 DRIP IRRIGATION SPECIALTY INSTALLATION

- A. Install freestanding emitters on poly flex tubing riser to mounting height indicated.

- B. Install application pressure regulators in piping near device being protected, and in control-valve boxes.
- C. Install air/vacuum relief valves and flush valves in piping, and in control-valve boxes.

3.9 DRAWINGS OF RECORD AND TURNOVER ITEMS

- A. Record Drawings: The Contractor shall provide and keep up to date, a complete full size set of prints which shall be corrected daily and show every change from the original drawings and specifications and the exact locations, sizes and kinds of equipment. Prints for this purpose may be obtained from the Owner. This set of drawings shall be kept on the site and shall be used only as a record set.
- B. The drawings shall also serve as work progress sheets, and the contractor shall make neat and legible annotations thereon daily as the work proceeds, showing the work as actually installed. These drawings shall be available at all times for inspections and shall be kept in a location designated by the Owner.
- C. In order to complete the record drawings in a neat, legible manner, the contractor shall employ a competent draftsman, satisfactory to the Owner's authorize representative, to indicate the necessary changes on CAD drawings procured from the Owner and deliver same to the Owner two weeks prior to the final review by the Architect.
- D. The contractor shall dimension from two (2) permanent points of reference, building corners, sidewalks, or road intersections, etc., the location of the following items:
 1. The routing of the irrigation main lines
 2. Connections to the existing water lines
 3. Control valves and Butterfly valves
 4. Hose Bibs
 5. Any other pertinent underground item, if so deemed by the Landscape Architect.
- E. Controller Charts:
 1. Provide one controller chart for each controller supplied.
 2. Record drawings shall be recommended for approval by the Landscape Architect before charts are prepared.
 3. These charts shall be completed and reviewed prior to final observation of the irrigation system, and prior to final payment.
 4. Update and prepare new controller charts at end of the 1 year maintenance period.
 5. The chart shall show the area controlled by automatic controller and shall be no larger than the 24" x 36" original.
 6. The chart is to be a reduced drawing of the actual system. However, the chart shall only be reduced to a size which is completely legible.
 7. Chart shall be black line print and shall be colored with a different color for each station.
 8. The chart shall be mounted using Velcro, or an approved equal type of tape.
 9. When completed and recommended for approval, the chart shall be hermetically sealed between two pieces of plastic, each piece being a minimum 20 mils thick.
- F. Turnover Items

1. Supply as part of this contract the following items:
 - a. Four (4) additional sprinkler and bubbler heads of each type and spray pattern shown on plans.
 - b. Two (2) wrenches for disassembly and adjustment of each type of sprinkler and bubbler head shown on plans.
 - c. Two (2) keys for each automatic controller.
 - d. Two (2) quick couplers with a 3/4" bronze hose bib, bent nose type with hand wheel and two (2) quick coupler keys to match quick couplers shown on plan.
 - e. Two (2) valve box cover keys or wrenches.
 - f. One (1) 5-foot tee wrench for operating butterfly valves 3 inches or larger.
 - g. Backflow device valve handles and Water Department inspection documentation.
 - h. Ten (10) drip emitters of each type and (10) poly flex risers.

3.10 TESTS

A. Pressure Tests:

1. All pressure lines shall be tested under hydrostatic pressure of 125 pounds per square inch, and all non-pressure lines shall be tested under the existing static pressure and both be proved watertight. Contractor shall provide all equipment for hydrostatic tests at no cost to the Owner.
2. Pressure shall be sustained in the lines for not less than two (2) hours. If leaks develop, the joints shall be replaced and the test repeated until the entire system is proved watertight.
3. Tests shall be observed and recommended for approval by the Landscape Architect prior to backfill.

B. Coverage Test:

1. When the irrigation system is completed, the Contractor, in the presence of the Architect, shall perform a test coverage of water afforded the planting areas, complete and adequate. The Contractor shall furnish all materials and perform all work required to correct any inadequacies of coverage disclosed arising from his work.
2. Contractor shall inform the Owner's representative of any deviation from the plan required due to wind, planting, soil or site conditions that bear on proper coverage; and upon approval, perform changes to provide for proper coverage at no additional cost to the Owner.

3.11 REVIEWS

A. Normal Progress Reviews: Normal progress reviews shall be requested from the Architect at least 48 hours in advance of any anticipated review. A review will be made by the Architect on each of the steps listed below. The Contractor will not be permitted to initiate the succeeding steps of work until he has received written approval to proceed by the inspector.

