SECTION 16500

LIGHTING SYSTEM

PART 1 - GENERAL

1.01 CONDITIONS

A. The Division 16 and Division 1 General Requirements are hereby made a part of this Section as fully as if repeated herein.

1.02 WORK INCLUDED

A. Furnish all labor, materials and equipment and perform operations required for furnishing and complete installation of lighting fixtures as shown and specified.

1.03 QUALITY ASSURANCE

A. Reference Standards:

1. ETL - Electrical Testing Laboratories.

2. NEMA - National Electrical Manufacturer's Association.

   a. LE-1-1974 Fluorescent Luminaires

3. CEC - 2001 California Electrical Code.

   a. Article 410 California Electrical Code

4. CBM - Certified Ballast Manufacturer's Association.

5. UL - Underwriter's Laboratories, Inc.

   a. 57 Electric Lighting Fixtures.

   b. 496 Edison-Base Lampholders.

   c. 542 Lampholders, Starters, and Starter Holders for Fluorescent Lamps.

   d. 935 Fluorescent-Lamp Ballasts.

   e. 1571 Incandescent luminaire, recessed.

6. CCR - California Code of Regulations, Title 24, Part 2.

B. Acceptable Manufacturers:

1. One substitution for each fixture type is permitted and shall be reviewed on an "equal to" basis. All substitutions shall meet all of the quality and performance requirements of that specified and all substitutions shall be approved by the Electrical Engineer and Architect.

2. Fixtures finished as standard by manufacturer for fixtures specified. Furnishing material applies in a manner that will produce a durable finish. Metallic finishes, except chromium, given an even coat of high grade lacquer, baked on. Exposed, surfaces of aluminum parts, such as frames, given an anodic treatment when required by drawing and/or specifications.

C. Design Criteria: Lighting fixtures conform to the detail drawings, NEC 410, UL 57, "Electrical Lighting Fixtures", and Title 24 "Energy Efficiency Standards for Non-Residential Buildings", latest edition.

D. Requirements of Regulatory Agencies: Manufacturing and installation workmanship of the best quality and conform with Code requirements and accepted practices of the electrical industry.

1.04 SUBMITTALS

A. Shop Drawings:

1. Lighting fixtures submittal for each fixture type includes:

a. Requirements in Section 16000, GENERAL REQUIREMENTS.

b. Independent Testing Laboratory distribution curves and report as directed.

c. Manufacturer's data, specifications, installation instructions, and catalog cuts showing construction details, mounting details and photometric data fixture, unless otherwise specified. Where data is incomplete, supplement with shop drawings.

d. Lighting fixtures submitted for review shall state that fixture bears UL label of approval and/or acceptable independent testing laboratory for the application in which the fixture is intended to be used.

e. When catalog data and/or shop drawing for fluorescent fixtures are submitted for acceptance, photometric data from an independent testing laboratory included with submittal, indication average brightness and efficiency of fixture, as specified in contract drawings. Coefficient of utilization data will not be considered a suitable substitute.

f. Contractor shop drawing showing seismic restrain for all fixtures and signed by a California State Licensed Structural Engineer.

g. Initial submittals must cover every lighting fixture type required on this project. (No partial submittals will be reviewed.) Partial submittals will be returned rejected.

h. Submittals shall include lamp data for each fixture type.

i. Lighting fixture submittals presentation in the following form:

1) Total submittal placed in a hardbound notebook.

2) Within notebook in alphabetical order place each fixture type by letter under separate tab, in corresponding order with Fixture Schedule on drawings.

3) Each fixture tab includes all information pertinent to that fixture type. No front-end general notes and description pertaining to a multitude of fixtures will be accepted.

4) The first page of notebook includes a detail summary of each fixture type with its manufacturer's name and complete catalog number.

5) Submit legible reading material. Catalog pages must be clearly marked as to the precise piece of equipment being furnished, listing all information to be reviewed.

6) Each sheet of submittal must clearly indicate project name, an individual fixture type, and be date stamped by the Contractor.

7) Test reports shall clearly identify lighting fixture by manufacturer and catalog number. These catalog numbers shall cross-reference between report and catalog number of fixture.

