This is a guidance document which was made for the U.S. General Services Administration ARRA PMO for standardization. Any use of this content would need to be edited for applicability to the specific agency and project goals.

Attachment X

Specifications

This specification document is part of a set of documents used for ARRA relighting projects. It is an attachment to the Statement of Work which is an attachment to the Commercial Item for Construction Contract. This document is used as applicable to the specific project scope.

Edit this document based on the blue guidance text.

INTERIOR LIGHTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Interior lighting fixtures, components, lamps, and ballasts.
2. Lighting fixture supports.

1.2 DEFINITIONS

A. AFF: Above finished floor.

B. BF: Ballast factor.

C. DALI: Digital Addressable Lighting Interface.

D. CCT: Correlated color temperature.

E. CRI: Color-rendering index.

F. FC: Footcandles.

G. LER: Luminaire efficacy rating.

H. Lumen: Measured output of lamp and luminaire, or both.

I. Luminaire: Complete lighting fixture, including lamp, lens, shielding and ballast housing if provided.

J. Personal Control: Within the context of these documents as it pertains to lighting personal control is individual occupant control of lighting levels within an individual workstation or private office.

K. Workstation Specific Luminaire: Individual suspended direct/indirect lighting fixture installed in immediate proximity to individual workstation with direct lighting (downlight) controlled by workstation occupant and indirect component (uplight) controlled by zone control.

1.3 REFERENCE AND STANDARDS

A. Regulatory Agencies

1. Provide luminaires constructed, wired and installed in compliance with the current edition of applicable city, state and national codes. Provide luminaires conforming to or exceeding Underwriters Laboratories (UL) standards, and to provisions of applicable codes which exceed those standards.
2. For any category of luminaire tested by any of the following agencies, provide luminaires listed and labeled by an independent Nationally Recognized Testing Laboratory (NRTL) such as UL, ETL, CSA, MET.
3. Use only electrical components listed by the above agencies.

B. Recognized Standards: Luminaires shall comply with the applicable standards of the following organizations.

1. Underwriters Laboratories (UL).
2. National Electrical Code (NEC).
3. Certified Ballast Manufacturers Association (CBM).
4. Illuminating Engineering Society of North America (IESNA).
5. American Society for Testing and Materials (ASTM).
6. American National Standards Institute (ANSI).
7. National Electrical Manufacturer's Association(NEMA)

1.4 QUALITY ASSURANCE

A. Luminaires of same type and style shall be from a single manufacturer.

B. Lamps shall be from a single manufacturer and batch.

C. Components and fixtures shall be listed and approved for use by Nationally Recognized Testing Laboratory (NRTL) including: UL, ETL, and CSA, or equivalent.

D. Submitted products shall meet all aspects of this performance specification, or clearly indicate any variations, with a description of how the proposed product meets or exceeds the required performance.

E. Luminaire Photometric Data Testing Laboratory Qualifications: Shall be provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910, complying with the IESNA Lighting Measurements Testing & Calculation Guides.

F. 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.

G. Comply with NFPA 70.

H. Mockups: Provide interior lighting fixtures for room or module mockups, complete with power and control connections.

1. Obtain GSA's approval of fixtures for mockups before starting installations.
2. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
3. Approved fixtures in mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.5 SUBMITTALS

A. Shop drawings, samples, test data and certificates must be submitted to the GSA for approval in accordance with the requirements of the Contract Documents and General Requirements. Lighting control system components must not be shipped, stored or installed into the Work unless prior approval has been received, based upon the submittal of shop drawings, samples, catalogue cuts, test data, certificates or other material submitted for approval.

B. The GSA will make the final determination as to whether or not the submittal contains sufficient information and reserves the right to request a shop drawing of any component if a standard catalogue cut is deemed insufficient.