1. Immediately prior to the commencement of the work of the section.
2. Irrigation materials and equipment to be used.
3. After trenching and before backfill.
4. Completion of line testing, test to be made prior to backfill.
5. After placement of all heads, bubblers, emitters, valves and controllers for coverage.
6. Final review and receipt of "Record Drawings"/"Controller Charts".

7. Contractor shall have foreman from plant establishment period train onsite staff in regards to equipment operation, watering schedules, fertilization schedule, and plant material care/maintenance prior to turn over. Contractor is responsible for setting up the training session and to notify Landscape Architect as to date and time of the meeting.
8. Final acceptance of project by Owner.
9. In no event shall the Contractor cover up or otherwise remove from view any work under this contract without prior approval. Any work covered prior to review shall be opened to view by the Contractor, at his expense.

B. Unprepared Review Requests: In the event the Contractor requests review of work and said work is incomplete, the Contractor shall be responsible for review cost.

C. Completion: The work will be accepted, in writing, when the whole shall have been completed satisfactorily to the Owner and the Architect. In judging the work, no allowance for deviation from the original plans and specifications will be made unless already approved by Owner, in writing, at the proper times.

1. Leave the entire installation in complete operating order, free from any and all defects in material, workmanship or finish, regardless of any discrepancies and/or omissions in plans or specifications.
2. Remove from the site all debris and rubbish resulting from the work, and leave the installation in clean condition.

3.12 GUARANTEE

A. General: The entire irrigation system, including all work done under this contract, shall be guaranteed against all defects and fault of material and workmanship for a period of one (1) year following the filing of the Notice of Completion. All materials used shall carry a manufacturer's guarantee of one (1) year.

Should any problem with the irrigation system be discovered within the guarantee period, it shall be corrected by the Contractor at no additional expense to the Owner within ten (10) calendar days of receipt of written notice from the Owner. When the nature of the repairs as determined by the Owner constitute an emergency (e.g. broken pressure line) the Owner may proceed to make repairs at the Contractor's expense. Any and all damages to existing improvement resulting either from faulty materials or workmanship, or from the necessary repairs to correct same, shall be repaired to the satisfaction of the Owner by the Contractor, all at no additional cost to the Owner.

B. Form of Guarantee: Guarantee shall be submitted on Contractors own letterhead as follows:

FORM OF GUARANTEE FOR IRRIGATION SYSTEM

We hereby guarantee that the irrigation system we have furnished and installed is free from defects in materials and workmanship, and the work has been completed in accordance with the drawings and specifications, ordinary wear and tear and unusual abuse, or neglect excepted. We agree to repair or replace any defects in materials or workmanship which may develop during the period of one year from date of filing of the Notice of Completion and also the repair or replace any damage resulting from the repairing or replacing of such defects at no additional cost to the Owner. We shall make such repairs or replacements within 10 calendar days following written notification by the Owner. In the event of our failure to make such repairs or replacements within the time specified after receipt of written notice from the Owner, we authorize the Owner to proceed to have said repairs or replacements made at our expense and we will pay the costs and charges therefore upon demand.

PROJECT: _____
LOCATION: _____
SIGNED: _____
ADDRESS: _____

PHONE: _____

- C. After the system has been completed, the Contractor shall instruct the Owner's Representative in the operation and maintenance of the system and shall furnish a complete set of operating instructions.
- D. Any setting of trenches which may occur during the one-year period following acceptance shall be repaired to Owner's satisfaction by the Contractor without any additional expense to the Owner. Repairs shall include the complete restoration of all damage to planting, paving or other improvements of any kind as a result of the work.

3.13 MAINTENANCE

- A. Maintenance of irrigation system prior to job completion, and during the Landscape Maintenance period, shall be the responsibility of the Contractor including, but not limited to, the following:
 - 1. Cleaning of plugged irrigation heads.
 - 2. Irrigation heads adjustments.
 - 3. Volume of water being applied (coordinate with landscape maintenance.)
 - 4. Programming of the controller (coordinate with landscape maintenance.)
 - 5. Repairing leaking valves, etc.
 - 6. Any other problem areas which occur after installation attributed to the irrigation system.
 - 7. Repair or replace equipment due to acts of vandalism, theft or pest damage.
 - 8. Lower all seeded area heads to final grades prior to final acceptance by Owner.

3.14 PAYMENT TERMS

- A. Payment for irrigation work will be at the lump sum price bid for irrigation. Payment shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work in irrigation as herein specified. A 10% retention shall apply to all irrigation work.

END OF SECTION

SECTION 32 93 00
LANDSCAPE PLANTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

The provisions of the "**Standard Specifications for Public Works Construction, (SSPWC)**" latest edition, shall apply except as modified herein.

