



Recommended Practice
for Installing

Industrial Lighting Systems



Published by
National Electrical
Contractors Association



Jointly developed with
Illuminating Engineering
Society of North America



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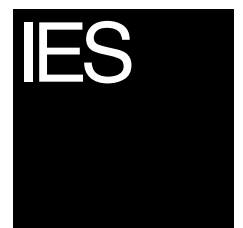
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National Electrical Installation Standards™

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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:

“Industrial lighting systems shall be installed in accordance with NECA/IESNA 502, *Recommended Practice for Installing Industrial Lighting Systems* (ANSI).”

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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 con-

struction. 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 recommended practice describes installation procedures for lighting systems commonly used in industrial and storage buildings, including, but not limited to, the following:

- a) High intensity discharge (HID) low-bay and high-bay lighting systems.
- b) Fluorescent strip lights and general purpose industrial overhead lighting systems.
- c) Common special-purpose and special-environment industrial luminaires.
- d) Lighting installed on industrial wireway and track lighting systems.

1.2 Lighting Systems and Equipment Excluded

While this recommended practice generally covers most industrial lighting systems, the following are specifically excluded:

- a) Recessed and surface mounted indoor commercial lighting systems covered by NECA/IESNA 500-1998 (ANSI).
- b) Lighting systems designed for hazardous (classified) locations, as defined by National Electrical Code Article 500, in which special equipment listings or ratings are required.

c) Lighting systems designed for manufacturing clean rooms, food preparation areas, and other special environments.

d) 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, and other related components and parts.

1.4 Regulatory and Other Requirements

This recommended practice is intended to define what is meant by installing equipment in a “neat and workmanlike manner” as required by the National Electrical Code, Section 110-12. All recommendations of this publication are intended to comply with the National Electrical Code (ANSI/NFPA 70), and in general the typical recommendations of industrial lighting equipment manufacturers. Installers should always comply with the NEC, applicable state and local codes, manufacturer’s instructions, and contractual obligations, when installing industrial lighting systems.

2. Definitions

Environment	The air surrounding the luminaire, including moisture, temperature, corrosive vapors or agents, dirt, dust, combustibles, etc.	Industrial fluorescent	A fluorescent luminaire designed for industrial applications, generally an open-bottom luminaire with a simple metal reflector, often with a corrosion resistant and/or anti-static finish.
HID	High intensity discharge lamp. HID lamp types include mercury vapor, metal halide, high-pressure sodium, and low-pressure sodium (low pressure sodium, while not technically an HID lamp, is considered an HID lamp for the purpose of this standard).	Industrial lighting track	Structural support system for industrial lighting having an internal electrical raceway allowing installation of luminaires at any point along the system.
High bay	Applications where the minimum recommended luminaire mounting height is at least 20 feet above the finished floor.	Low boy	Applications where the maximum recommended luminaire mounting height is 25 feet above the finished floor.
High bay luminaire	The name given to HID luminaires specifically intended for high bay spaces, so as to distinguish them from HID luminaires intended for low bay spaces.	Low bay luminaires	The name given to HID luminaires specifically intended for low bay spaces, so as to distinguish them from HID luminaires intended for high bay spaces.
Industrial equipment	Manufacturing equipment, machines, machine tools, ovens, booths, racks, shelves, assembly lines, tanks, benches, and other industrial equipment, processes, systems or workstations.	Luminaire	Utilization equipment that includes 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.

Modular wiring system	A prefabricated wiring system consisting of specific receptacles, armored cables, and other components that permit plug-together wiring of lighting systems.	Stroboscopic effect	Pulsating light caused by the frequency of the AC power line. Stroboscopic light or flicker can cause rotating machines or tools to appear to be standing still, creating a potential hazard for users, and may also cause a mild sense of disorientation and nausea. (<i>See Annex B.</i>)
Owner	For the purposes of this publication, this may mean the owner, tenant, architect, builder, developer, or consultants who are or represent the interests of the party for whom the lighting is being installed.	Tap (ballast)	HID and fluorescent ballasts may have two or more taps, input leads, or connections to permit various common input voltages. Common types include “multi-tap,” “quad-tap,” and “dual tap.”
Portable luminaire	A luminaire designed with a cord-and-plug and intended to be portable. It is located and connected by building occupants.	Vaportight luminaire	A gasketed luminaire that may be suitable for use in wet or dusty applications. Some vaportight luminaires may also be listed for certain hazardous (classified) locations.
Staging area	An area in which luminaires are removed from packing and prepared for installation, including installing whips, accessories, etc.	Whip	A flexible wiring connection from a junction box or other termination to a luminaire, usually individual conductors in flexible metallic conduit or a prefabricated cable of similar construction.
Storage facilities	Racks, shelving, and other storage areas, provisions, or equipment.	Wraparound	A surface-mounted or suspended luminaire in which a lens surrounds the lamp(s) on three or more sides.
Structural support	A physical connection capable of supporting the dead and live load of the luminaire and stabilizing the luminaire in place for proper alignment.		
Stabilizing support	A physical connection not intended to bear the weight of the luminaire but necessary for proper alignment and/or electrical connection.		

