



Recommended Practice
for Installing

Indoor Commercial Lighting Systems



Published by
National Electrical
Contractors Association



Jointly developed with
Illuminating Engineering
Society of North America



An American National Standard

NECA/IESNA 500–1998

Recommended Practice for

Installing Indoor Commercial Lighting Systems

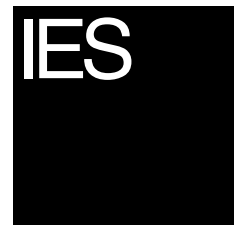


*National
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National Electrical Installation Standards™

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(This foreword is not a part of the standard)

Foreword

National Electrical Installation Standards™ are designed to improve communication among specifiers, purchasers and suppliers of electrical construction services. They define a minimum baseline of quality and workmanship for installing electrical products and systems. *NEIS™* are intended to be referenced in contract documents for electrical construction projects. The following language is recommended:

Lighting systems shall be installed in accordance with **NECA/IESNA-500, *Recommended Practice for Installing Indoor Commercial Lighting Systems* (ANSI).**

Use of *NEIS* is voluntary, and neither the National Electrical Contractors Association nor the Illuminating Engineering Society of North America assume any obligation or liability to users of this standard. Existence of a standard shall not preclude any member or non-member of either organization for specifying or using alternate construction methods permitted by applicable regulations.

Everything in this publication is intended to comply with the edition of the National Electric Code® (NEC) in effect at the time of publication. *NEIS* are not intended to duplicate NEC requirements nor to establish regulatory requirements for electrical construction. It is the responsibility of users of this

Standard to comply with state and local electrical codes when installing electrical products and systems.

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1. Scope

1.1 Lighting Systems and Equipment Included

This standard describes installation procedures for lighting systems commonly used in commercial and retail buildings, including but not limited to the following:

- Recessed lighting systems such as troffers, downlights, wallwashers, valance lights, and accent lights.
- Ceiling surface-mounted lighting systems such as surface troffers, wraparounds, surface downlights, monopoints, and decorative fixtures.
- Ceiling-suspended lighting systems such as pendant luminaires, warehouse or industrial luminaires, uplight systems, or decorative luminaires.
- Wall mounted lighting systems such as sconces or wallpacks.
- Track lighting systems.

1.2 Lighting Systems and Equipment Excluded

While this standard is generally applicable to most commercial lighting systems, the following are specifically excluded:

- Lighting systems supported and installed from industrial lighting track or wireway systems.

- Low voltage lighting systems in which the transformer is not integral to the luminaire and secondary wiring is required.
- Lighting systems designed for showcases, refrigerated cases, and other special conditions.
- High voltage lighting systems such as neon or cold cathode.
- Outdoor lighting systems including site or roadway lighting
- Portable lighting.

1.3 Related Construction Materials

In addition to the luminaire(s) proper, this standard includes related construction materials including lamps, conduit, wire, various special screws and clips, structural suspension components.

1.4 Code Requirements and Manufacturers' Recommendations

All recommendations of this publication are intended to comply with the National Electrical Code®, NFPA Standard 70, and in general the typical recommendations of commercial luminaire manufacturers.

However, regardless of these recommendations, installers should always follow the NEC®, applicable state and local codes, and manufacturer's instructions.

2. Definitions

Downlight	A recessed, surface- mounted or suspended luminaire, usually a round cylinder, with an opening on the bottom to direct light downward. Called “cans” or “top hats,” downlights generally house single-ended lamps. There are many different types and styles. Downlights using compact fluorescent and high-intensity discharge lamps generally include the necessary ballast(s) for the lamp(s) within the luminaire.	Owner	For the purposes of this standard, this may mean the owner, tenant, architect, builder, general contractor, or consultants who represent the interests of the party for whom the project is being built.
		Portable Luminaire	A luminaire designed with a cord-and-plug and intended to be located and connected by building occupants.
Industrial Luminaire	luminaires designed for industrial applications, typically either open-bottom fluorescent or open or lensed high intensity discharge (HID) luminaires.	Reflected Ceiling Plan	A drawing usually prepared by the architect which indicates ceiling systems, finishes, and the location and coordination of systems or devices of all trades.
Light Fixture	A luminaire designed for permanent attachment to a building.	Staging Area	An area in which luminaires are removed from packing and prepared for installation, including installing whips, accessories, and so forth.
Lighting Track	A manufactured assembly designed to support and energize lighting fixtures that are capable of being readily repositioned along the track.	Trim	A finishing piece usually intended to cover a joint or hole. In recessed luminaires, the trim is often a substantial part, which may include a reflector, lampholder, and/or a flange or ring designed to cover the joint between the luminaire and the ceiling.
Luminaire	Device including lampholder(s), wiring, and means of support and connection to source of power. A luminaire may include ballast, lens(es), louvers, reflectors, and/or structural or ornamental fittings.		

Troffer	A recessed luminaire consisting of a metal box with lamps inside, and having the light emitting aperture on the bottom side. The two principal types of troffers are lensed troffers, in which the lamps are shielded from view by a plastic or glass lens, and parabolic troffers in which the lamps are shielded from view by metal louver blades.
Whip	A flexible wiring connection from a junction box or other termination to a luminaire, usually wiring in a flexible metallic conduit or a pre-fabricated cable of similar construction.
Wraparound	A surface-mounted or suspended luminaire in which a lens surrounds the lamp(s) on three or more sides.

3. General Installation Procedures

3.1 Receiving, Storing, Protecting, and Delivering

3.1.1 Receiving Material on Site

- a) Unload carefully, observing all packing label warnings.
- b) Use forklifts or other loading equipment only for palletized shipments.
- c) Leaving protective coverings in place as much as possible, open and inspect the shipment completely and, as quickly as possible initiate recovery of loss due to shipping damage. Undamaged material should be carefully repacked unless intended for immediate installation. *(Note: Depending on specifications, company policy, or project circumstances, it may be necessary to receive, unpack and check all material at the company shop or other staging area, in which case careful repacking is essential.)*
- d) Verify receipt of manufacturer's literature on luminaire installation and maintenance.

3.1.2 Storage and Protection

- a) Store material in a clean, dry location. Especially avoid spaces where water might accumulate or where significant airborne dust or dirt is present. (If such a location is not available, store material on pallets or other means to raise above floor and possible water levels and wrap in protective plastic sheeting.)
- b) Stack or otherwise store equipment carefully to prevent damage. Observe warnings and stacking instructions on packaging or shipping materials,
- c) Do not stack boxes which are partially crushed even if the products are intact.