1.2 SCOPE

- A. Work of this Section includes all material, equipment, and labor necessary for and incidental to completing all Landscape Planting work as indicated on the Drawings, or as reasonably implied, or as designated herein, including, but not limited to, the following.
1. Soil testing approvals.
 2. Weed abatement.
 3. Soil preparation.
 4. Finish grading.
 5. Preparation of all planting holes.
 6. Furnishing and installation of all plant materials unless otherwise noted.
 7. Furnishing and installation of all required fertilizers, planting backfill materials, top
 8. Dressing and miscellaneous materials.
 9. Staking and tying trees.
 10. Providing plant establishment (30 days).
 11. Providing landscape maintenance (90 days after 1st mowing).
 12. Clean-up and weeding of all landscape areas.
 13. One year guarantee.
 14. Provide landscape maintenance training to site's permanent onsite landscape maintenance crew.

1.3 RELATED WORK SPECIFIED ELSEWHERE

- A. Irrigation system: Section 32 84 00

1.4 QUALITY ASSURANCE

- A. The Contractor shall provide at least one person who shall be present at all times during execution of this portion of the work, who shall be thoroughly familiar with the type of materials being installed and the proper materials and methods for their installation, and who shall direct all work performed under this Section.

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- B. All plants and planting material shall meet or exceed the specifications of Federal, State and County laws requiring inspection for plant disease and insect control.
- C. Quality and size shall conform with the current edition of "Horticultural Standards" for number one grade nursery stock as adopted by the American Association of Nurserymen, and California Department of Agriculture regulations.
- D. The Applicator of all weed control materials shall be licensed by the State of California as a Pest Control Operator and a Pest Control Advisor in addition to any subcontractor licenses that are required.
- E. All materials and methods used for Weed Abatement must conform to Federal, State, and Local Regulations.

1.5 APPROVALS

- A. All irrigation system work shall be inspected for recommended approval by the Landscape Architect and/or the Owner's Representative prior to start of any work in this section.

1.6 TESTING

- A. An Agricultural Soil Suitability Report for all planting areas shall be obtained by the Contractor, after completion of rough grading, and prior to start of soil preparation work. The Contractor, at his own expense, shall submit at least four (4) site soil samples to a Soil Laboratory recommended by the Landscape Architect. Samples are to be taken from the top six inches (6") of soil in areas to receive planting. All test results and recommendations shall be provided to the Landscape Architect and/or the Owner's Representative. The requirements for fertilization and amendments as specified herein, may be modified as necessary prior to start of work in this section.
- B. After the completion of soil preparation and prior to the start of any planting, soil samples shall again be taken to confirm adequacy of soil preparation. Quantity and methods shall be the same as previously executed. Contractor shall not commence planting until so directed by the Landscape Architect and the Owner's Representative.

1.7 SUBMITTALS

- A. Materials lists: Within forty-five (45) days after award of the Contract, submit a complete list of all materials proposed to be furnished and installed under this Section, demonstrating complete conformance with the requirements specified.
 - 1. Materials list shall include the weed control materials and quantities per acre intended for use in controlling the weed types prevalent and expected on the site, as supplied by the Pest Control Advisor. Pest Control Advisor shall furnish the Landscape Contractor and Landscape Architect data to demonstrate the compatibility of the weed control materials and methods with the intended plant and seed varieties.
- B. Certificates: Deliver all certificates to the Landscape Architect upon delivery to job site. Include:
 - 1. Quantity of commercial fertilizers used.
 - 2. Quantity of soil amendments.
 - 3. Quantity of seed.

- 4. Quantity of plant material.

1.8 PRODUCT HANDLING

A. Delivery and Storage:

- 1. Deliver all items to the job site in their original containers with all labels intact and legible at time of Landscape Architect's review.
- 2. Immediately remove from the site all plants which are not true to name, and all materials which do not comply with the specified requirements.
- 3. Use all means necessary to protect plant materials before, during, and after installation and to protect the work and materials of all other trades.

B. Replacements: In the event of damage, immediately make all repairs and replacements necessary to the recommended approval of the Landscape Architect and at no additional cost to the Owner.

1.9 RESPONSIBILITY AND COORDINATION DURING WEED ABATEMENT

A. During Weed Abatement procedures, the Landscape Contractor is responsible for the erection of all signs and barriers required to prevent intrusion into the treated areas and to notify the public.

B. No material or methods used for Weed Abatement shall affect the landscape planting. No material or method shall render the job site unusable for more than ten (10) days from date of application.