C. Product Data: For each type and model of lighting fixture, arranged in order of fixture designation. Include data on features, accessories, finishes, and the following:

1. Detailed and dimensioned Shop Drawings indicating kind, weight and thickness of materials, method of fitting and fastening parts together, location and number of sockets, size of lamps, and complete details of method of fitting suspension and fastening fixtures in place. Provide wiring diagrams for lighting control equipment. Drawings shall contain sufficient information to assemble and install equipment at the Project site without further instructions.
2. Ballast, including Ballast Factor (BF).
3. Lamp data including life, output, lumens, CCT and CRI.
4. Energy-efficiency data including but not limited to nominal lamp wattage, ballast input wattage, ballast efficiency and mean efficacy (mean lumens/input watts), Luminaire Efficiency Rating (LER), and Coefficient of Utilization (CU).
5. Photometric data and adjustment factors based on laboratory tests, complying with IESNA Lighting Measurements Testing & Calculation Guides, of each lighting fixture type. The adjustment factors shall be for lamps, ballasts, and accessories identical to those indicated for the lighting fixture as applied in this Project.

    a. Testing Agency Certified Data: For indicated fixtures, photometric data shall be certified by a qualified independent testing agency. Photometric data for remaining fixtures shall be certified by manufacturer.
    b. Manufacturer Certified Data: Photometric data shall be certified by a manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.
6. Air and Thermal Performance Data: For air-handling lighting fixtures.
7. Sound Performance Data: For air-handling lighting fixtures. Indicate sound power level and sound transmission class in certified test reports.

D. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
2. Wiring Diagrams: For power, signal, and control wiring.

E. Samples: For each lighting fixture. Each Sample shall include the following:

1. Lamps and ballasts, installed.
2. Cords and plugs for 120 volt supply.
3. Pendant support system.

F. Installation instructions.

G. Product Certificates: For each type of ballast from manufacturer.

H. Field quality-control reports.

I. Operation and Maintenance Data: For lighting equipment and fixtures, to include emergency, operation, and maintenance manuals.

1. Provide a list of all lamp and ballast types used on Project; use ANSI and manufacturers' codes.

J. Warranty: Sample of special warranty.

1.6 COORDINATION

A. Coordinate layout and installation of lighting fixtures and suspension system with other construction that penetrates ceilings or is supported by them, including HVAC equipment, fire-suppression system, and partition assemblies.

1.7 WARRANTY

A. Special Warranties: Manufacturer's standard form in which manufacturer agrees to repair or replace components that fail in materials or workmanship within specified warranty period.

1. Lamps: 24 months from date of Substantial Completion.
2. Ballasts: 60 months from date of Substantial Completion.
3. Fixtures: 36 months from date of Substantial Completion.
4. Controls mounted on or integral to luminaires: 6- months from date of Substantial Completion.

B. Contractor shall provide a 2-year labor guarantee. In the event of lamp or ballast failure during the warranty period, Contractor shall provide GSA with replacement allowance of $15.00 per failed fixture.

1.8 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Lamps: [**10 for every 100**] <**Insert quantity**> of each type and rating installed. Furnish at least one of each type.
2. Plastic Diffusers and Lenses: [**One for every 100**] <**Insert quantity**> of each type and rating installed. Furnish at least one of each type.
3. Ballasts: [**One for every 100**] <**Insert quantity**> of each type and rating installed. Furnish at least one of each type

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR LIGHTING FIXTURES AND COMPONENTS

A. Recessed Fixtures: Comply with NEMA LE 4 for ceiling compatibility for recessed fixtures.

B. Fluorescent Fixtures: Comply with UL 1598. Where LER is specified, test according to NEMA LE 5 and NEMA LE 5A as applicable.

C. Capable of operating at input voltage of **[120 V] [277 V] [120 V and 277 V].**

D. Maximum fixture length shall be 8 feet. Maximum depth shall 5 inches. Design unit for no deflection with two end supports.