- d) Should any event occur, such as a water leak, which could damage stored material, immediately reinspect it and obtain replacements for damaged goods.

3.1.3 Moving Material on Site

- a) In general, move material as few times as possible.
- b) Move material by hand, dolly or other device in a manner so as not to damage material.
- c) Leave material in original packing until ready to prepare to install.

3.2 Site Preparation

3.2.1 General

- a) Clean the work area to prevent scratching or damaging material.
- b) Organize material and trash areas.
- c) Set up a place for staging and pre-wiring, using a soft material like plywood or wallboard for layout.

3.2.2 Assuring Structural Readiness

Make certain that the structural support for the lighting systems is complete.

3.2.3 Assuring Electrical Readiness

Make certain that the junction boxes and home are in place and ready for expansion.

3.3 Unpacking and Handling Material

3.3.1 (Partial) Unpacking

- a) Remove material from shipping packaging.
- b) Leave protective coverings in place as long as possible.
- c) Move material to staging area.

3.3.2 Special Care Items

- a) Carefully unpack lenses, louvers, trims, lamps, and other parts that can easily be broken, marred, or damaged.
- b) Set breakable parts aside, using extra padding or other means to prevent damage.

3.3.3 Proper Type and Application

Determine that the luminaires are the types specified and approved for the application. Advise the general contractor or other proper party if any luminaire appears to be of the incorrect type, wrong voltage, or inappropriately listed for its intended application.

3.4 Coordination With Other Trades

3.4.1 General

- a) In general, luminaire locations should take precedence over other devices or systems unless specific code requirements are involved. Obtain direction from code officials or owner when conflicts involve code issues.
- b) Expect the reflected ceiling plans to coordinate the various systems and to allow scaling of dimensions.
- c) Expect the general contractor, architect/engineer, or owner to coordinate building systems and to reconcile interferences.
- d) Advise the general contractor, architect/engineer, or owner if luminaire locations have been compromised by framing or other coordination problems, prior to installing luminaires.

3.4.2 General Trades

- a) Determine that all general construction is sufficiently complete to allow installation of lighting systems without future removal or damage to material.
- b) Make certain that framing and other preparations for lighting are in the correct places and of proper dimensions. If not, appropriate changes will be required before proceeding.

3.4.3 Mechanical Trades

- a) Determine that HVAC, plumbing, and fire protection systems are sufficiently complete to allow installation of lighting systems without future removal or damage to material.
- b) Make certain that sprinkler head locations are coordinated with lighting. If not, appropriate adjustments will be required before proceeding.
- c) Make certain that plumbing and fire protection piping, mixing boxes, ductwork, diffusers, grilles and concealed mechanical system elements are located to permit lighting systems to be installed. If not, appropriate changes will be required before proceeding.
- d) Assist the HVAC contractor as necessary, to assure proper connection onto luminaires of HVAC devices such as supply and return air boots.

3.4.4 Electrical Systems

Determine that all other electrical systems are sufficiently complete and coordinated to allow installation of lighting systems without compromising design or requiring future removal or damage. Resolve conflicts among electrical systems in accordance with applicable codes, giving lighting locations preference whenever possible.

3.5 Securing Equipment in Place

3.5.1 General

- a) Consult the electrical plans and manufacturer's literature for the intended means of support.

- b) The principal means of support is usually the adjacent building surface that is ceiling or wall.
- c) Safety and seismic supports for whole luminaires should be attached to the main building structure, that is concrete or steel floor deck, beams, columns, and so forth.
- d) Safety supports for luminaire pieces, for example, reflectors, may be attached to the luminaire itself.

3.5.2 Safety Reinforcements

If safety reinforcements such as cables are provided, attach them first in accordance with luminaire manufacturer's instructions.

3.5.3 Basic Suspension

- a) Place the luminaire in the intended location.
- b) Secure it in place per luminaire manufacturer, or as described in 5.1 or 5.2 below.

3.5.4 Seismic Reinforcements

If required by specification or local code, provide additional luminaire support independent of the ceiling system. In general, this means providing one or more support wires in addition to the ceiling support wires. The number and gauge of wires may need to be determined by an engineer. Coordinate with the ceiling contractor and, if appropriate, have the wires provided by him or her.

3.6 Wiring Connections

3.6.1 General

- a) Check supply wires for temperature rating according to label on luminaire, and if necessary, splice on pigtails of appropriate gauge and temperature rating. Whips should use wire rated for fixture supply. Wire connectors should be of the proper type and rating.
- b) For luminaires with self-contained emergency power, locate indicating devices where readily visible but not offensive, as directed by the owner.

- c) For luminaires with remote emergency sources, apply identification of luminaire(s) as emergency source for safety and maintenance. Consult with owner and make label as inconspicuous as possible.

3.6.2 Conventional Power Wiring

- a) For luminaires mounting to a lighting-outlet or junction box, knock out and deburr a wiring hole in the fixture body if required, making certain to protect finished parts of the luminaire from damage when doing so. Connect supply conductors, observing good electrical practice and assuring a good ground. Avoid wiring splices inside luminaire.
- b) For luminaires connecting to electric power via a whip, connect whip to appropriate conduit entry or knockout and make up terminations. In some cases, it may be desirable to install the whip to the luminaire in the staging area, then terminate the whip to the junction box after the luminaire is installed.
- c) When luminaires are through-wired, either from luminaire-to-luminaire or to carry a circuit through luminaire raceways, make certain that luminaires are listed for through-wiring, and that wiring splices and terminations are made properly.

3.6.3 Modular Wiring Systems

- a) For luminaires to be supplied by modular power systems, prepare luminaire by installing modular connector prior to installation of luminaire.
- b) Connect modular wiring harnesses to luminaires according to modular wiring system manufacturer's instructions.

3.6.4 Controls and Special Features

- a) Determine whether luminaire has any special wiring requirements such as for control or emergency power. Follow system manufacturer's wiring diagrams and recommendations.
- b) In many cases, two switched circuits of normal power are provided to a multi-lamp luminaire or to a pre-wired pair of luminaires. Connect the two circuits according to plans and specifications. If specific

connections are not indicated or specified, connect the two circuits so that luminaires appear identically illuminated under all switching positions.