PART 2 - MATERIALS

All materials shall conform to the requirements of Section 212 of the Standard Specifications, except as modified herein.

2.1 LANDSCAPE FINISH GRADING

A. Site topsoil material - No import soil.

2.2 NON-SELECTIVE HERBICIDES

A. Non-selective contact herbicide and/or non-selective systemic herbicides (as recommended by the Pest Control Advisor).

2.3 SELECTIVE HERBICIDES

A. Selective pre-emergent herbicides ('Ronstar G' or equal or as recommended by the Pest Control Advisor).

2.4 SOIL CONDITIONERS AND FERTILIZERS

A. Soil conditioners may include any or all of the conditioners herein specified and shall be applied at rates indicated on the plans or as determined by the Agronomical Soils Report.

1. Shavings: Nitrogen stabilized organic amendments derived from redwood sawdust, fir sawdust or finely ground bark of fir or pine containing the following physical properties:

<u>Percent Passing</u>	<u>Sieve Size</u>
95 – 100	6.33 mm (1/4 inch)
80 – 100	2.38 mm (No. 8, 8 mesh)
0 – 30	500 Micron (No. 35, 32 mesh)

2. Nitrogen Content - Dry weight 0.56% - 0.84%
3. Iron Content - Minimum 0.08% dilute acid soluble Fe. on dry weight basis.
4. Soluble Salts - 2.5 millimhos/centimeter at 25 degrees C. as determined by maximum saturation extract method.
5. Ash - (Dry weight) 0 - 6.0%
6. Fertilizer: Commercial fertilizers with an analysis of 5-3-1 Gro-Power Plus, 16-20-0, and 12-8-8 Gro-Power Controlled Release Nitrogen, as designated herein, or approved substitute as required by the Agronomical soils report.
 - a. Fertilizer shall be delivered to the site in the original unopened containers, bearing the manufacturer's guaranteed analysis. Any fertilizer that becomes caked or damaged, making it unsuitable for use, will not be accepted.
 - b. Available from: Gro Power (213) 245-6849 or (714) 750-3830.
7. Gypsum: To be agricultural grade gypsum and shall conform to Section 212-1.2 of Standard Specifications for Public Works Construction, Latest Edition.
8. Iron Sulfate: Pelleted or granular form containing not less than 18.5% expressed metallic iron and shall be registered as an agricultural mineral, with the State Department of Agriculture in compliance with Article 2 - "Fertilizer Materials," Section 1030 of the Agricultural Code.
9. Ammonium Sulfate: Granular form containing not less than 21% nitrogen and 24% sulfur and shall be registered as an agricultural miner, with the State Department of Agriculture in compliance with Article 2 - "Fertilizer Materials," Section 1030 of the Agricultural Code.

2.5 PLANTING TABLETS

- A. Fertilizer planting tablets shall be tightly compressed commercial grade planting tablets having a 12-8-8 formula, weighting 7 grams each, as "Gro-Power" planter tablets or equal. The planting tablets shall be delivered to the site in the original, unopened containers, bearing the manufacturer's guaranteed analysis. Any damaged tablets will not be accepted.

2.6 PLANT MATERIALS

- A. Nomenclature: The scientific and common names of plants herein specified conform to industry standards. (Refer to list of plant materials on Drawings).
- B. Labeling: Each group of plant materials delivered to the site shall be clearly labeled as to species and variety and nursery source.
- C. Quality and Size:
 1. Plants shall be in accordance with the California State Department of Agriculture's regulation for nursery inspections, rules and grading. All plants shall have a normal habit of growth and shall be sound, healthy, vigorous, and free of insect infestations, plant diseases, sun scalds,

fresh abrasions of the bark, excessive abrasions, or other objectionable disfigurements. All plants shall have normally well-developed branch system, with vigorous and fibrous root systems which are not root or pot bound. In the event of disagreement as to condition of the plants furnished by the Contractor in containers will be determined by removal of earth from the roots of not less than two plants or more than 2% of the total number of plants of each species or variety. Where container grown plants are from several sources, the roots of not less than two plants of each species or variety from each source will be inspected. In case the sample plants reviewed are found to be defective, the Landscape Architect and the Owner's Representative may judge acceptability. Any plants rendered unsuitable for planting because of this review will be considered as samples and will be provided at the expense of the Contractor.

2. The size of the plants will correspond with that normally expected for species and variety of commercially available nursery stock, or as specified in the special Conditions or Drawings. The minimum acceptable size of all plants measured before pruning with the branches in normal position, shall conform with the measurements, if any, specified on the Drawings in the list of plants to be furnished. Plants larger in size than specified may be used with the recommended approval of the Landscape Architect, but the use of larger plants will make no change in contract price. If the use of larger plants is recommended for approval, the ball of earth or spread of roots for each plant shall be increased proportionately.

