

SECTION 26 55 61

THEATRICAL LIGHTING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. Section Includes:
 - 1. Dimmer racks.
 - 2. Control console and control devices.
 - 3. Luminaires and accessories.
 - 4. Distribution components.

1.03 DEFINITIONS

- A. Fade Time: The time it takes all zones to fade from one lighting scene to another, with all zones arriving at the next scene at the same time.
- B. Control Voltage: As defined in NFPA 70, term for circuits and equipment operating at less than 50 V or for remote-control, signaling, and power-limited circuits.
- C. Scene: The lighting effect created by adjusting several zones of lighting to the desired intensity.
- D. Channel: An individual control output on a control console, accessed and regulated by a slider, switch, or button; or in some cases, accessed by a discretely assigned address and regulated by a data input apparatus.

1.04 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For theatrical lighting.
 - 1. Include plans, elevations, sections, and **[mounting]** **[attachment]** details.
 - 2. Detail fabrication and installation for dimmer racks and arrangements, characteristics, and circuit assignments of various modules and rack-mounted accessories.
 - 3. Elevation views of front, rear, and side panels indicating devices and controls, including illustrations and dimensioned outline drawings.
 - 4. Include diagrams for power, signal, and control wiring. Show connections, circuits, and channel assignments.
 - 5. Equipment legend showing a unified system of designations for lighting instruments, panels, dimmers, circuits, and equipment.

1.05 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Floor plans, reflected ceiling plan(s), and other details drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 - 1. Required working clearances for operation, maintenance, and environmental conditions.
 - 2. Areas above and around dimming equipment where piping and ducts are prohibited.
 - 3. Rack layout and relationships between components and adjacent structural and mechanical elements.
- B. Field quality-control reports.

1.06 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For luminaires, distribution components, software operating manuals, and controls to include in emergency, operation, and maintenance manuals.
1. In addition to items specified in Section 01 78 23 "Operation and Maintenance Data," include the following:
 - a. Instructional DVD: Professionally produced informational presentation to provide comprehensive instructions for equipment installation, connectivity, programing, and functional use. Information provided shall be specific to equipment provided for Project and shall include ancillary equipment and its integration into the theatrical lighting control system.
 2. In addition to items specified in Section 01 78 23 "Operation and Maintenance Data," include the following:
 - a. Control-Console Introduction:
 - 1) Descriptions of controls and features.
 - 2) Software instruction manuals.
 - 3) Setup requirements for unit and related equipment.
 - 4) Default settings.
 - 5) Maintenance procedures and schedules.
 - b. Control-Console Operation:
 - 1) Elementary on-off operation.
 - 2) How to set cues manually.
 - 3) How to patch dimmer to channels electronically.
 - 4) How to operate presets manually.
 - 5) How to operate fundamental memory.
 - 6) How to set and record simple cues.
 - 7) How to recall, play back, and revise cues and scenes.
 - 8) How to use submasters, groups, focus points, fader channels; and how to split cues, store and recall programs, set up special effects, and print out cues.
 - 9) How to set up and run system for a typical event or performance.
 - 10) How to get help.
 - c. Dimming Racks:
 - 1) Descriptions of features, functions, and safety and security precautions.
 - 2) Descriptions of dimming module features, software-driven functions, non-dim functions, and associated racking systems.
 - 3) How to compare connected loads against dimmer capacity ratings.
 - 4) How to terminate basic power-in and power-out connections.
 - 5) Basic maintenance requirements, including need for qualified electrician for internal maintenance; basic maintenance schedule; techniques for keeping terminals properly tightened, filter screens clean, and overheat sensors checked; and techniques for performing other required servicing.
 - 6) How to adjust dimmer-control module.
 - 7) How to get help.

- 8) Description of warranty.
- d. System Troubleshooting: Procedures for handling problems with common software, programming, control console, dimmer rack, and distribution system; include information on how to get help.
- B. Software and Firmware Operational Documentation:
 - 1. Software operating and upgrade manuals.
 - 2. Program Software Backup: On USB drive or compact disk, complete with data files.
 - 3. Device address list if applicable.
 - 4. Printout of software application and graphic screens.