3.7 Interior Clean-out

- a) For surfaces that have become dirty or paint-splattered, remove the dirt or paint using water and a non-abrasive cleaner. Do not use solvents other than water without first verifying that they will not damage the luminaire finish or create a hazard of any kind.
- b) Final-clean all surfaces as recommended by the luminaire manufacturer, paying close attention to highly finished surfaces such as glass and polished aluminum. If no recommendation is available, wipe all surfaces using a mild non-abrasive solution and a soft damp cloth, followed by a soft dry cloth. Repeat the process until all surfaces are clean and free from streaks or smudges.
- c) Parts whose visible surfaces which are scratched, scraped, oversprayed, or otherwise sufficiently ruined so as not to be repairable shall be replaced with new parts.
- d) Parts not visible: Surface defects which do not compromise luminaire function, structural integrity, or life may be left in place provided damage is minor and not able to be seen from any normal viewing position.

3.8 Preliminary Field Adjustments

3.8.1 Lamp Socket Position

In luminaires with adjustable lamp sockets, position socket according to intended lamp and/or distribution.

3.8.2 Orientation, Tilt

If the luminaire is intended to be aimed, adjust its orientation and tilt so as to point the beam in the intended direction. (Note: If the adjustment is part of an artistic process, see 3.15.)

3.8.3 Special Equipment and Devices

Set or adjust other equipment or devices on the luminaire according to manufacturer's recommendations.

3.9 Lamping

- a) Install specified lamps in each luminaire. If none are specified, install the lamp type recommended by the luminaire manufacturer.
- b) Unless specified to the contrary, all fluorescent and compact fluorescent lamps on the same project should be from the same manufacturer and of the same color temperature to assure color matching.

3.10 Final Cleaning and Completion of Luminaire Installation

- a) In general, do not complete installation until all other trades, especially painters, have completed work in the area.
- b) Install trims, special lenses, louvers, protective covers, and/or other accessories specified or called for by the application. Wear gloves as necessary to avoid fingerprints or smudges on highly finished surfaces.
- c) Remove protective coverings from lenses, reflectors, etc.
- d) Wipe fingerprints, dust, and other dirt from visible surfaces using a clean, soft, dry cloth or as recommended by the manufacturer.
- e) Wipe lamps clean.
- f) Complete luminaire installation by closing and latching doors, installing accessories, and so forth.
- g) Check luminaires for plumb and adjust as required.

3.11 Testing

- a) Energize luminaire and check to make certain all lamps operate properly.
- b) Repair or replace defective components.

3.12 Burn-In

Burn-in all lamps which require a specific aging period to operate properly, if possible prior to occupancy by owner or tenant. (Note: It is critical that fluorescent or compact fluorescent lamps intended to be dimmed are burned-in for at least 100 hours at full voltage.)

3.13 Site Clean-Up

- a) Depending on terms of contract, clean up site as required.
- b) When recycling options are available at the job site, separate used packing materials by type and recycle them.
- c) Dispose of nonrecyclable packing materials appropriately.

3.14 Punchlist and Acceptance

Note: This should precede the walk-through that may be conducted by the owner and other consultants responsible for preparing punchlists.

- a) Walk through and assure completeness of project and clean-up.
- b) Note minor defects.
- c) Touch-up and repair all defects.
- d) Turn project over to owner or general contractor, as required by contract.

3.15 Aiming and Artistic Adjustments

If required by contract, adjust lighting for artistic effect or for specific tasks such as retail sales. In general this should be done as requested by and in the presence of the owner. It may be necessary to conduct some or all of this work after dark.

3.16 Controls Adjustments

With the participation of the owner, set lighting controls to work in an agreed-upon manner.

3.17 Spare Parts

Turn over all spare parts, and a set of special tools where required for luminaire adjustment or tamper-proof hardware, to owner or general contractor. Obtain a delivery receipt.

3.18 Lamp List

Give the owner or general contractor a list of all lamp types used on the project. Use ANSI and manufacturers' codes. Obtain a delivery receipt.

4. Recessed Lighting Systems

4.1 Suspended Accessible (Grid) Ceilings

This section applies to suspended ceilings consisting of a support grid and ceiling surface of acoustic tile, metal pan, or other removable elements.

4.1.1 Lay-In Luminaires

This section applies to recessed troffers and similar luminaires.

- a) In general, follow the recommendations of 5.1.1 or 5.1.2 as applicable.
- b) Make certain luminaire mounting requirements and ceiling system match. See Annex A.
- c) If luminaire serves a mechanical HVAC function, make certain luminaire is properly equipped for the required connections. Coordinate with HVAC contractor and remove knock-outs or slot covers as required.
- d) Confirm adequate clearance above luminaire location for installation and proper operation.
- e) Lift luminaire into place, generally with two installers working together. Lay into opening in ceiling.
- f) Secure luminaire to ceiling framing member(s) by mechanical means such as bolts, screws, rivets, or clips identified for the purpose.
- g) Where required by local codes: Install support wires independent of ceiling system. A minimum of two wires should be used at diagonal corners of the troffer.

4.1.2 Downlights

This section applies to recessed downlights and similar fixtures, such as wallwashers and accent lights,

having a housing above the ceiling and a trim installed from below the ceiling.

- a) Determine exact location of luminaire. (Note: While a downlight looks best at the center of the ceiling tile, for functional reasons it may be desirable to locate the luminaire toward a side or corner.)
- b) Make certain the luminaire is properly rated for the application. See Annex B.
- c) Cut a hole in the ceiling tile matching the aperture flange of the housing.
- d) Install the ceiling tile.
- e) Lay the housing over the ceiling tile. If the housing is heavy (as with an HID luminaire) support it carefully to avoid breaking the tile. Center the housing over the hole so that the plaster flange fits into the hole.
- f) Using hanger bars or C-channels, secure the housing to the ceiling suspension system. Make certain that the housing is raised slightly above the ceiling tile so that all of the weight of the luminaire is borne by the hanging system. Adjust the luminaire so that the plaster flange is as flush with the ceiling surface as possible.
- g) Install trim into housing. Wear cotton gloves if necessary to prevent smudging or fingerprinting of finished surfaces. Seat trim carefully to cover cutout hole and prevent light leaks.
- h) Where required by local codes: install at least one support wire independent of ceiling system.

4.1.3 Other Recessed Luminaires

- a) Continuous row trough and wall slot luminaires: Coordinate with ceiling contractor and install per manufacturer's recommendations.

b) Some wallwashers and other troffer-like luminaires may not completely fill the ceiling opening and are furnished with pans or flanges to permit filling the space with cut ceiling tile. Coordinate installation with ceiling contractor.

4.2 Wallboard and Other Inaccessible Hard Ceilings

This section applies to suspended gypsum wallboard ceilings or gypsum wallboard ceilings directly attached to structural framing, as in conventional wood frame construction. Applicability to other ceiling materials, like wood or plaster, is likely but should be checked prior to installation. As most wallboard ceilings have a fire rating, installing a luminaire in them may compromise the fire rating. UL standards for fire rating of construction may permit recessed luminaires provided they are listed and/or properly enclosed to meet UL requirements for this application.