- D. Rejection or Substitution: All plants not conforming to the requirements herein specified shall be considered defective, and such plants, whether in place or not, shall be marked as rejected and immediately removed from the site of the work and replaced with new plants at the contractor's expense. The plants shall be of the species, variety, size and condition specified herein or shown on the drawings. Under no condition will there be any substitution of plants or sizes for those listed on the accompanying plans, except with the expressed consent of the Landscape Architect.
- E. Pruning: At no time shall the tree or plant materials be pruned, trimmed or topped prior to delivery, and any alteration of their shape shall be conducted only with the recommended approval and when in the presence of the Landscape Architect.
- F. Protection: All plants at all times shall be handled and stored so that they are adequately protected from drying out, from wind burn, or from any other injury.
- G. Right of Review: The Landscape Architect reserves the right to recommend approval or rejection at any time upon delivery or during the work, any or all plant material regarding size, variety or condition.

2.7 MULCH

- A. Ground wood product shall be Type I, as specified in the "Standard Specifications for Public Works Construction," latest edition, Section 212-1.2.4.

2.8 TREE SUPPORTS

- A. Tree ties shall be "CINCH-TIE" black rubber ties, and shall be uniform throughout the project. Or, Owner's Representative approved equal.
- B. Tree support stakes shall be minimum two inches (2") diameter lodge pole pine, copper naphthenate treated, ten feet (10') length.

2.9 JUTE NETTING

- A. Jute netting shall be new and shall be of uniform, plain weave, flame-retardant mesh. The mesh shall be dyed green and shall be made from unbleached single jute yarn. The yarn shall be of loosely twisted construction and shall not vary in thickness by more than one-half its normal diameter. Jute netting shall be furnished in rolled strips and shall meet the following requirements:
1. Width 48 inches, with a tolerance of one inch wider or narrower.
 2. Minimum 78 warp ends per width of roll.
 3. Minimum 41 weft ends per yard of length.
 4. Weight shall average 1.22 pounds per linear yard, with a tolerance of 5 percent heavier or lighter.

PART 3 - EXECUTION

Installation shall conform to the requirements of Section 308 of the "Standard Specifications," except as modified herein.

3.1 GENERAL

- A. Prior to the start of work of this Section, all trash and deleterious materials on the surface of the ground shall be removed and legally disposed of.

3.2 WEED ABATEMENT

- A. Prior to the installation of the irrigation system, all weed growth shall be removed within the areas designated to be cleared and grubbed. Refer to plans for limit of work.
1. If in the opinion of the Pest Control Advisor, perennial grasses and weeds existing in the planting areas will require control prior to removal, spray these areas per Pest Control Adviser's recommendations. Allow herbicide to kill all weeds. Rake or hoe off all dead weeds to a depth of one to two inches (1" to 2") below the surface of the soil. Physically remove all weeds from the site.
- B. Upon completion of the irrigation system and rototilling of soil amendments into the soil and immediately preceding the installation of plant material, perform weed abatement as follows, and per Pest Control Advisors recommendation.
1. Apply Sulfate of Ammonia at the rate of five pounds (5 lbs.) per one thousand square feet (1,000 sf.) to all planting areas.
 2. Irrigate area for fourteen (14) consecutive days, to germinate existing weed seeds.
 3. Apply by spray a non-selective herbicide to eradicate all existing weeds. Do not irrigate for seven (7) days after application.
 4. Remove weeds after herbicide has had time to sufficiently kill. Remove all dead weeds by rake or hoe to a depth of one to two inches (1" to 2") below the surface of the soil. Remove all weed residue and top growth and dispose of in a legal manner.

3.3 SOIL PREPARATION AND FINE GRADE

- A. Soil Preparation: Prior to spreading soil amendments and prior to installation of irrigation systems, crossrip or otherwise till to a depth of ten inches (10") all planting areas to receive soil preparation. All rock one inch (1") and larger shall be removed to a depth of twelve inches (12"). Dispose of all debris off-site in a legal manner.
- B. Planting Areas: To all planting areas (shrub and groundcover), uniformly broadcast soil amendments and thoroughly incorporate to a minimum six inch (6") depth by means of a rototiller or equal.
- C. Soil Amendments are to be thoroughly incorporated at the following rates per one thousand square feet (1,000 sf.) by rototilling or other approved method:

3 cu. yds.	Nitrogen stabilized organic amendment
200 lbs.	5-3-1 commercial fertilizer indicate as shown
10 lbs.	Iron Sulfate*
50 lbs.	Agricultural Gypsum

(Mix to be used for bidding purposes only, to be verified with Agronomical Soils Test.)
*** Care shall be taken when using or handling Iron Sulfate to avoid contact with cement.**
- D. Finish Grade:
 1. Rough grade has been left within one tenth (1/10) of one foot (1') of finish grade.
 2. Work such as fine grading and light cultivation are required of all planting areas indicated on plan to prepare grades.
 3. After approximate finished grades have been established, all soil areas shall be compacted and settled by application of heavy irrigation to a minimum depth of twelve inches (12").

3.4 EROSION CONTROL

- A. Jute Netting. All slopes areas greater than 5 feet in height and exceeding 3:1 shall receive jute netting. Netting shall also be provided during the Plant Establishment & Maintenance Period, when and as directed by the Landscape Architect, along flow lines and other locations where erosion is evident. Jute netting shall be installed loosely, up and down the slope. The installed netting shall fit the soil surface contour and shall be held in place by 9-inch long, 11-gauge (minimum) steel wire staples driven vertically into the soil at approximately 24-inch spacing. Jute netting strips shall overlap along the sides at least 6 inches. Ends of strips shall be buried into the soil at least 6 inches. Lap all ends of rolls a minimum of 24".

3.5 FINAL GRADES

- A. After the foregoing specified deep watering, minor modifications to grade may be required to establish the final grade. These areas shall not be worked until the moisture content has been reduced to a point where working it will not destroy soil structure.
- B. Finish grading shall ensure proper drainage of the site.
- C. Finished earth berm surfaces shall be smooth and even between contours; shapes shall be to the satisfaction of the Landscape Architect.
- D. All areas shall be graded so the final grades will be one inch (1") below adjacent paved areas, sidewalks, valve boxes, clean-outs, drains, manholes, etc.

- E. Unless otherwise stated on plans, all shrub areas to receive three inches (3") of bark chips, but only one and one half inches (1 ½") in groundcover areas.
- F. Surface drainage shall be away from all building foundations.
- G. Eliminate all erosion scars.
- H. The Contractor shall request a review by the Landscape Architect for recommended approval of the final grades and elevations before beginning planting operations.

3.6 TREE AND SHRUB INSTALLATION

- A. All planting and bare dirt areas are to be treated with a pre-emergent chemical (subject to approval by Landscape Architect prior to application). Chemicals are to be applied by a licensed by a Pest Control Agent at the rates recommended by the manufacturer. This treatment shall be applied at the following times during the contract: a) before planting, b) at the beginning of plant establishment period and c) at the end of the plant establishment period. No chemicals shall be applied other than in the presence of the inspector.
- B. Actual planting shall be performed during those periods when weather and soil conditions are suitable and in accordance with locally accepted practice, as reviewed by the Landscape Architect.
- C. All irrigation work shall have been reviewed by the Landscape Architect prior to beginning any planting.
- D. Installation of all plant material shall be in accordance with the details on the Planting Plans.
- E. Locations for plants and outlines of areas to be planted shall be marked on the ground by the Contractor before any plant pits are dug. All such locations shall be reviewed by the Landscape Architect and Owner/Agent. If an underground construction or utility line is encountered in the excavation of planting areas, notify Landscape Architect so that other locations for planting may be selected.
- F. Excavation for Planting:
 1. Excavation for planting shall include the stripping and stacking of all acceptable topsoil encountered within the areas to be excavated for trenches, tree holes, plant pits and planting beds.
 2. Protect all areas from excessive compaction when trucking plants or other material to the planting site.
 3. All excavated holes shall have vertical sides with roughened surfaces and shall be of a size that is at least two times the width and depth of the original plant container. The holes shall be, in all cases, large enough to permit handling and planting without injury or breakage to the roots or root ball.
- G. Planting:
 1. No planting shall be done in any area until the area concerned has been satisfactorily prepared in accordance with these Specifications.
 2. No more plants shall be distributed in the planting area on any day than can be planted and watered on that day.
 3. Containers shall be cut and plants shall be removed in such a manner that the ball of earth surrounding the roots is not broken, and they shall be planted and watered as herein specified

immediately after the removal from the containers. Containers shall not be cut prior to placing the plants in the planting area.