B. Samples:

1. Shop inspection when requested by Engineer or Architect shall consist of examination of a representative sampling of fixtures and fixture parts required for the building project.

a. Light fixture shall be supplied with a cord and plug, fully lamped and ballasted for a complete working sample.

b. Any action taken as result of shop inspection must be construed as final acceptance of fixtures, which must fully meet all contract requirements after installation in project and at time of final inspection.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Electronic Fluorescent Ballasts:

1. Fluorescent lamp ballasts shall be electronic type instant start, high power factor greater than 90%, crest factor < 1.4, and UL listed class P with thermal protection. Input current third harmonic shall not exceed 10%, total harmonic distortion not to exceed 32% per ANSI recommendations. Ballast Factor shall be minimum 0.88 and Ballast Efficacy Factor (BEF) shall be minimum 1.4.

2. The ballast shall be solid state electronic design consisting of rectifier, high frequency inverter and power control and regulation circuitry. No PCB's shall be used. It shall be designed to withstand line transients per IEEE 587, category A, and shall meet FCC Rules and Regulations part 18, for class "A" operations. Manufacturer shall be Advanced Transformer Co. type Mark V or equal.

3. Ballast sound rating shall be equivalent to G.E. sound rating "A" and shall be quiet operating. Ballasts found to be noisy after installation, in opinion of Architect, shall be removed and replaced at no increase in contract price. Ballast(s) in luminaire recessed in a fire rated ceiling shall be approved for such use.

4. Dimming Ballasts: Electronic dimming ballasts and controls shall be produced by the same manufacturer.

   Dimming shall be smooth and continuous without flicker down to 10% light * output. Ballasts shall be capable of striking lamps at any light level without first flashing to full light. Different lamp lengths of the same lamp type shall dim evely when controlled by the same dimmer. One- and two-lamp ballasts shall dim evenly when controlled by the same dimmer.

   Ballasts shall be inaudible in a 27 dB room ambient throughout the dimming range. Ballasts must comply with FCC Part 18 configurations and shall not interfere with other properly installed electrical equipment. Ballasts shall be UL listed, Class P and meet ANSI C62.41 (IEEE Publication 587, category A) standards for surge protection. Ballast and controls shall be Lutron Hi-Lume (or equal).

5. Provide low temperature ballasts for outdoor and cold room applications.

6. Ballast shall be serviceable while fixture is in its normally installed position and not be mounted to removable reflectors or wireway covers unless so specified.

7. Each basic fluorescent fixture equipped with necessary number and type of ballast to operate only the lamps within the particular basic unit. Single-lamp fixtures contain one single-lamp ballast; two-lamp fixtures contain one two-lamp ballast; and four-lamp fixtures contain two-lamp ballast. Basic fluorescent fixtures containing three or four lamps internally wired to have the two outer lamps operated by a common ballast and the center lamp or lamps operated by the remaining ballast Slave/Master requirements.

8. Ballast for use with "PL" lamps shall be HIGH POWER FACTOR where available.

9. Ballast(s) in luminaire recessed in fire rated ceiling shall be approved for such use.

10. High Intensity Discharge (HID): HID lamp ballast shall have power factor of 90% of higher, premium constant wattage (regulator stabilized) type conforming to ANSI specifications and UL listed. Ballast shall be independent and with individual fuses. Use appropriate rated ballast in high ambient temperature application. Equip ballasts with individual fuses.

B. Fluorescent Emergency Power Supply: Emergency lighting shall be provided by standard fluorescent fixtures equipped with self-contained battery-inverter power pack. Battery shall be sealed, maintenance free, pure lead. A remote test switch, indicator light, and installation hardware shall be provided to monitor the battery and charger. Powr supply shall be capable of fully automatically operating one four foot (4') lamp in the emergency mode for a minimum of 90 minutes with a minimum of 800 lumens. An integrated chip shall constantly monitor performance and automatically exercise the battery every 28 days. The unit shall be Dual-Lite Lampak II Model UFO-2E-I.

C. Fluorescent luminaire lenses: 100 percent virgin acrylic; 0.125-inch, pattern 12 except shown or specified otherwise.

D. Equip exposed fluorescent lamps with safety lamp holders or wire guard.

E. Provide lamps in all lighting fixtures as required; lamps shall be compatible with ballast supplied. Fluorescent lamps: G.E., Sylvania, Phillips or equal.

F. Equip exposed fluorescent lamps with safety lamp holders or wire guard.

G. Provide lamps in all lighting fixtures as required; lamps shall be compatible with ballast supplied. Fluorescent lamps: G.E., Sylvania, Phillips or equal.

H. Fixtures and other lighting equipment. Deliver complete with suspension accessories, canopies, castings, sockets, holders, reflectors, ballasts, diffusing material, louvers, frames, and recessing boxes all wired and assembled.