4.2.1 Recessed troffers

This section applies to recessed troffers and similar luminaires:

- a) Make certain that the troffer is either a “flanged” troffer (NEMA style F) or a grid-style lay-in troffer supplied with a “flange frame.”
- b) For flanged luminaires: cut (or have cut) a hole in the ceiling with framing as a minimum along long sides of luminaire. In true plaster ceilings, use a plaster frame to serve as a straight side and plaster screed. Raise luminaire into position from below and tighten clamps against framing.
- c) For grid luminaires: cut (or have cut) a hole in the ceiling with framing as a minimum along long sides of luminaire. Install flange frame and secure to framing. Lift lay-in luminaire into opening. (Note: A troffer installed in this manner can be used as an access panel.)

4.2.2 Downlights

This section applies to recessed downlights and similar luminaires, such as wallwashers and accent lights,

having a housing above the ceiling and a trim installed from below the ceiling.

- a) Determine exact location of luminaire. Note that the exact center may have to be moved slightly to avoid framing.
- b) Make certain luminaire is properly rated for the application.
- c) Make certain luminaire is designed to accommodate ceiling thickness. If the thickness of the ceiling exceeds the adjustment range of the luminaire, it may be necessary to obtain extension rings or other parts to assure the trim will fit properly.
- d) Make certain luminaire includes sloped ceiling adapter if needed.
- e) Using C-channels or hanger bars, secure luminaire in place solidly to structure. Adjust the height of the housing so that the flat bottom of the housing (if any) rests atop the ceiling surface, and the flange of the aperture protrudes into the hole through the ceiling sufficiently far to permit proper installation of trim.
- f) As the ceiling is installed, cut (or have cut) a hole in it matching the aperture flange of the housing. Make power connection.
- g) During ceiling installation, align the hole under the housing so that the plaster flange fits into the hole.
- h) After the ceiling is completed and painted, install trim into housing. Wear cotton gloves if necessary to prevent smudging or fingerprinting of finished surfaces. Seat trim carefully to cover cutout hole and prevent light leaks.

4.2.3 Other Recessed Luminaires

Most other recessed or semi-recessed luminaires are designed to be installed in a manner similar to downlights. Check manufacturer’s recommendations.

5. Surface and Suspended Lighting Systems

5.1 Ceiling Mounted Lighting

This section includes common commercial luminaires and typical mounting situations onto or beneath a finished ceiling. When the ceiling is unfinished, as with a painted steel or concrete exposed structure, most of the following applies taking the installation conditions into account.

5.1.1 General

- a) Install at least one central or two end-structural support(s) for each luminaire. Depending on the luminaire and ceiling, it may be necessary to provide additional structural and/or stabilizing supports. A structural support is defined as physical connections capable of supporting the dead and live load of the luminaire and stabilizing the luminaire in place for proper alignment. A stabilizing support is defined as physical connections not intended to bear the weight of the luminaire but necessary for proper alignment and/or electrical connection.
- b) For continuous-row mounting of fluorescent luminaires, install luminaires accordingly or use standard parts or accessories to produce a straight and aligned row. A single circuit and through-wiring will generally be used, in which case each luminaire must have at least one structural support and is not required to be listed for use as a raceway.
- c) Where required by local codes: further support luminaire by additional seismic supports bearing weight of luminaire.
- d) In lieu of standard boxes and suspension materials, specialized suspension devices or components (often provided by luminaire manufacturer) may be used according to manufacturer's instructions. See Annex C.

e) Suspended grid ceiling systems: Cut needed hole(s) in ceiling tiles. Install an outlet box secured to the building structure by threaded rod or wire suspension. Connect the outlet box to the power source using cable, or conductors in raceway. (Note: Outlet boxes are permitted to be secured to a fire-rated suspended ceiling system only when specifically permitted by the product listing; see the manufacturer's literature.)

f) Wallboard ceilings: Secure a lighting-outlet box to structure at the location corresponding with the power feed knockout on the luminaire body. Install and finish the ceiling.

g) Exposed structure (no finished ceiling): Secure an outlet or junction box to the structural member or ceiling or roof deck, using and anchoring or attaching method suitable for the weight and moment arm of the luminaire. Connect to power source; when using conduit, install it parallel with or perpendicular to building structural lines.

5.1.2 Ceiling Surface Luminaires

This section generally applies to wraparounds and other enclosed luminaires.

- a) Suspended grid ceilings: Install luminaire onto outlet or junction box. Luminaire may be additionally stabilized by t-bar clips. In some cases, luminaire may be fed directly from whip.
- b) Wallboard ceilings: After ceiling is finished and painted, install luminaire onto outlet. Add stabilizing screws into structure or screw anchors as needed. As an option, luminaire may be fed from a whip provided end supports are structurally secure and stabilizing attachments hold luminaire properly onto surface.

5.1.3 Close-to-ceiling luminaires

This section generally applies to industrials and other luminaires mounted close to ceiling on short spacers or stems, and often in continuous rows. (Note: Make certain that outlet box and means of attachment are adequate for the weight and/or moment arm of the luminaire to be supported.)

- a) Suspended grid ceiling systems: In general, provide threaded-rod suspension from the structure deck above at a minimum of two structural support points for each luminaire. Depending on the luminaire the power supply may be fed from the box through a stem, cord or whip. Install ceiling spacers at all support points.
- b) Wallboard ceilings: Secure a lighting-outlet box to structure at the location corresponding to the power feed knockout on the luminaire body. Install luminaire onto outlet using spacer feed. Add stabilizing and support spacers along luminaire as needed. Depending on the luminaire the power supply may be fed from the box through a stem, cord or whip.

5.1.4 Suspended Direct, Indirect and Direct/Indirect Lighting Systems

As there are special mounting systems for most suspended luminaires, utilize the system recommended by the manufacturer for the ceiling condition and the lighting system configuration. See Annex C. The following apply in the absence of specific manufacturer recommendations:

- a) Suspended grid ceiling systems: In general, provide threaded-rod suspension from the structure deck above at a minimum of two structural support points for each luminaire. Depending on the luminaire, the power supply may be fed from the box through a stem, cord or whip. Suspend the luminaire by pendant rods, aircraft cable or other provision furnished with the luminaire.
- b) Wallboard ceilings: Secure a lighting-outlet box to building structure at the location corresponding to the power feed on the luminaire body. Suspend luminaire below the outlet by pendant rods, aircraft cable, or other provision furnished with the luminaire.