4. Over excavate 12" and recompact native soil.
 5. The amended surface soil can be used for backfill around trees and shrubs; where additional quantities are required, use the following formula (thoroughly blended):
 - a. Native On-Site Soil (No rock larger than 1") 6 parts
 - b. Nitrolized Wood Shavings 4 parts
 - c. Commercial Fertilizer Gro-Power Plus, 5-3-1 15 lbs/cy
 - d. Iron Sulfate 2 lbs/cy
 - e. For Acid Loving Plants
 - 1) 80% Course Peat Moss
 - 2) 20% Sponge Rock or Light Soil Mix

(Mix to be used for bidding purposes only, to be verified with Agronomical Soils Test).
 6. Three inches (3") of amended backfill shall be thoroughly mixed with three inches (3") of native soil at the bottom of each hole to provide a transitional soil mix of at least six inches (6") between the native soil and the backfill. Agronomic soils report will take precedence over this specification line item.
 7. Backfill shall be placed at the bottom of each hole, and thoroughly compacted to a height that when a plant is placed in the hole, its root crown is slightly above the established final grade. Any plants which settle deeper than specified above shall be raised back to the correct level. After the plant has been placed, additional backfill shall be added to the hole to cover approximately one-half the height of the root ball. At this stage, water shall be added to the top of the partly filled hole to thoroughly saturate the root ball and adjacent soil.
 8. After the water has completely drained, fertilizer tablets shall be placed as indicated below:
 - a. 3 tablets per one gallon container.
 - b. 6 tablets per five gallon container.
 - c. 12 tablets per fifteen gallon container.
 - d. 14 tablets per 24" box container.
 - e. 18 tablets per 36" box container.
 - f. 22 tablets per 48" box container.
 - g. 32 tablets per 60" box container.
 9. The remainder of the hole shall then be backfilled.
 10. Set the tablets to be used with each plant on the top of the root ball while the plants are still in their containers so the required number of tablets to be used in each hole can be easily verified.
 11. After backfilling, an earthen basin shall be constructed around each plant. Each basin shall be of a depth sufficient to hold at least two inches (2") of water. Basins shall be of a size suitable for the individual plant. In no case, shall the basin for a fifteen (15) gallon plant be less than four feet (4') in diameter; a five (5) gallon plant less than three feet (3') in diameter; and a one (1) gallon plant less than two feet (2') in diameter. The basins shall be constructed of amended backfill material. Rake out basins prior to planting groundcover areas.
- H. Pruning: Pruning shall be limited to the minimum necessary to remove injured twigs and branches, and to compensate for loss of roots during transplanting, but never to exceed one-third (1/3) of the branching structure. Upon recommended approval of the Landscape Architect, pruning may be done before delivery of plants, but not before plants have been reviewed and recommended for approval.

Cuts over three quarters of an inch (3/4") in diameter shall be painted with an approved tree wound paint.

I. Staking and Tying:

1. Support stakes tall enough to support the particular tree shall be driven thirty-six inches (36") into the soil. Stake shall be placed on the leeward side of the tree from the most troublesome direction, refer to details on Drawings.
2. Ties shall be placed as low on the trunk as possible but high enough so the tree will return to upright after deflection.
3. To find the proper height for tie locations, hold the trunk in one hand, pull the top to one side and release. The height at which the trunk will just return to the upright when the top is released is the height at which to attach the ties.
4. Ties are to form a loose loop around the tree trunk so that the trunk cannot work towards the support stakes.
5. One tree of each size shall be staked and reviewed by the Landscape Architect prior to continued staking.

3.7 WATERING

- A. Apply water to all planted areas during operations and thereafter, until acceptance of the work.
- B. Immediately after planting, apply water to each shrub by means of a hose. Apply water in a moderate stream in the planting hole until the material about the roots are completely saturated from the bottom of the hole to the top of the ground.
- C. Apply water in sufficient quantities and as often as seasonal conditions require to keep the planted areas sufficiently moist at all times, well below the root system of grass and plants.
- D. All groundcover areas shall be kept damp at all times and irrigation should be adjusted accordingly. This normally would involve four (4) to six (6) watering periods daily, each watering period (ON) regulated to just dampen the mulch without creating run off.
- E. Intervals between irrigation (OFF) sequence should be judged by the length of the time mulch remain damp. Once the mulch begins to dry out, the water (ON) sequence should be repeated.