E. Metal Parts: Free of burrs and sharp corners and edges.

F. Finishes: Baked-on enamel or powder coated unless indicated otherwise.

G. Sheet Metal Components: Steel unless otherwise indicated. Form and support to prevent warping and sagging.

H. Lamp holders: Low profile, medium Bi-Pin fluorescent of high-strength and quickwire pressure terminals with recessed wire wells to insulate against shorting; chemical-resistant thermoplastic body and equipped with a captive nut.

I. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.

J. Diffusers:

1. Diffusers: Acrylic Lighting Diffusers: High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.

    a. Lens Thickness: At least [**0.125 inch (3.175 mm)**] <**Insert dimension**> minimum unless otherwise indicated.
    b. UV stabilized.

K. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps and ballasts. Labels shall be located where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.

1. Label shall include the following lamp and ballast characteristics:

    a. "USE ONLY" and include specific lamp type.
    b. Lamp diameter code (T-5, T-8, etc.), tube configuration (twin, quad, triple, etc.), base type, and nominal wattage for fluorescent and compact fluorescent luminaires.
    c. Start type for fluorescent luminaires.
    d. CCT and CRI for all luminaires.

[Use paragraph below only if air-handling fluorescent fixtures are specified:]

L. Air-Handling Fluorescent Fixtures: For use with plenum ceiling for air return and heat extraction and for attaching an air-diffuser-boot assembly.

1. Air-Supply Units: Slots in one or both side trims join with air-diffuser-boot assemblies.
2. Heat-Removal Units: Air path leads through lamp cavity.
3. Combination Heat-Removal and Air-Supply Unit: Heat is removed through lamp cavity at both ends of the fixture door with air supply same as for air-supply units.
4. Dampers: Operable from outside fixture for control of return-air volume.
5. Static Fixture: Air-supply slots are blanked off, and fixture appearance matches active units.

2.2 BALLASTS FOR LINEAR FLUORESCENT LAMPS

A. All linear fluorescent ballasts shall be electronic solid state.

B. General Requirements for Electronic Ballasts:

1. Comply with NEMA Premium for non-DALI systems.
2. Comply with UL 935 and with ANSI C82.11.
3. Ballasts may be non-dim or dimming. Non-dim ballasts may be instant start or programmed rapid start. For vacancy/occupancy sensors controlled units programmed rapid start must be used Designed for type and quantity of lamps served.
4. Low-mercury type meeting federal TCLP standards.
5. Ballasts shall be designed for full light output unless another BF, dimmer, or bi-level control is indicated.
6. Designed for wiring as both Class 1 and Class 2 circuit.
7. Minimum starting temperature: 10 deg C.
8. Sound Rating: Class A.
9. Total Harmonic Distortion Rating: Less than 10 percent.
10. Transient Voltage Protection: IEEE C62.41.1 and IEEE C62.41.2, Category A or better.
11. Operating Frequency: 42 kHz or higher.

12. Lamp Current Crest Factor: 1.7 or less.
13. BF for Super T8 systems 0.87-0.88 unless otherwise noted.
14. BF for Super High Performance T8 systems may be (a) LBF=Low Ballast Factor, ballast factor lower than 0.78, (b) NBF=Normal Ballast Factor, ballast factor between 0.78 and 1.00, or (c) HBF=High Ballast Factor, ballast factor greater than 1.00.
15. Power Factor: 0.95 or higher.
16. “”Parallel Lamp Circuits: Multiple lamp ballasts shall comply with ANSI C82.11 and shall be connected to maintain full light output on surviving lamps if one or more lamps fail.

C. Electronic Programmed-Start Ballasts for T5 or T8 Lamps: Comply with ANSI C82.11 and the following:

1. Lamp end-of-life detection and shutdown circuit for T5 diameter lamps.
2. Automatic lamp starting after lamp replacement.

D. Single Ballasts for Multiple Lighting Fixtures: Factory wired with ballast arrangements and bundled extension wiring to suit final installation conditions without modification or rewiring in the field.

E. Comply with 47 CFR 18, Ch. 1, Subpart C, for limitations on electromagnetic and radio-frequency interference for consumer equipment.