Depending on the luminaire, the power supply may be fed from the box through a flexible cord, stem or whip.

5.1.5 Pendant Luminaires

The following procedures apply to ordinary luminaires weighing less than 25 pounds. For heavier luminaires and/or luminaires having unusually long suspension, make certain a structural support capable of bearing the luminaire's weight and/or moment arm is installed.

- a) Suspended grid ceiling systems: Identify luminaire location and cut a ceiling hole to accommodate a lighting-outlet extension ring. Install ceiling tile. Using electrical box hangers or C-channels spanning across the ceiling grid and tied to it, install a junction box with lighting-outlet extension ring. Install luminaire using junction box ring as support and power supply.
- b) Wallboard ceilings: Secure a lighting-outlet box to structure at the required location. Set height to permit flange to fit into hole in ceiling. Install ceiling. Once ceiling is completed and painted, install luminaire onto outlet box ring.

5.1.6 Track Lighting Systems

The following apply to most types of surface or pendant track lighting systems. For raceway track, recessed track and other special systems, follow manufacturer's specific recommendations.

- a) Connect two-, three-, or four-circuit track with common neutral onto separate phases of power supply. For track with two phase conductors and two neutrals, supply circuits may be of the same phase.
- b) Suspended grid ceiling systems: Identify track location and cut a hole in the ceiling tile at the end or floating feed location. Install a junction box with lighting-outlet extension ring, secured to the building structure by threaded rod or wire suspension. Connect the outlet box to the power source using cable, or conductors in raceway. Install track feed connector using the junction box ring as support and power source.
- c) Wallboard ceilings: Secure a lighting-outlet box to structure at the required location. Set height to permit flange to fit into hole in ceiling. Install ceiling.

Once ceiling is completed and painted, install track feed connector using junction box ring as support and power supply. Provide structural support for every four-foot length of track using screws into structure or wallboard anchors as needed. Use joints, intersections, ells, and other track components as required to complete layout

- d) Pendant track: Use manufacturer's pendant assembly and provide a structural mounting point every four feet along track route in a manner similar to that described above in 5.1.5.
- e) Sideways mounting: For track mounted with its opening not in the horizontal plane, provide additional supporting or securing as required to prevent torquing or twisting when lampholders are attached to track.
- f) Track should only be field-cut if manufacturer recommends it. Use a miter box saw with appropriate blade, making sure to position conductors and insulation according to manufacturer's recommendations.

5.2 Wall Mounted Lighting

This section applies to wall sconces, wall brackets, wall mounted exit signs, and other luminaires designed for wall mounting.

- a) Secure a lighting-outlet box to the building wall structure at the location corresponding with the power feed knockout on the luminaire body. (*Note: The Americans with Disabilities Act (ADA) restricts luminaire projection to 4 inches when mounted along the path of egress at or below 80 inches above finished floor.*)
- b) Cut hole in wallboard or other finish material.
- c) Add extension rings as needed to bring outlet to face of wall. Complete wall and finish.
- d) Install luminaire onto outlet and make level.
- e) Add stabilizing screws into structure or wallboard anchors as needed. As an option, a wall mounted luminaire may be fed from a whip, provided other supports are structurally secure and stabilizing attachments hold the luminaire properly onto surface.

Annex A: Troffer Compatibility Considerations

Troffers are manufactured in different types for installation in different ceiling constructions. Some are also air-handling luminaires integrated into the mechanical system. This Annex provides guidance in ordering the appropriate troffer types for different applications.

A.1 Standard Suspended Ceilings

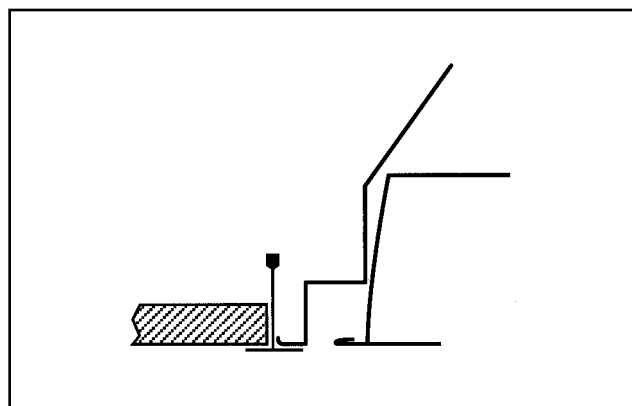
The following chart lists the most common ceiling systems. Some luminaires can be adjusted in the field to match the ceiling, but most must be ordered for the matching ceiling type. For unusual ceilings not listed in the chart, it is very important to order fixtures to exactly match the ceiling system. Most ceiling manufacturers of unusual ceiling suspension systems are capable of coordinating with lighting manufacturers on a special order basis.

Table A-1. Most common ceiling systems.

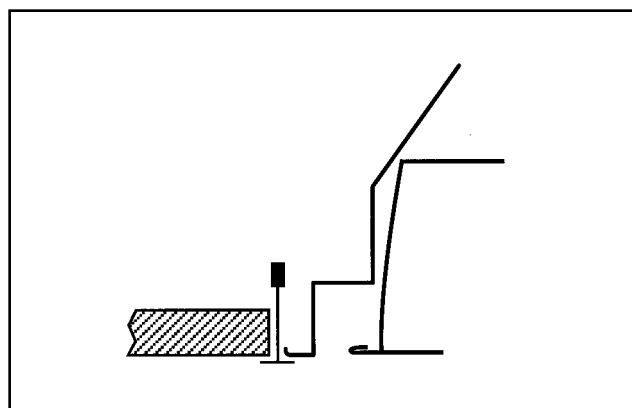
NEMA Type	Ceiling System Description
G	1" wide exposed grid inverted tee bar
NFG	9/16" wide exposed inverted grid tee bar
Z	Concealed-grid Z-spline
M	Metal pan ceiling
GR	Concealed grid inverted tee bar
SS	Screw slot inverted grid tee bar
NFSG	Narrow faced slot inverted grid tee bar
F	Flanged

The following illustrations show typical installation relationships between NEMA standard ceiling types and troffer luminaires designed for them.