1.07 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Dimmer Modules: One of each type and rating installed.
 - 2. Fuses: Three of each kind.

1.08 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

1.09 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of the complete dimming control system and luminaires that fail in materials or workmanship within specified warranty period.
 - 1. Lamps are not included as part of the special warranty.
 - 2. Warranty Period: Cost to repair or replace parts for two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with NFPA 70.

2.02 PLUG CONNECTORS

- A. Twist-Locking Type: NEMA WD 6, two pole, three wire, 20 A.

2.03 LUMINAIRES AND ACCESSORIES

- A. General:
 - 1. Comply with UL 1573 and listed and labeled by an NRTL.
 - 2. Luminaires: Equipped with pigtail, yoke with pipe clamp, safety cable for batten mounting, and filter holder.
 - 3. Metal Parts: Free of burrs, sharp corners, and edges.
 - 4. Sheet Metal Components: Steel unless otherwise indicated. Form and support to prevent warping and sagging.
 - 5. Luminaire Doors and Their Internal Access: Smooth operating, free of light leakage under operating conditions, and arranged to permit relamping without use of tools. Doors, lenses, diffusers, and other pieces arranged to prevent accidental falling during relamping and when secured in operating position.

6. Pigtail: Factory wired, 36-inch-long, three-wire cord and plug connector assembly with cord encased in woven fiberglass or silicone tubing.
 7. Lamp Sockets: Relampable without disturbing alignment or focus adjustment.
 8. Luminaire Ventilation Openings: Baffled against light leaks.
 9. Luminaire Operating Controls and Handles: Thermally insulated.
 10. Lenses: Borosilicate glass in silicone mountings.
 11. Framing Shutters: Stainless steel, four way; with each blade in a separate plane under adjustable tension mounting. Blades adjust plus or minus 30 degrees of rotation in gate for 120-degree-minimum total angular rotation between adjacent blades.
 12. Color Filter Frame Holder: Attached to front of luminaire.
 13. Luminaire Yoke: Rigid metal, arranged for vertical aiming of unit and equipped with T-bolt or hand screw to lock alignment.
- B. Ellipsoidal Spotlights: Luminaires with an elliptical reflector mounted in a fixed relationship to the lamp. Light shall be projected through a gate where the beam is shaped by using shutters, a gobo, or an iris. The shaped beam shall then be focused by a system of lenses.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Electronic Theatre Controls, Inc.
 - b. Strand Lighting.
 2. Tag: ES-1 (26 degree):
 - a. Lamp: 575 W ANSI HPL.
 - b. Pattern Holders: Three for each luminaire, with framing shutters.
 - c. Color Frame: Black, metal.
 - d. 26 Degree – Basis of Design luminaire: ETC Source 4jr #426J-C with 400CC C-Clamp 400SC safety chain, (3) 400PH-M pattern holders (M size), and RT171 120V long life lamp.
 3. Tag: ES-2 (36 degree):
 - a. Lamp: 575 W ANSI HPL.
 - b. Pattern Holders: Three for each luminaire, with framing shutters.
 - c. Color Frame: Black, metal.
 - d. 36 Degree – Basis of Design luminaire: ETC Source 4jr #436J-C with 400CC C-Clamp 400SC safety chain, (3) 400PH-M pattern holders (M size), and RT171 120V long life lamp.
- C. Zoom Ellipsoidal Spotlights: Luminaires with an elliptical reflector mounted in an adjustable relationship to the lamp. Light shall be projected through a gate where the beam is shaped by using shutters, a gobo, or an iris. The shaped beam shall then be focused by a system of lenses.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Electronic Theatre Controls, Inc.
 - b. Strand Lighting.
 2. Tag: ZES-1:
 - a. Lamp: 575 W ANSI HPL.
 - b. Pattern Holders: Three for each luminaire, with framing shutters.