3. General Installation Practices

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 with palletized shipments.
- c) Inventory packages with packing slips and/or purchase orders. Document back orders and verify new shipping schedules. If approved project data (shop drawings) are utilized, check all products for completeness and timely delivery. Expedite or otherwise resolve product delivery schedule problems.
- d) 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 repackaging is essential.)*

3.1.2 Storage and protection

- a) Store material in a clean, dry and secure location. Especially avoid spaces where water might accumulate or where significant airborne dust or dirt is present. If such a location is not available, wrap it in suitable protective covering and use pallets, shelves, or other means to elevate the material above the floor to protect it from possible water damage.

- b) Observing warnings and stacking instructions on packaging or shipping materials, stack or otherwise store equipment to prevent damage.

- c) Organize storage with essential information such as luminaire type, project destination, voltage, job tags, or labels for easy reference and access.

- d) Verify input voltage on ballasts and transformers.

- e) Do not stack boxes that are partially crushed even if the products are intact.

- f) Should any event occur, such as a water leak, that could damage stored material, immediately re-inspect 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 material like plywood, wallboard, or the cardboard in which the material was shipped.

3.2.2 Assuring structural readiness

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

3.2.3 Assuring electrical readiness

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

3.3 Unpacking and Handling Material

3.3.1 (Partial) unpacking

- a) Remove material from shipping packaging, including manufacturer's installation instructions. Keep instructions with luminaire until installation is complete.
- b) Leave protective covering(s) 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 breakable or easily marred or damaged material.
- b) Set breakable parts aside, using extra padding or other means to prevent damage.

3.3.3 Proper type and application

- a) Determine that the luminaires supplied are the types specified and approved for the application, including, but not limited to, the following:
 - Voltage
 - Mounting
 - Label, listing or rating for environment or application, including the safety certification label of a recognized independent testing laboratory
 - Starting and operating temperatures
 - Special ballast, e.g. two level or dimming
 - Accessories or auxiliaries, e.g. emergency lighting device(s)

- b) Advise the general contractor or other proper party if any luminaire appears to be of the incorrect type.

3.4 Coordination with Other Construction

3.4.1 General

- a) In general, luminaire locations should take precedence over the location of other building equipment or devices such as air diffusers and sprinkler heads. Obtain direction from code officials or the owner when conflicts involve code issues.
- b) Expect the reflected ceiling plans to show the coordination of the various systems and to allow scaling of dimensions.
- c) Expect the architect or engineer to coordinate building systems and to reconcile interferences.
- d) Expect the general contractor to coordinate the trades and to reconcile inter-trade coordination problems.
- e) Luminaire locations may need to be adjusted to coordinate with industrial equipment and storage facilities. To the extent possible, check proposed installation locations of all items that may affect lighting before beginning any work in the area.
- f) If luminaire locations need to be adjusted to coordinate with equipment, storage shelving, etc., coordinate changes with the owner.
- g) Advise the architect, engineer and/or other consultants if luminaire locations have been compromised by any of the coordination problems described above, prior to roughing-in or installing luminaires.
- h) Determine that all general construction is sufficiently complete to allow installation of lighting systems without future removal or damage to material.
- i) 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.

3.4.2 Mechanical systems

- 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 sprinkler head locations are coordinated with lighting. If not, appropriate changes 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, changes will be required prior to proceeding.

3.4.3 Electrical systems

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

3.5 Securing Equipment in Place

3.5.1 General

- a) Consult the manufacturer's installation instructions for the intended means of luminaire support.
- b) The principal means of support is usually the adjacent building surface or structural member (i.e., beam, truss or joist). In some cases a lighting track or other provision is made for lighting support.
- c) Make certain that the supporting system is appropriate for the application and the surrounding atmosphere.
- d) Avoid direct contact of dissimilar metals, and the use of steel or other supporting materials subject to

corrosion unless specifically directed to do so by the luminaire manufacturer or engineer.

- e) Place the luminaire in the intended location.
- f) Secure the luminaire in place in accordance with manufacturer's instructions, or as described below.

3.5.2 Safety reinforcements

- a) If safety reinforcements such as cables or chains are provided, attach them first in accordance with luminaire manufacturer's instructions. Make certain that safety cables or chains and attachments are resistant to types of corrosion that might occur in the application.
- b) Safety supports for luminaires should be attached to the main building structure (i.e., concrete or steel floor deck, beams, columns, etc.). If a lighting track is provided, safety supports from luminaires may also attach to it.
- c) Safety supports for luminaire pieces such as reflectors may be attached to the luminaire body itself.

3.5.3 Seismic reinforcements

- a) If required by local code, provide additional luminaire support independent of the primary means of support. Consult with manufacturer and local authorities for specific requirements of each luminaire type and application.
- b) In general, seismic supports should limit luminaire movement such as swing or sway under earthquake conditions to prevent the luminaire from hitting adjacent structures or becoming a personnel hazard.