Exposed "Tee" Grid Ceiling Systems

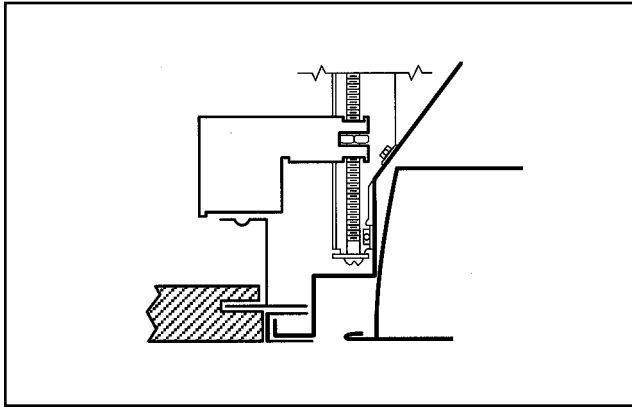


G — The most common ceiling type has a nominal 1" wide tee face (usually 15/16"). Some ceiling tile types, such as "tegular," are designed to help hide the grid. While in most cases these are compatible with NEMA type G luminaires, the installer should check the specific lighting fixture recommendations for the ceiling system actually being used.

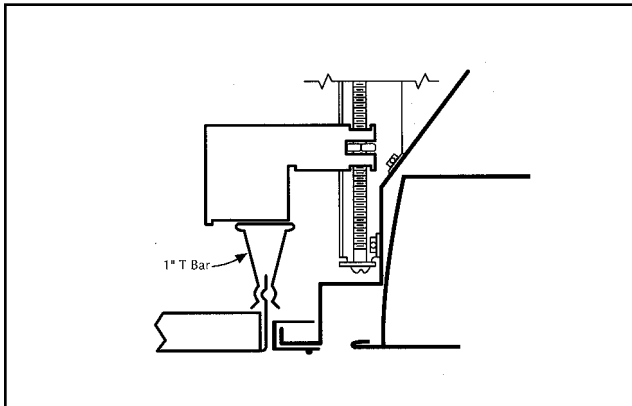


NSG — This variation has a narrow 9/16" tee face. Because this weight-bearing flange is so narrow, additional clips are generally required to secure NEMA type NSG luminaires.

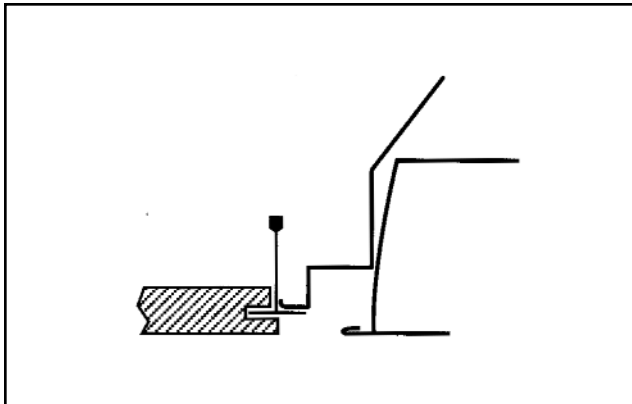
Concealed-Grid Ceiling Systems



Z — Concealed-grid systems are intended to provide a more finished appearance by hiding the ceiling support grid within the tiles. NEMA type Z luminaires are intended for installation in concealed Z-spline ceilings.



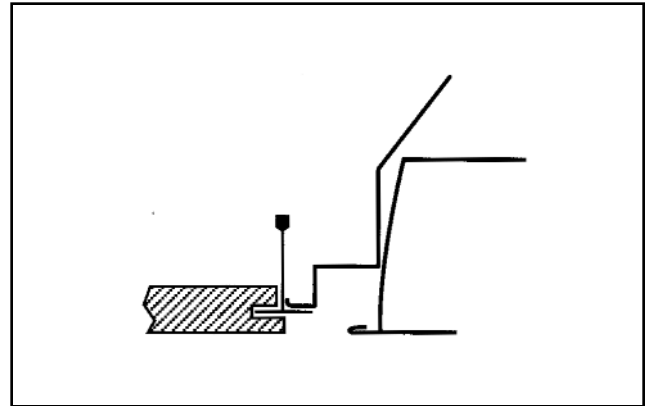
M — This luminaire type uses a trim fitting for metal pan and similar ceiling types.



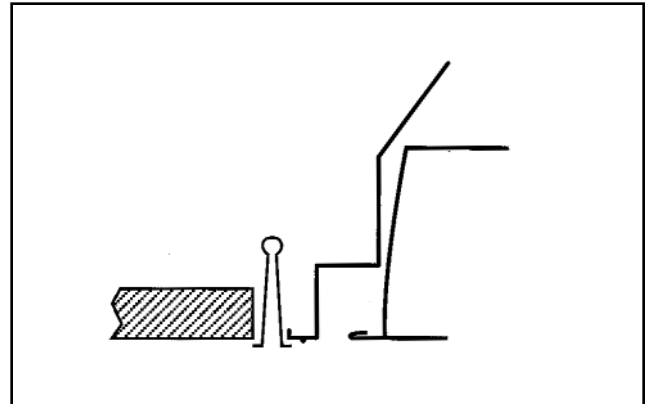
GR — This luminaire, which is similar to NEMA type G, has a fixture support flange above the bottom of the adjacent tile. It can be furnished with a

shroud or trim to finish off the regress.

Screw Slot Grid Ceiling Systems

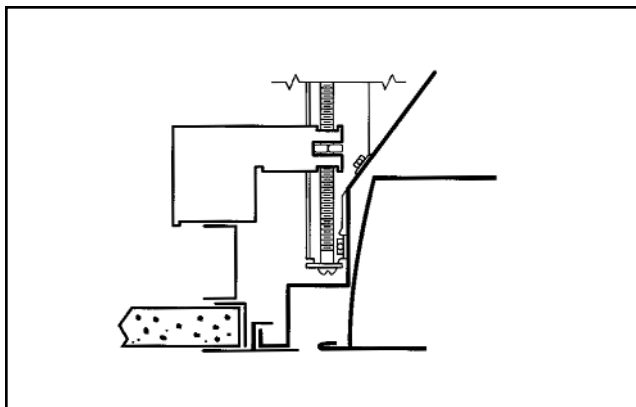


SS — In luminaires for screw slot or “fine line” ceiling systems, the fixture support flange is above the bottom of the adjacent tile.



NSFG — The less-costly narrow faced slot grid appears similar to NEMA type SS, but uses a lay-in luminaire and securing clips.

Wallboard and Other Ceiling Systems



F — The most popular used general-purpose luminaire is NEMA type F, which can be used with many types of ceiling construction including drywall.

ic ballasts ran hotter and the heat extraction feature helped keep lamp temperature at a more optimum level. T-8 lamps run cooler and electronic ballasts regulate light level better, making heat extraction less necessary and possibly not desirable. Likewise, the wider spacing of lighting fixtures practiced today may not provide sufficient CFM (cubic foot per minute) capacity in any mechanical mode; engineers often find that separate mechanical provisions work better and cost less.