- c. Operator adjustable from 25- to 50-degree field angle.
 - d. Field-angle adjustment scale label on instrument housing for field reference.
 - e. Basis of Design luminaire: ETC Source 4jr Zoom #42550J-C with 400CC C-Clamp 400SC safety chain, (3) 400PH-M pattern holders (M size), and RT171 120V long life lamp.
- D. Fresnel Lens Spotlights:
- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Electronic Theatre Controls, Inc.
 - b. Strand Lighting.
 - 2. Die-cast extruded-aluminum housing, with hinged front for relamping.
 - 3. Tag: FLS-1.
 - a. Lamp: 575 W ANSI HPL.
 - b. Lens: 7 inches.
 - c. Basis of Design luminaire: ETC Source 4 Fresnel #FRES7-C with 400CC C-Clamp 400SC safety chain, 400BD Barn Door, and RT171 120V long life lamp.
 - d. Barn Doors: Two four-leaf rotatable metal flaps for every three luminaires.

2.04 DISTRIBUTION COMPONENTS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. Electronic Theatre Controls, Inc.
 - 2. ESL Power Systems, Inc.
 - 3. Performance Electric.
 - 4. SSRC.
- B. Connector Strip: Listed and labeled by an NRTL; factory-wired wire way and receptacle assembly.
 - 1. Wire way: Steel or extruded aluminum, with removable cover and nominal cross-section dimensions of 3 by 4-1/2 inches.
 - 2. Accessories: Cable clamps, support cradles, and cable strain relief grips for each cable.
 - 3. Receptacles: Flush mounted in wire way cover, 120V, 20 A rated twist-locking type.
 - 4. Receptacle Wiring: For connecting to terminal blocks; with 125 deg C, crosslinked, PE-insulated, identification-labeled wire.
 - 5. Terminal Blocks: Molded-barrier type with screw lugs to suit supply conductors.
 - 6. Mounting Hardware: Furnished with each unit; permits surface, single-pipe-bracket, or double-pipe-bracket mounting.
 - 7. Finish: Semi gloss or matte black.

2.05 WIRE AND CABLE

- A. Building Wire in Raceways: Comply with requirements specified in Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."
- B. Portable Power Cable: Listed and labeled by an NRTL; flexible stage and lighting power cable; Type SC, SCE, or SCT; 600 V; multiconductor; 60 deg C temperature rating.

- C. Ethernet Cabling: Comply with requirements specified in Section 26 05 23 "Control-Voltage Electrical Power Cables."
 - 1. For 10/100BaseT, comply with provisions for UTP cable and hardware.
- D. ANSI E1.11 (USITT DMX512-A) Control Cabling: Comply with requirements specified in Section 26 05 23 "Control-Voltage Electrical Power Cables."
 - 1. Standard Cable: NFPA 70, Type CM.
 - a. Paired, low-capacitance computer cable for ANSI E1.11 (USITT DMX512-A) applications. Two pairs, twisted, No. 22 AWG, stranded, tinned-copper conductors.
 - b. PE insulation.
 - c. Inner Shield: 100 percent coverage, aluminum foil-polyester tape.
 - d. Outer Shield: 90 percent coverage, tinned-copper braid.
 - e. Outer Shield Drain Wire: Stranded, tinned copper.
 - f. PVC jacket.
 - g. Flame Resistance: Comply with UL 1581.
 - 2. Plenum-Rated Cable: NFPA 70, Type CMP.
 - a. Paired, low-capacitance computer cable for ANSI E1.11 (USITT DMX512-A) applications. Two pairs, twisted, No. 22 AWG, stranded, tinned-copper conductors.
 - b. Insulation: Foam fluoridated ethylene propylene.
 - c. Inner Shield: 100 percent coverage, aluminum foil-polyester tape.
 - d. Outer Shield: 90 percent coverage, tinned-copper braid.
 - e. Outer Shield Drain Wire: Stranded, tinned copper.
 - f. Low-smoke PVC jacket.
 - g. Flame Resistance: Comply with NFPA 262.
- E. Control-Voltage Control Cabling:
 - 1. Control-Cable Conductors:
 - a. Class 1 Control Circuits: Stranded copper, Type THHN, in raceway; complying with UL 44.
 - b. Class 2 Control Circuits: Stranded copper, Type THHN, in raceway where installed in open areas, power-limited cable, where concealed in building finishes; complying with UL 44.
 - c. Class 3 Remote-Control and Signal Circuits: Stranded copper, Type TW or Type TF; complying with UL 83.
 - 2. Paired Cable: NFPA 70, Type CMG.
 - a. One pair, twisted, No. 16 AWG, stranded, tinned-copper conductors.
 - b. PVC insulation.
 - c. Unshielded.
 - d. PVC jacket.
 - e. Flame Resistance: Comply with UL 1581.
 - 3. Plenum-Rated, Paired Cable: NFPA 70, Type CMP.
 - a. One pair, twisted, No. 16 AWG, stranded (19x29), tinned-copper conductors.
 - b. PVC insulation.