3.8 ESTABLISHMENT AND MAINTENANCE PERIOD

- A. The Contractor shall continuously maintain all areas involved in this contract during the progress of the work and during the establishment and maintenance period until final acceptance of the work by the Owner's Representative.
 1. Plant Establishment & Maintenance Period: The contractual Plant Establishment & Maintenance Period shall be for no less than ninety (90) continuous calendar days and shall begin after accepted planted areas are brought to a neat, clean and weed free condition.
 - a. All areas shall be kept of debris, and all planted areas shall be weeded at intervals of not more than ten (10) days. Watering, trimming, fertilization, spraying and pest control, as may be required, shall be included in the maintenance period. Maintenance shall include gopher control. In order to carry out the Plant Establishment & Maintenance Period work, the contractor shall furnish sufficient men and adequate equipment to perform the work.

- b. Grading and Drainage: During the Plant Establishment & Maintenance Period all flow lines shall be maintained to allow for free flow of surface water. Displaced material which interferes with drainage shall be removed and placed as directed. Low spots and pockets shall be graded to drain properly. Jute netting shall be installed at flow lines and other locations where erosion is evident, when directed by Landscape Architect.
 - c. Any day upon which no work will be required, as determined by the Landscape Architect, will be credited as one of the plant establishment working days regardless of whether or not the Contractor performs plant establishment work.
 - d. Any day when the Contractor fails to adequately maintain plantings, replace unsuitable plants or do weed control or other work, as determined necessary by the Landscape Architect, will not be credited as one of the plant establishment working days.
 - e. Improper maintenance or possible poor condition of any planting at the termination of the scheduled establishment period may cause postponement of the final acceptance of Plant Establishment & Maintenance Period. Contractor shall bear all costs for extension of the Plant Establishment & Maintenance Period.
 - f. Post fertilize all groundcover areas at the end of every thirty (30) days (of maintenance) at the rate of thirty pounds (30 lbs.) per one thousand square feet (1,000 s.f.), using 5-3-1 Gro-Power. For the final feeding of all areas, use 12-8-8 Gro-Power Controlled Release Nitrogen at the rate of thirty pounds (30 lbs.) per one thousand square feet (1,000 s.f.).
 - g. During the maintenance period, the Contractor shall be responsible for maintaining adequate protection for all planting areas. Any damaged areas shall be repaired and any plant materials replaced at the Contractor's expense.
- 2. The Contractor shall maintain the irrigation systems in a like new operating condition; adjusting head heights and spray arcs as necessary. The Contractor is responsible for proper watering of all planting areas, for providing any necessary supplemental water as may be required, and shall replace any material damaged due to improper moisture.
 - 3. The Contractor's maintenance period will be extended past ninety (90) days if these provisions are not filled.
 - 4. The Contractor shall have foreman from plant establishment period train onsite staff regards to equipment operation, watering schedules, fertilization schedule, and plant material care/maintenance prior to turn over. Contractor is responsible for setting up the training session and to notify landscape Architect as to date and time of the meeting.

3.9 GUARANTEE AND REPLACEMENT

- A. All plant material installed under the contract shall be guaranteed against any and all poor, inadequate or inferior materials and/or workmanship for a period of one (1) year. Any plant found to be dead or in poor condition due to such faulty materials or workmanship, as determined by the Landscape Architect, shall be replaced by the Contractor at his expense.
- B. All palms shall be guaranteed by the contractor for twenty-four (24) months after final acceptance of the project. Contractor liability shall cover cost of labor, equipment, and materials to replace trees of similar size during the covered period.
- C. Any material found to be dead, missing, or in poor condition during the establishment period shall be replaced immediately. The Landscape Architect shall be the judge as to the condition of material. Material to be replaced within the guarantee period shall be replaced by the contractor within fifteen (15) days of written notification by the Owner's Representative.

- D. Replacement shall be made to the same specifications required for original plantings within five (5) working days after written notification.
- E. Material and Labor involved in the replacing of material shall be supplied by the Landscape Contractor at no additional cost to the Owner.

3.10 REVIEWS

- A. Normal progress reviews shall be requested from the Landscape Architect at least forty-eight (48) hours in advance of an anticipated inspection. A review will be made by the Landscape Architect on each of the steps listed below. The Contractor will not be permitted to initiate the succeeding steps of work until he has received written recommendation of approval to proceed by the Landscape Architect.
 - 1. Immediately prior to the commencement of the work on this Section.
 - 2. Spotting of all shrubs, trees and palms, and minor adjustments prior to planting.
 - 3. Preparation of areas to groundcover installation.
 - 4. Final review, start of establishment & maintenance period.
 - 5. After thirty (30) day plant establishment & maintenance.
 - 6. Final acceptance of project/ninety (90) day maintenance.

3.11 PAYMENT TERMS

- A. Payment for planting work will be at the lump sum price bid for planting. Payment shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work in planting as herein specified. A 10% retention shall apply to all planting work.

END OF SECTION