F. Ballasts for Dimmer-Controlled Lighting Fixtures: Electronic type.

1. Dimming Range: 100 to [**5] [10]** percent of rated lamp lumens, without flickering, continuous or no greater than 1 percent steps.
2. Compatibility: Certified by manufacturer for use with specific dimming control system and lamp type indicated.
3. Control: Coordinate wiring from ballast to control device to ensure that the ballast, controller, and connecting wiring are compatible.

G. Ballasts for Bi-Level Controlled Lighting Fixtures: Electronic type.

1. Operating Modes: Ballast circuit and leads provide for remote control of the light output of the associated lamp between high- and low-level and off.

    a. High-Level Operation: 100 percent of rated lamp lumens.
    b. Low-Level Operation: 30 percent of rated lamp lumens.

2. Ballast shall provide equal current to each lamp in each operating mode.
3. Compatibility: Certified by manufacturer for use with specific bi-level control system and lamp type indicated.

H. Digitally addressable ballasts - DALI

1. Must be in accordance with IEC 60929 Annex E & G, or IEC 62386 when adopted, 0-10v ballasts, or 3-wire ballasts. 0-10v or 3-wire ballasts

2. Must be used with interfaces that allow interface with the digital control system.

3. See Lighting Controls Specification 2.2 System Description.

2.3 FLUORESCENT LAMPS

A. General requirements for lamps:

1. Color Temperature: 3500 K, 4100 K, or as indicated. Color shall be consistent throughout Project and the same manufacturer.
2. Low-mercury complying with EPA's Toxicity Characteristic Leaching Procedure standards.

B. Super T8, high-performance lamps

1. Basis-of-Design Product: Subject to compliance with requirements, provide one of the products listed below:

   a. GE "HL"
   b. Sylvania "Xtreme"
   c. Philips "Advantage"

2. Rating: 32 Watts maximum.
3. Nominal length: 48 inches (1220 mm).
4. Initial lumens (minimum): 3100 at 32 Watts.
5. Minimum CRI: 85.
6. Lamp lumen depreciation: 92% or higher at 20,000 hours.
7. Extended rated life: 24,000 to 30,000 hours at 3 hours per start.
8. Lower wattage (25W-30W) Super T8 lamps are acceptable in non-dim applications as long as Mean System Efficacy (mean lumens / input watts) is 98 or higher when calculated with instant start ballast.

C. T5 lamps

1. Rating: 28 Watts maximum.
2. Nominal length: 45.2 inches (1150 mm).
3. Initial lumens (minimum): 2900 at 35 degree C
4. Minimum CRI: 85.
5. Lamp lumen depreciation: 92% or higher at 20,000 hours.
6. Extended rated life: 24,000 to 30,000 hours at 3 hours per start.

2.4 LIGHTING FIXTURE SUPPORT COMPONENTS

A. Single-Stem Hangers: ½-inch (13-mm) steel tubing with swivel ball fittings and ceiling canopy. Finish same as fixture.

B. Twin-Stem Hangers: Two, ½-inch (13-mm) steel tubes with single canopy designed to mount a single fixture. Finish same as fixture.

C. Wires: ASTM A 641/A 641M, Class 3, soft temper, zinc-coated steel, [**12 gauge (2.68 mm)**] <**Insert size**>.

D. Wires for Humid Spaces: ASTM A 580/A 580M, Composition 302 or 304, annealed stainless steel, [**12 gauge (2.68 mm)**] <**Insert size**>.

E. Rod Hangers: 3/16-inch (5-mm) minimum diameter, cadmium-plated, threaded steel rod.

F. Hook Hangers: Integrated assembly matched to fixture and line voltage and equipped with threaded attachment, cord, and locking-type plug.