A.2 Mechanical System Connections

Fluorescent troffers can also be furnished in following configurations::

- **Static**- in which the luminaire has no provisions for specific interaction with HVAC systems.
- **Heat Extraction**- in which the luminaire is designed to serve as a return air path for plenum return HVAC systems by pulling air into the luminaire (usually through the ends) and past the lamps before exiting through the luminaire top. Troffers can be ordered with adjustable dampers.
- **Air Handling**- in which the luminaire has slots along the side which can be connected to supply air ducts, return air ducts, or serve as a grille for plenum return air. Troffers can be ordered with adjustable dampers and air control blades.

Troffers can generally be purchased in a “universal” configuration in which the heat extraction openings can be activated using a simple damper, and the air handling slots are activated by knocking out or removing material that blocks the air slots.

It is important to remember that air-handling lighting systems were more popular and probably more important with traditional T-12 fluorescent lamps and magnetic ballasts than with modern T-8 lamps and electronic ballasts. The T-12 lamps and magnet-

Annex B: Standard Downlight Ratings and Details

Downlights are rated for specific applications and are labeled as such. Some of the following ratings apply in all U.S. jurisdictions, while others may be required only in certain locales. Additional listings may be required by some cities, for example, Chicago plenum. Note that HID, fluorescent and compact fluorescent downlights must utilize “P” rated ballasts.

Table B-1. Standard Downlight Ratings	
Rating	Application
T or none	<i>Thermally Protected.</i> Required in all applications except concrete pour downlights
IP	<i>Insulation Protected.</i> City of Chicago rating. Required in certain applications where luminaire is being used near insulation.
IC	<i>Insulated Ceiling.</i> Required in all applications where luminaire is in direct contact with insulation.
ICAT	<i>Insulated Ceiling.</i> Required by State of Washington and possibly other locations in residential applications where luminaire is in direct contact with insulation and must not permit air flow through luminaire into plenum.
Damp	Damp label for protected outdoor and certain indoor locations.
Wet	Wet label for exposed outdoor and certain indoor locations.
Spa and Shower	Specific label for these applications.
Feed-through	Luminaire is listed for branch-circuit feed-through wiring through a wireway integral to the fixture.

Annex C: Special Mountings for Suspended Luminaires

The following products are examples of special- purpose mounting devices useful for installing commercial lighting systems.

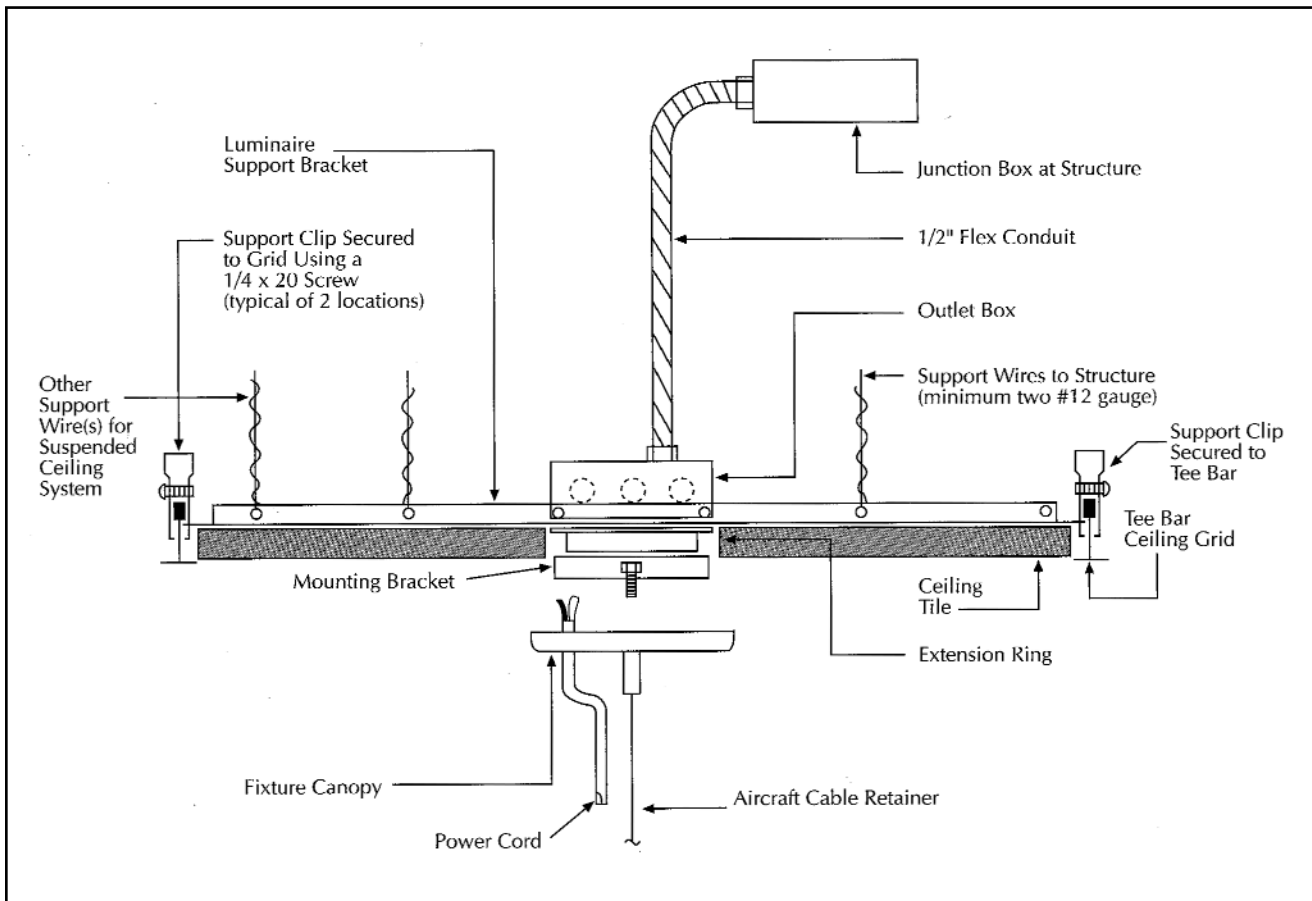


Figure C-1. Aircraft cable suspended luminaire feed support.