- c. Unshielded.
- d. PVC jacket.
- e. Flame Resistance: Comply with NFPA 262.

2.06 LIGHTING CONTROL SYSTEM

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. Electronic Theatre Controls, Inc.
 - 2. Strand Lighting.
- B. Description: Microprocessor-based modular system consisting of dimmer and control modules operated from remote-control stations and a control console.
 - 1. Comply with UL 508.
 - 2. Comply with ANSI E1.11 (USITT DMX512-A) ACN for data transmission.
- C. Dimmer Racks: Listed and labeled by an NRTL; dead-front, front-access, wall-mounted rack for mounting modular dimmers; formed-steel or extruded-aluminum structural members; completely enclosed with steel or aluminum panels. Painted with manufacturer's standard corrosion-resistant primer and finish coats, and having the following features:
 - 1. Primary Circuit Breaker: Fault-current withstand rating of the rack; not less than 10,000 A, symmetrical.
 - 2. Hinged, locking front door, with openings to allow air intake across the face of all dimmer modules.
- D. Dimmers: Modular solid-state units that operate smoothly over their operating ranges without audible lamp noise or radio-frequency interference at any setting. Modules shall be dead-front, draw-out type with floating line, load, and control sockets for smooth insertion and withdrawal; with load-side thermal-magnetic circuit breaker, speed-controlled cooling fan, and over temperature sensor.
 - 1. Non-Dim Units: On-off relay control only. Capable of serving inductive loads, such as motors or HID luminaires.
 - 2. Surge Protection: Modules shall withstand power-line surges of 6000 V/3000 A according to IEEE C62.41.1 and IEEE C62.41.2.
 - 3. Filter each dimmed circuit to provide a minimum 350-mic.sec., current-rise time at a 90-degree conduction angle at 50 percent of rated dimmer capacity. At any load within rating, rate of current rise shall not exceed 30 mA/mic.sec., measured from 10 to 90 percent of load current waveform.
- E. Control System: Microprocessor-based control system, ANSI E1.11 (USITT DMX512-A) ACN protocol, with a nonvolatile system memory to adjust dimmer channel settings for different scenes, to patch dimmers to channels, and to manually or automatically change dimmer settings from one preset scene to another.
 - 1. Control shall support Ethernet-based LAN at devices.
 - 2. Provide means to create and monitor show data on a PC using software by console manufacturer. Software shall be capable of the following:
 - a. Creating show and providing for use of show files.
 - b. Playing back show in a console-simulation mode.
 - c. Accessing all remote-control stations associated with the console and control system.
 - d. Providing standard Ethernet connection between the console control system and the lighting system components.
 - e. System shall be compatible with Audio/Visual "Crestron" control interface system for sharing of scene preset operation controls.