[Remove Luminaire Types that are not used on this specific project:]

2.5 PRIMARY LUMINAIRES

A. WORKSTATION-SPECIFIC DIRECT/INDIRECT PENDANT FLUORESCENT FIXTURE

1. Description: Linear-shaped luminaire utilizing linear fluorescent light sources, directing illumination directly downward and indirectly upwards. Luminaire must use either three high performance T8 lamps or three T5 lamps. T5HO lamps are not acceptable.
2. The downlight and uplight components shall be compartmentalized to reduce distraction of lamps operating at different output, and wired for separate control.
3. See Division 26 Interior Lighting Control Performance Specifications. All control provisions related to workstation-specific lighting apply to this section.
4. All provisions related to workstation-specific lighting the Scope of Work apply to this section.
5. An occupancy sensor sensitive to workstation occupancy and vacancy shall be integrated into the fixture housing and operation for open-plan workstation applications. Sensors shall be capable of reliably distinguishing workstation occupancy and vacancy from adjacent circulation traffic or adjoining workstations. The sensor shall control the downward lamp component.
6. In open plan offices a photosensor sensitive to light reflected from the viewed plane must be integrated into the fixture's design and operation. In

enclosed offices, either luminaire-based or architectural-mounted sensors are acceptable. Photosensors are not required in fixtures located outside daylighted areas. The control photosensor must be capable of automatically regulating the light intensity of the "ambient" component..

7. Dimming ballasts shall be provided for both the direct and indirect components
8. Luminaire shall be capable of workstation occupant personal dimming and switching control of direct component, using one of the following:

    a. Computer based solution as designed and implemented by GSA
    b. Handheld personal digital assistant
    c. RF or IR Wireless Remote
    d. Other method acceptable to GSA.

9. Pendant-mounted workstation specific linear fluorescent luminaire shall be suspended below the finished ceiling, with a suspension length of 16 inches or longer with 18 to 24 inches recommended. Bottom of fixture shall be mounted between 80 and 84 inches AFF.
10. Suspend with stems or cables at power feeds, and aircraft cable for all other supports. Luminaires shall be mounted level and true
11. Housing: Extruded aluminum or die-formed and welded steel suitable for continuous mounting.
12. Shield bare lamps with baffles or lenses. Baffles shall be semi-specular or high reflectance white. Specular materials or T5 lamps shall not be visible from any viewing angles below the luminaire.
13. Photometric characteristics:

    a. Total Luminaire Efficiency: 60 percent or higher.
    b. Direct component (0-90 degree zone) shall be 45% of total fixture lumens or higher, not to exceed 60%.
    c. Luminaire sides may emit no more than 10% of total lumen output, distributed uniformly between 80 and 100 degrees.
    d. Indirect component (90-180 degree zone) shall be 30% of total fixture lumens or higher, not to exceed 55%. In order to reduce ceiling luminance ratios the percentage of fixture lumens in the 90-120 degree zone shall be 18% or higher.

B. DIRECT/INDIRECT PENDANT FLUORESCENT FIXTURE

1. Description: Two-lamp, linear-shaped luminaire utilizing linear fluorescent light sources, directing illumination directly downward and indirectly upwards. Super T8 or T5 lamps. . T5HO lamps are not acceptable.
2. The pendant-mounted direct/indirect linear fluorescent luminaire shall be suspended below the finished ceiling such that the bottom of the luminaire is mounted at 7 feet AFF. If this results in a condition where suspension from the ceiling would be greater than 24 inches, then the mounting height

AFF can exceed 7 feet and the following alternate requirement applies: stem length must be 24 inches

3. Housing: Extruded aluminum or die-formed and welded steel suitable for continuous mounting.
4. Shield bare lamps with baffles or lenses. Baffles shall be semi-specular or high reflectance white. Specular materials or T5 lamps shall not be visible from any viewing angles below the luminaire.
5. Suspension shall be achieved with stems or cables at power feeds, and aircraft cable for all other supports.
6. Photometric characteristics for luminaires mounted on ceilings at least 100 inches AFF

    a. Total Luminaire Efficiency: 85 percent or higher.
    b. Direct component (0-90 degree zone) shall be 25% of total fixture lumens or higher, not to exceed 50%. To reduce veiling reflections, the percentage of total fixture lumens in the 0° to 30° zone shall not exceed 15%. Percentage of total fixture lumens emitted in the 60° to 90° zone shall not exceed 8%.
    c. Photometrics: Indirect component (90-180 degree zone) shall be 50% of total fixture lumens or higher, not to exceed 75%. In order to reduce ceiling luminance ratios the percentage of fixture lumens in the 90-120 degree zone shall be 18% or higher.