I. Hangers: Swivel-type to allow for free movement of 45 degrees from vertical at canopy and at luminaire housing. Steel tube hangers shall include a 1/16-inch diameter galvanized wire cord or equivalent (100-pound break strength) in stem assembly attached to luminaire housing and building structure. Attach loop with C-type tool applied compression splice.

J. All metal halide lamp luminaries shall be the enclosed type with diffuser or lens to withstand an arc tube rupture.

K. Louvers for fluorescent luminaires which are removable for relamping but no hinged shall be securely fastened near each end between the fixture housing and louvers using No. 16 jack chain for louvers.

PART 3 - EXECUTION

3.01 PREPARATION/COORDINATION

A. Lighting fixtures of the types, sizes, etc., shown in fixture schedule and notes referenced herein.

1. Drawings show fixture types by means of letter or number reference. Where no reference letter or number is shown, use fixture type for similar areas.

2. Location of fixtures on drawings is generalized. Carefully verify locations of fixtures with Architectural reflected ceiling plans or other reference data for final location in advance of installation, including headroom clearances and interferences with ceiling components, ducts or openings.

B. Coordinate between electrical and ceiling trades to see that accepted lighting fixtures are furnished in the proper sizes and installed with proper devices (hangers, clips, trim frames, flanges, etc.) to match ceiling system being installed.

3.02 INSTALLATION/APPLICATION/ERECTION

A. Install lighting fixtures in accordance with manufacturer's recommendations. Mount in accordance with 1998 C.E.C., paragraphs 410-16 and 410-76.

B. Align, mount and level lighting fixtures uniformly. Final decision is reserved by the Architect as to adequacy of alignment leveling.

C. Report proposed changes in outlet locations for luminaires found necessary due to interference with structure, pipes, ducts, and other items to Architect for direction before installation. Luminaires specified with overall lengths are subject to change. Adjust as directed by Architect.

D. Avoid interference with and provide clearance for equipment. Where indicated locations for lighting fixtures conflict with locations for equipment, change locations for lighting fixtures by the minimum distances necessary as accepted by the Architect.

E. Particular care shall be used to eliminate light leaks around edge of recessed fixture trims.

F. Luminaire recessed in fire rated ceilings shall be in accordance with UL Fire Resistance Directory.

G. Lighting fixtures shall be properly grounded.

H. Install recessed luminaires with separate junction box, flexible conduit, and heat-resisting wire as required by 1998 CEC. Set junction box in furred space facing luminaire for maximum accessibility. Furnish and install metal ceiling frame so luminaire can be removed without damaging finish.

I. Luminaire recessed in fire rated ceiling shall conform to UL Standards, equipped with yoke where in tee ceiling and field fabricated fire protection box in accordance with latest UL Fire Resistance Directory, constructed of 5/8 inch thick UL listed gypsum board.

J. Pendant or surface-mounted fixtures furnished and installed with required mounting devices and accessories and include hickeys, stud extensions, ball-aligners, canopies and stems. Ball-aligners swivel devices at the ceiling shall permit fixture to swing at least 45 degrees in all directions. Mounting stems of pendant fixtures of the correct length to uniformly maintain fixture heights shown on drawings. Allowable variations in tolerance of mounting shown on drawings. All fixture mounting shall be per Title 24 requirements. See electrical drawings for additional information and requirements.

1. Suspension length of ceiling-mounted suspended types of lighting fixtures (fluorescent and HID) as listed in fixture schedule the overall length from ceiling to lowest point of fixture body, reflector or glassware in its hanging position.

K. Lighting Fixture Supports:

1. Fixtures shall be delivered complete with suspension accessories, canopies, castings, sockets, holders, reflectors, ballasts, diffusing material, louvers, frames, and recessing boxes all wired and assembled.

2. Supports provide support for all fixtures. Supports may be anchored to channels of ceiling construction, to structural slab or to structural members within a partition or above a suspended ceiling.

3. Supports maintain fixture positions after cleaning and relamping.

4. Supports support lighting fixtures without causing ceiling or partition to deflect.

5. Fixture hangers shall be swivel-type to allow for free movement of 45 degrees from vertical at canopy and at luminaire housing. Steel tube hangers shall include a 1/16-inch diameter galvanized wire cord or equivalent (100-pound break strength) in stem assembly attached to luminaire housing and building structure. Attach loop with C-type tool applied compression splice.