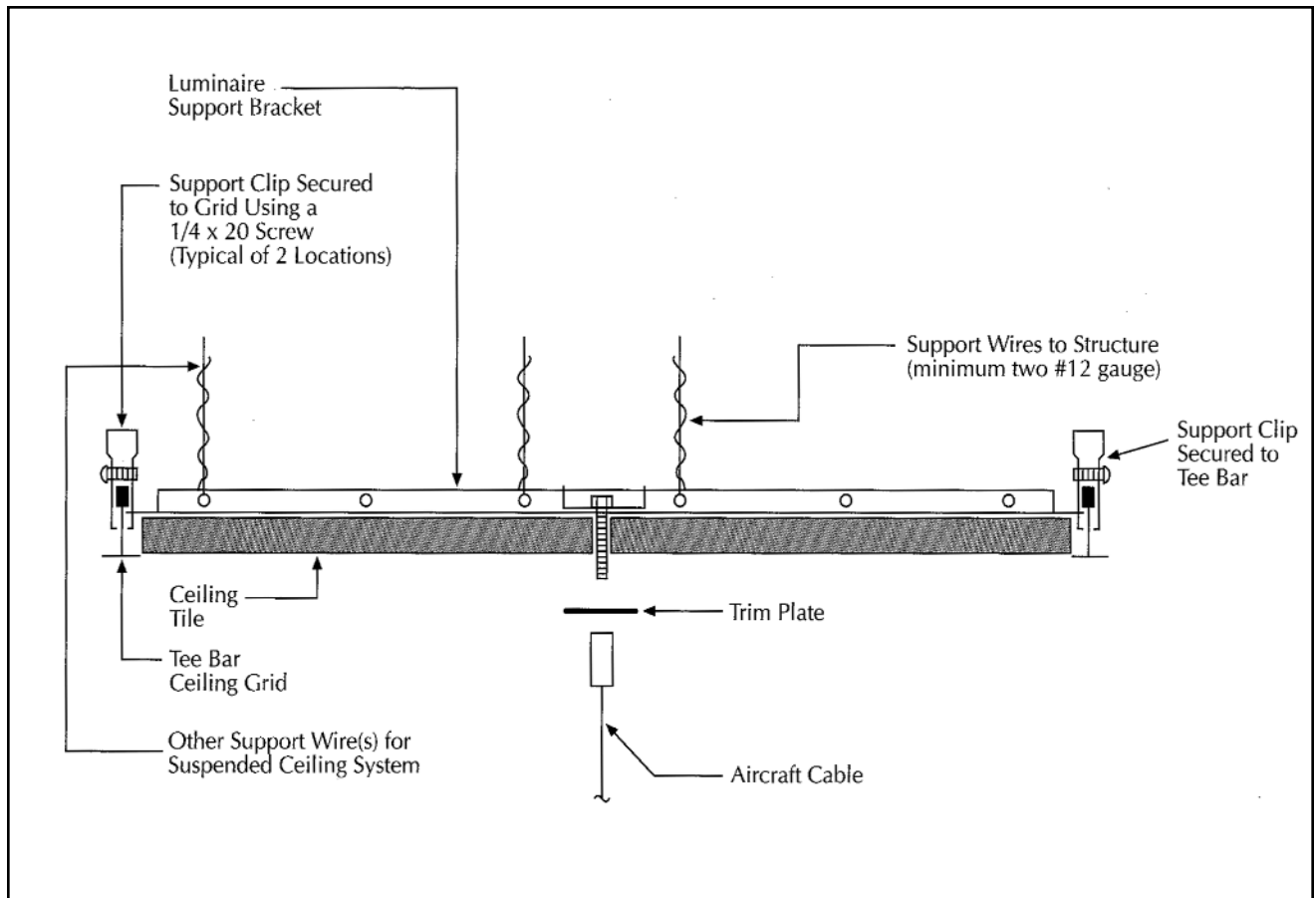


Figure C-2. Aircraft cable suspended luminaire non-feed support.

Annex D: Reference Standards

This publication, when used in conjunction with the National Electrical Code and switchboard manufacturers' literature, provides sufficient information to install and maintain deadfront switchboards operating at 600 volts and less. The following publications may also provide useful information:

National Electrical Manufacturers Association
1300 North 17th Street, Suite 1847
Rosslyn, VA 22209
(703) 841-3200
(703) 841-3300 Fax

NEMA PB 2.1-1996, *General Instructions for Proper Handling, Installation, Operation, and Maintenance of Deadfront Distribution Switchboards Rated 600 Volts or Less*

NEMA PB 2.2-1988 (R1994), *Application Guide for Ground-Fault Protective Devices For Equipment*

NEMA AB 4-1996, *Guidelines for Inspection and Preventive Maintenance of Molded Case Circuit Breakers Used in Commercial and Industrial Applications*

National Fire Protection Association
1 Batterymarch Park
P.O. Box 9101
Quincy, MA 02269-9101
(617) 770-3000
(617) 770-3500 Fax

ANSI/NFPA 70-1999, *National Electrical Code*

ANSI/NFPA 70B-1998, *Electrical Equipment Maintenance*

InterNational Electrical Testing Association
106 Stone Street
P.O. Box 687
Morrison, CO 80465
(303) 697-8441
(303) 697-8431 Fax

NETA ATS-1995, *Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems*

NETA MTS-1993, *Maintenance Testing Specifications for Electrical Power Distribution*

Other *National Electrical Installation Standards*™ published by NECA:

National Electrical Contractors Association
3 Bethesda Metro Center, Suite 1100
Bethesda, MD 20814
(301) 215-4504 tel
(301) 215-4500 fax
www.neca-neis.org

NECA 1-2000, *Practices for Good Workmanship in Electrical Contracting* (ANSI)

NECA 100-1999, *Symbols for Electrical Construction Drawings* (ANSI)

NECA 101-2000, *Standard for Installing Steel Tube (Rigid, IMC, EMT)*

NECA/AA 104-2000, *Recommended Practice for Installing Aluminum Building Wire and Cable* (ANSI)

NECA/FOA 301-1997, *Standard for Installing and Testing Fiber Optic Cables*

NECA 400-1998, *Recommended Practice for Installing and Maintaining Switchboards* (ANSI)

NECA 402-2000, *Recommended Practice for Installing and Maintaining Motor Control Centers*

NECA/EGSA 404-2000, *Recommended Practice for Installing Generator Sets* (ANSI)

NECA/IESNA 500-1998, *Recommended Practice for Installing Indoor Commercial Lighting Systems* (ANSI)

NECA/IESNA 501-2000, *Recommended Practice for Installing Exterior Lighting* (ANSI)

NECA/IESNA 502-1999, *Recommended Practice for Installing Industrial Lighting Systems* (ANSI)



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Standards & Safety
Index: NECA 500
1K/5-99