7. Photometric characteristics for luminaires mounting on ceilings less than 100 inches AFF:

    a. Total Luminaire Efficiency: 70 percent or higher.
    b. Direct component (0-90 degree zone) shall be 12% of total fixture lumens or higher, not to exceed 25%. To reduce veiling reflections, the percentage of total fixture lumens in the 0° to 30° zone shall not exceed 8%. Percentage of total fixture lumens emitted in the 60° to 90° zone shall not exceed 5%.
    c. Indirect component (90-180 degree zone) shall be 75% of total fixture lumens or higher, not to exceed 86%. In order to reduce ceiling luminance ratios the percentage of fixture lumens in the 90-120 degree zone shall be 27% or higher.
    d. Ceiling luminance ratios shall not exceed 10:1.
    e. Mockup required, consisting of at least three rows.

C. RECESSED FLUORESCENT FIXTURE

1. Description: Nonplanar-lensed, recessed troffers mounted flush with finished ceiling.

    a. Rectangular 2x4 recessed luminaire utilizing fluorescent light sources and a nonplanar lens (e.g., curved, multi-angled lens, etc) that redirects the light from the lamps to increase the amount of light

leaving in high vertical angles (i.e., greater than 60°) compared to a traditional troffer with a flat lens or parabolic louver.

b. All luminaire components are aligned with or above the plane of the ceiling.

2. Housing: Die-formed 20 gauge steel with a maximum depth of 5.5 inches. Visible surfaces shall be white.

3. Lamps: Two T8 or two T5 fluorescent lamps. T5HO lamps are not acceptable.

4. Photometric characteristics:

   a. Total Luminaire Efficiency: 88 percent or higher.
   b. To reduce veiling reflections, the percentage of total fixture lumens in the 0° to 30° zone shall not exceed 32%.
   c. To achieve the wide distribution, the Spacing Ratio across (perpendicular to the long side) shall be between 1.24 and 1.35.
   d. In order to achieve the high-angle distribution required to light vertical surfaces without excessive glare, the percentage of total fixture lumens emitted in the 60° to 90° zone shall not exceed 20 %.
   e. To reduce glare at high angles, the average luminance of all luminances in the zone 65° - 90° above nadir shall not exceed 2500 candelas per meter square.

2.6 LUMINAIRE SCHEDULE

Describe luminaire applications and reference location of Luminaire Schedule.

A. Open offices with ceilings higher than 100 inches AFF: **[Direct/indirect pendant luminaires] [Workstation Specific Luminaires].**

B. Open offices with ceilings less than 100 inches AFF: **[Recessed 2x4 luminaires] Direct/indirect pendant luminaires- using photometrics for less than 100 inches AFF].**

C. Private offices: **[Recessed 2x4][Direct/indirect pendant][Recessed 2x4 or Direct/indirect pendant]** luminaires.

D. See complete Luminaire Schedule, including fixture descriptions, lamps, ballasts, voltages, integral control equipment and manufacturers' product designations **[and catalogue extracts]** that meet the performance specifications herein and are used as a basis of design. Luminaire Schedule is a part of the Contract Documents and **[is included as Appendix A herein] [can be found on the Electrical Drawings.]**

PART 3 - EXECUTION

3.1 INSTALLATION

A. Lighting fixtures:

1. Set level, plumb, and square with ceilings and walls unless otherwise indicated.
2. Install recessed and surface-mounted fixtures, with plaster frames compatible with ceiling and wall systems employed; secure fixtures mechanically to frames.
3. Install lamps in each luminaire.