3. Display the following system status information on a color, 17-inch LCD monitor associated with the control console:
 - a. Current channel intensities.
 - b. Cue information.
 - c. Monitor.
- F. Control Console: Tabletop unit with manual and computer-based programming controls, memory units, indicating devices, and the following features:
1. Grand-master level control.
 2. Blackout switch.
 3. Multiple submaster level controls with overlapping pile-on performance.
 4. Bump buttons for momentary control of channels or submasters, one for each submaster level control.
 5. Two cross-fade controls for split dipless fade between scenes, each with its own fade progress indicator.
 6. One set of scene level controls for each scene when used in two-scene preset mode. Second set of scene level controls to allow setting levels into memory for expanded single scenes when used in multiple single-channel scene mode. Each set shall have same quantity of scene level controls as is used for submaster level controls.
 7. Multibutton keypad for programming in multiscene memory mode.
 8. Fade time control for assigning fade time to cues, with individual cue adjustment from one second to five minutes, minimum.
 9. Digital display, for operating menus and memory readout.
 10. Controls for setting levels into memory.
 11. Cord and connector for connecting console to outlets for console power and control.
- G. System Operation: Selectable between multichannel two-scene preset and four-channel single-scene memory. Console features include electronic patching of control signals for up to 512 dimmers and off-line data storage using USB drive port. Operational capability includes the following:
1. Live and blind programming.
 2. Special effects programmability for automatic operation of lights in pulsating, sequential dimming and brightening, and other special operating modes. Special effects menu displays operator guidance for programming and individual step levels.
 3. Signal from fire-alarm control panel that automatically brings selected circuits to fully on or fully bright condition, overriding normal dimming and on-off controls.
 4. Inserting cues between designated cues without renumbering.
 5. Out-of-sequence playback of cues.
 6. Controlling houselights and stage lights from console by assigning their dimmers or non-dim on-off controls to a channel.
 7. Retaining programmed cues in memory for minimum of one year after power outage.
 8. Automatic sequential execution of programmed cues.
 9. Printing cues using parallel or serial printer port, cable, and printer. Cable and printer are not included with this system.
- H. Console Power and Control Outlets: Multiple receptacles matched to connector on console connector cord.
- I. House Lighting Control Station: Architectural-type, multichannel, remote-dimmer-control station with the following features:

1. System controls designated houselights, stage lights, and other lights.
 2. Stage lighting controls compatible with dimming and control system.
 3. System compatible with LED light engines and drivers based on 0-10V dimming configuration.
 4. Flush mounting.
 5. Eight channels, each with slider control.
 6. Master-slider that controls lights on all channels proportionally from completely dimmed to degree of brightness that corresponds to individual slider positions.
 7. Fully on switch that turns all channels on at full brightness regardless of slider position.
 8. Take-control/off switch that places station in control of channels and sets lighting to levels dictated by channel and master-slider controls.
 9. Legend on face of wall plate that identifies items as "House Lighting Control Station" and identifies functions of each slider and switch position, with slider positions individually graduated from zero to maximum.
 10. Illuminated push buttons for activating preset scenes of house lighting and labeled "Entry" and "Panic."
 11. Flush wall mounted unless otherwise indicated.
- J. Key-Entry Station: Key-operated switch controls station to activate or deactivate indicating light and presets scene of lighting control system.
1. LED indicating light illuminates when preset command is executed.
 2. Labeled "Entry."
 3. Flush wall mounted unless otherwise indicated.
- K. Flush wall mounted unless otherwise indicated.

2.07 RIGGING COMPONENTS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
1. James Thomas Engineering, Inc.
 2. SSRC.
- B. Pipe Clamps: Malleable iron, suitable for clamping luminaires or items to pipe from 3/4 to 2 inches in OD. Arranged for horizontal rotation of yoke for aiming; equipped with T-bolt to lock alignment.
- C. Safety Cables: Heavy-duty, flexible steel; 30-inch nominal length, with spring clip at one end and steel ring at the other end.
- D. Cable Grips: Stainless steel; basket-weave type for supporting stage cables.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Comply with NECA 1.
- B. Set permanently mounted items level, plumb, and square with ceilings and walls.
- C. Indicated mounting heights are to bottom of unit for suspended items and to center of unit for wall-mounted items.
- D. Mount and connect luminaires, and install and connect distribution devices.
 1. If arrangement is not indicated, install so each luminaire, dimmer, house lighting circuit, control channel, and outlet circuit can be operated, and complete system demonstrated, in all operating modes.

2. Install safety cables secured to stage rigging or gridiron for all pipe-mounted electrical luminaires and equipment.
- E. Dimmer Rack Mounting: Install and anchor dimmer rack on wall plumb and level. Maintain clearance recommended by manufacture for working clearance and ventilation.
1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around full perimeter of base.
 2. For dimmer racks, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
 3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 4. Install anchor bolts to elevations required for proper attachment to dimmer racks.
- F. Provide control interface with Fire Alarm Control Panel to place house lighting at 100% output upon activation of alarm.
- G. Provide UL 924 emergency by-pass device for house lighting connected to emergency generator circuit. Lighting on emergency generator circuit shall return to 100% output upon loss of normal power.