6. Hardware for surface-mounting fluorescent fixtures to suspended ceilings as follows:

a. In addition to being secured to any required outlet box, fixtures bolted to a grid ceiling at four points spaced near corners at each fixture. Bolts not less than 1/4 inch, 20 secured to main exposed ceiling members and/or secured to channel members attached to and spanning the tops of ceiling structural grid members. Non-turning studs may be attached to ceiling structural grid

members or spanning channels by special clips designed for purpose, provided they lock into place and require simple tools for removal.

b. In addition to being secured to any required outlet, fixtures bolted to a plaster ceiling at four points spaced near corners at each fixture. Prepositioned 1/4 inch, 20 studs or threaded plaster inserts secured to ceiling structural members used to bolt fixtures to ceiling. In lieu of the above 1/4 inch, 20 toggle bolts may be used on new or existing ceiling provided plaster and lath can safely support fixtures without sagging or cracking.

7. Hardware for recessed fluorescent fixtures:

a. Where suspended ceiling system is supported at four corners of fixture opening, hardware devices, shall clamp fixture to ceiling system structural member or plaster frame at not less than four points in such a manner as to resist spreading of support members and safely lock fixture into ceiling system.

b. Where suspended ceiling system is not supported at four corners of fixture opening, support luminaire housings from structural members with a minimum of four (4) No. 12 galvanized iron wires. Clip fixture ends or end fixture of row to main tees near four corners. Join continuous row adjacent luminaires with two 8/32 bolts.

c. Plaster frames or mounting clips for recessed fixtures and required mounting accessories for dry gypboard ceilings.

d. Recessed lighting fixtures supported from building base structure and/or suspended ceilings in a manner satisfactory to State of California requirements of seismic design criteria, and Title 24, Section E410D.

L. In areas not having a demountable or accessible ceiling system, provide an accepted junction box allowing light fixture removal for access to circuit wiring, or an exposed box for feeding groups of light fixtures.

M. Wiring:

1. Lighting fixtures must be correctly wired for proper operation in accordance with design circuit and test free from short circuits and improper grounds.

2. Wiring between fluorescent lampholders and associated operating and starting equipment shall not be sized smaller than the leads furnished with approved types of ballasts and have equal or better insulating and heat resisting characteristics. All other wiring within fluorescent lighting fixtures or from the fixture for splicing to the building wiring shall conform to requirements of the latest issue of CEC and shall not be less than No. 16 gauge wire. Wiring shall be protected with tubing at all points where abrasion is liable to occur. Wiring shall be concealed within fixture construction, except where fixture design or mounting dictates otherwise.

3. Connection of wires to terminals of lampholdes and other accessories must be made in a neat and workmanlike manner and electrically and mechanically secure with no loose strands protruding. Number of wires extending to or from terminals of a lampholder or other accessory shall not exceed the number which the accessory is designed to accommodate.

4. Joints in wiring within lighting fixtures shall be so spliced that they will be mechanically and electrically secure and then soldered and taped to provide insulation equal to that of the conductors being joined. In lieu of solder and tape, approved types of adequately insulated solderless pressure crimped type connectors may be furnished provided sizes used, method of applications and tools employed are in accordance with the particular manufacturer's recommendations. Use of screwed-on type of solderless connector will not be accepted for making connections in wiring within lighting fixtures.

5. No splice or tape will be permitted within an arm or stem. Wiring shall be continuous from splice in outlet box on building wiring system to lampholder of an incandescent fixture or to wireway or space provided in a fluorescent lighting fixture for necessary splices between ballast and other accessories and lampholders.

6. Multiple section fluorescent lighting fixtures shall be internally wired and connected to accomplish the switching arrangement required by electrical drawings. Wiring shall conform to requirements of latest issue of CEC.

3.03 FIELD QUALITY CONTROL

A. Upon completion of installation of lighting fixtures and lighting equipment, they must be in first class operating order, in perfect condition as to finish and free from defects. At time of final inspection, all fixtures and equipment must be completely lamped and b complete with required glassware, reflectors, side panels, louvers or other components necessary to complete fixtures.

1. Replace burned out lamps during construction and up to date of final acceptance or project by Architect. All defective or burned out lamps shall be replaced for a period of one year from date of final acceptance of the project by the Architect.

2. All ballasts shall be warranted for a period of two (2) years from date of final acceptance of the project by the Architect.

3.04 ADJUSTING AND CLEANING

A. Clean all glass and plastic and polish all visible metal parts before submitting job to Owner's Representative for final acceptance. Remove all fingerprints and dirt from exposed surfaces. Parts scratched or damaged prior to final inspection must be replaced by Contractor.