B. Align rows of suspended and surface-mounted fluorescent fixtures to form straight lines at uniform elevations.

1. Recessed fixtures shall fit snugly against ceilings to prevent light leakage.
2. Pendants and Rods: Where longer than **48 inches (1200 mm)**, brace to limit swinging.
3. Stem-Mounted, Single-Unit Fixtures: Suspend with twin-stem hangers.
4. Continuous Rows: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of fixture chassis, including one at each end.
5. Do not use grid as support for pendant luminaires. Connect support wires or rods to building structure.

C. Recessed fixture suspension support in T-bar ceilings as follows:

1. Attach fixtures to ceiling grid to resist a horizontal force equal to the weight of fixtures.
2. For intermediate and heavy-duty grid systems, fixtures weighing less than 56 pounds shall also have three 12 gage slack safety wires from diagonal corners to the structure above; independently support fixtures weighing more than 56 pounds with not less than 4 taut 12-gage wires capable of supporting 4 times load. Fixture hanger wire ends shall be twisted 3 tight turns within a 1 ½ -inch distance. Provide positive point of attachment to T-bar ceiling with four (4), #8 wafer head tek screws (one at each corner), avoiding conflict with operation of the lens. Coordinate fixture installation with acoustical ceiling installation.
3. Provide each fixture with a six-foot section of MC cable connected from the electrical junction box to the fixture to allow for horizontal adjustment of fixture to coordinate with final furniture location. Junction boxes shall be labeled with panel and circuit contained with use of permanent marker on cover.

[Retain subparagraph below if Project requires seismic design.]

4. Install at least one independent support rod or wire from structure to a tab on lighting fixture. Wire or rod shall have breaking strength of the weight of fixture at a safety factor of 3.

3.2 IDENTIFICATION

A. Indicate circuit and panel location on as-built record drawings.

3.3 TESTING, ADJUSTMENT, AND COMMISSIONING

A. Check and adjust fixtures for required illumination.

B. Replace defective lamps and ballasts.

C. Test and adjust lighting control equipment for proper operation. Refer to the Interior Lighting Controls Specification for additional controls requirements..

1. Adjust aimable luminaires in the presence of GSA.

2. Commissioning of daylighting luminaires must be done after daylight hours

D. After adjustments, retest to demonstrate compliance with standards.

E. Supply personnel and equipment in accordance with local labor laws to adjust and focus fixtures (under GSA's supervision). Lock all fixtures into place so aiming is not disturbed during future re-lamping.

3.4 STARTUP SERVICE

A. Burn-in all lamps that require specific aging period to operate properly, prior to occupancy by GSA. Burn-in fluorescent lamps intended to be dimmed, for at least 100 hours at full voltage.

3.5 ADJUSTING

A. Occupancy Adjustments: When requested within [**12**] <**Insert number**> months of date of Substantial Completion, provide on-site assistance in adjusting aimable luminaires to suit actual occupied conditions. Provide up to [**two**] <**Insert number**> visits to Project during other-than-normal occupancy hours for this purpose. Some of this work may be required after dark.

1. Adjust aimable luminaires in the presence of GSA.

3.6 CLEANING

A. Remove rubbish, debris, and waste materials from all areas of work each shift. Occupied areas shall be left undisturbed. Care shall be taken not to move or break objects on occupants work surfaces.

B. Clean fixture surfaces of dirt, cement, plaster and debris. Furnish cleansers compatible with material surfaces being cleaned.

3.7 DEMONSTRATION AND TRAINING

A. In accordance with GSA-approved schedule and following approval of operations and maintenance documents submission, provide a minimum of four (4) hours, not to exceed eight (8) hours, of expertise and training concerning the installation, characteristics, operations, and maintenance of systems and equipment.

B. Videotape the training session. Provide two (2) copies in DVD.

END OF SECTION