3.02 WIRING

- A. Power Wiring:
1. Install wiring as specified in Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables" for hardwired connections. Install wiring in raceways except cable and plug connections. Install cable strain relief device on power and control cable drops.
 2. Install power wiring with a separate neutral for each output circuit from main dimmer and for each house and stage lighting circuit.
- B. Signaling, Remote-Control, and Power-Limited Circuits:
1. Comply with requirements specified in Section 26 05 23 "Control-Voltage Electrical Power Cables" for installation of wiring.
 2. Comply with the following unless otherwise indicated:
 - a. Size conductors according to lighting control device manufacturer's written instructions.
 - b. Select cable insulation, shielding, drain wire, and jacket complying with lighting control device manufacturer's written instructions.
 - c. Install circuits to eliminate RFI and electromagnetic interference.
 3. Remote-control circuits associated with emergency lighting control shall be installed complying with Class 1 circuit standards in NFPA 70.
- C. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points.
- D. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes and in terminal cabinets and equipment enclosures.
- E. Remove wall plates and protect devices and assemblies during painting.
- F. Support luminaires, distribution components, and accessories as specified in Section 26 05 29 "Hangers and Supports for Electrical Systems." Equip all pipe-mounted equipment with safety cables that are secured to supporting pipe.
- G. Ground equipment according to Section 26 05 26 "Grounding and Bonding for Electrical Systems."

3.03 IDENTIFICATION

- A. Identify components and power and control wiring according to Section 26 05 53 "Identification for Electrical Systems."

- B. Label each luminaire, lighting outlet, distribution device, and dimmer module with unique designation. Labels on elevated components shall be readable from the floor.

3.04 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
 - 1. Schedule visual and mechanical inspections and electrical tests with at least seven days' advance notice.
 - 2. Visual and Mechanical Tests and Inspections:
 - a. Inspect each luminaire, outlet, module, control, and device for defects, finish failure, corrosion, physical damage, labeling by an NRTL, and nameplate.
 - b. Exercise and perform operational tests on mechanical parts and operable devices according to manufacturer's written instructions.
 - c. Check tightness of electrical connections with torque wrench.
 - d. Verify proper protective device settings, fuse types, and ratings.
 - e. Record results of tests and inspections.
 - 3. Electrical Tests: Perform tests according to manufacturer's written instructions.
 - a. Continuity tests of circuits.
 - b. Operational Tests: Connect each outlet to a luminaire and a dimmer output circuit, so each dimmer module, dimmer-control and output circuit, outlet, and luminaire in a typical operating mode will be sequentially tested. Set and operate controls to demonstrate luminaires, outlets, dimmers, and controls in a sequence that cues and reproduces actual operating functions for a typical system of the size and scope installed. Include operation and control of houselights and stage lights from each control location and station, including optional plug-in, control-console outlet locations. Record luminaire and outlet assignments, control settings, operations, cues, and observations of performance.
- B. Stage lighting will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.
 - 1. Prepare a schedule of lighting outlets by number; indicate circuits, dimmers, connected luminaires, and control-channel assignments. Prepare a schedule of control settings and circuit assignments for house control channels. Prepare written reports of tests and observations. Report defective materials, workmanship, and unsatisfactory test results. Include records of repairs and adjustments made.

3.05 ADJUSTING

- A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.
- B. Modify the software programming as required to comply with the Contract Documents.

3.06 SOFTWARE SERVICE AGREEMENT

- A. Technical Support: Beginning at Substantial Completion, service agreement shall include software support for two years.
- B. Upgrade Service: At Substantial Completion, update software to latest version. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software shall include operating system and new or revised licenses for using software.
 - 1. Upgrade Notice: At least 30 days to allow Owner to schedule and access the system and to upgrade computer equipment if necessary.

3.07 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's staff to adjust, operate, and maintain stage lighting equipment.
 - 1. Training shall be one four-hour session.
 - 2. Include costs associated with the training with the equipment installation.
 - 3. Provide a 14-day notice to Owner prior to scheduling training period.

END OF SECTION 26 55 61