B. After ninety days from installation, parking lot fixture poles shall be inspected for alignment. Plumb and shim as required.

3.05 SCHEDULES

A. Furnishing and installation of lighting fixtures or lighting equipment must be executed in a manner that will insure completion coincident with completion of project construction, unless otherwise required by contract specifications.

1. Lighting fixtures shall not be installed on ceilings and walls scheduled to receive paint until such painting has been accepted by the Architect.

END OF SECTION

SECTION 16503

POLES, STANDARDS AND SITE LIGHTING

PART 1 - GENERAL

1.01 CONDITIONS

A. The Requirements of Division 1, General Conditions, Special Conditions and Section 16000 apply to Work of this Section as if fully repeated herein.

1.02 WORK INCLUDED

A. Provide and install poles, standards and site luminaires.

B. Base reinforcement and anchor bolts.

1.03 REFERENCES

A. American National Standards Institute, Inc. (ANSI):

C82.4	High Intensity-Discharge Lamp Ballasts (Multiple Supply Type).
C136.3	Luminaire Attachments Used in Roadway Lighting Equipment.
C136.11	Multiple Sockets Used in Roadway Lighting Equipment.

1.04 SUBMITTALS

A. Refer to Division 1 and Section 16000.

B. Submit pole manufacturer's installation instructions for recommended reinforcing of bases.

C. Submit Shop Drawings and product data including luminaire performance data and luminaire pertinent physical characteristics.

PART 2 - PRODUCTS

2.01 POLES

A. Configuration: Square tapered, steel dimension as shown, rated for minimum ninety (90) mph wind with specified luminaires at pole top. *

B. Handhole: Three inches (3") by five inches (5") complete with removal weatherproof cover installed eighteen inches (18") above bottom of pole.

C. Finish: Factory finished shall be as specified on Drawings.

D. Ground Lug: Provide ground lug at opposite wall of handhole.

2.02 TOP BRACKET

A. Provide bracket with slip fitter for pole and luminaire mounting. Arm arrangement shall be as specified on Drawings. *

2.03 ANCHOR BOLTS

A. Provide four (4) anchor bolts per pole, size as shown complete with three inches (3") right angle bend on one (1) end and six inches (6") of thread on the other end, galvanized. Provide flat washers, lock washers, and two (2) hexagonal nuts for each bolt. Bolt sized to withstand minimum eighty (80) mph wind loading.

B. Provide template for positioning of anchor bolts.

2.04 BASE COVERS

A. Full base cover designed to conceal entire anchor base and anchorage above the base, and finished to match pole.

2.05 CONCRETE AND REINFORCEMENT

A. Form Materials:

1. Conform to ACI 301.

2. Plywood Forms: Douglas Fir high density overlaid one (1) side; sound undamaged sheets.

B. Reinforcing Steel: ASTM A615, 40 ksi yield grade billet steel deformed bars; uncoated finish.

C. Concrete Materials:

1. Cement: ASTM C150, normal - Type II Portland, grey or white color as selected by Architect.

2. Fine and Coarse Aggregates: ASTM C33.

3. Water: Clean and not detrimental to concrete.

D. Accessories:

1. Non-Shrink Grout: Premixed compound with non-metallic aggregate, cement, water reducing and plasticizing agents; capable of minimum compressive strength of 2400 psi.

2. Form Release Agent: Colorless material which will not stain concrete or absorb moisture.

E. Concrete Mix:

1. Mix concrete in accordance with ASTM C94.

2. Compressive strength (7 days): 2000 psi.

3. Compressive strength (28 days): 3000 psi.

4. Slump: Four inches (4").

2.06 LUMINAIRES

A. Provide luminaires complete with gaskets forming weatherproof assembly designed to mount on pole as specified on drawings.

B. Provide low temperature ballasts.

C. Finish: Factory finish shall be as specified on drawing.

PART 3 - EXECUTION

3.01 BASES

A. Construct of concrete with minimum dimensions shown on Drawings.

B. Install anchor bolts with two inches (2") project above top of bases.

3.02 INSTALLATION

A. Verify lines, levels, and measurements before proceeding with form work.

B. Remove loose dirt.

C. Secure reinforcement against displacement.

D. Install pole anchor.

E. Mount standards on bases plumb and true, utilizing shims as necessary.

F. Touch-up chips and scratches on poles upon completion.

G. Install underground wiring in conduit, with watertight connections.

H. Install bracket on pole.

I. Install luminaires on brackets.

J. Adjust luminaire to provide maximum utilization of light.

END OF SECTION