3.6 Wiring Connections

3.6.1 General

- a) Use raceways and other wiring methods suitable for the surrounding atmosphere.

- b) Check supply wires for temperature rating according to label on luminaire, and if necessary, splice on pigtails of appropriate gauge and temperature rating. Whips, flexible cords, or other connections should use wire rated for fixture supply.
- c) Label junction, termination and outlet boxes with panel and circuit number.
- d) Verify correct input voltage on ballasts and transformers.
- e) Wire connectors should be of proper size for the conductors to be joined. Where subject to vibration, wrap wire connectors and conductors together with insulating tape.
- f) For luminaires with self-contained emergency power, locate indicating devices where readily visible and testing devices where readily accessible.
- g) Apply circuit identification to luminaires for safety and maintenance.
- h) Make certain power is off before connecting power supply feeds to luminaires. Observe lockout and tag-out procedures.
- i) Check luminaires and branch circuits for shorts before energizing.

3.6.2 Conventional power wiring

- a) For luminaires mounted 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 unnecessary wiring splices inside the luminaire.
- b) For luminaires connected to electric power via a whip, connect whip to appropriate conduit entry or knockout and make up termination. 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) Luminaires that have conductors running through the wiring compartment, that do not supply power to the luminaire (“through wiring”), must be listed for through wiring. The size and the number of through wiring conductors must not exceed the luminaire rating. (*NOTE: Conductors feeding the luminaire itself are not included in the through wiring count.*)

3.6.3 Modular wiring system

- a) Make certain the modular wiring system is suitable for the surrounding atmosphere.
- b) Prepare luminaires to be supplied by modular power systems in staging area, by installing modular connector prior to installation of luminaire. If luminaires have factory-installed connections, confirm that the connector is the proper type and rating for the intended application.
- c) Make certain wires are completely secured before closing fixture body. Reinsert and secure loose wires.
- d) Connect modular wiring harnesses to luminaires according to modular wiring system manufacturer’s instructions.

3.6.4 Controls and special features

Determine whether luminaire has any special wiring requirements such as for dimming, energy management control and/or emergency power. Follow manufacturer’s wiring diagrams and recommendations.

3.7 Installation

Install luminaire in intended manner. Be certain to install gaskets and other parts in accordance with manufacturer’s instructions. Make certain luminaire is level and/or plumb and tighten mounting securely.

3.8 Temporary Lighting

If it is necessary to use permanent luminaires for temporary lighting, install and energize the minimum number of luminaires necessary. When construction is sufficiently complete, remove the tempo-

rary luminaires, disassemble, clean thoroughly, relamp with new lamp(s), and install along with other new luminaires to complete the lighting system installation.

3.9 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.

b) Finally, 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 clean all surfaces with a mild non-abrasive solution and a damp soft cloth followed by a clean dry soft cloth. Repeat the process until all surfaces are clean and free from streaks or smudges.

c) Visible parts — Parts whose visible surfaces are scratched, scraped, over sprayed, or otherwise sufficiently ruined so as not to be repairable shall be replaced with new parts.

d) Concealed parts — 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.

3.10 Preliminary Field Adjustments

a) In luminaires with adjustable lamp socket positions, set socket according to intended lamp and/or distribution.

b) If the luminaire can be aimed, adjust its rotation and elevation so as to point the beam in the intended direction. Tighten or lock adjustments.

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

3.11 Lamping and Accessories

a) Install lenses, louvers, shields and/or other accessories as specified or required.

b) Install the specified or recommended lamp for each luminaire. (*NOTE: In some instances lamps may be installed prior to installation of luminaire, but as a general practice installation after luminaire is secured is preferable, to prevent damage to lamps by handling.*)

c) For all lamps of a specific type, use products of the same manufacturer.

d) For metal halide lamps in open luminaires, determine that the lamp is suitable for the application.

e) Determine that the lamp is appropriately matched to the ballast. This precaution is especially important considering the numerous different combinations of metal halide lamps and ballasts that may be permitted by ANSI standards for luminaires of the same wattage.

3.12 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 remaining components of lighting system.

c) Remove plastic protective covering from lenses, reflectors, etc.

d) Wipe fingerprints, dust and other dirt from all visible surfaces using a clean soft dry cloth.

e) Wipe lamps clean.

f) Complete luminaire installation by closing doors and lenses, installing accessories, etc.

g) Check luminaires for plumb and adjust as required.

3.13 Testing

a) Energize luminaire and check to make certain all lamps operate properly.

b) Repair or replace defective components.

c) Test emergency lighting features.

3.14 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. The burn-in period is preferably continuous, but may be carried out in a series of periods of at least the period of a typical work-day.)*

3.15 Site Clean-Up

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

3.16 Lighting Walk-Through

An initial walk-through of the lighting installation should be conducted before the final walk-through that may be conducted by the general contractor, architect, 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.

3.17 Adjustments

- a) With the participation of the owner, architect, or engineer, adjust luminaire distribution, rotation and elevation, and set lighting controls to work in an agreed-upon manner.
- b) Advise the owner as to specific maintenance and adjustment procedures.

3.18 Spare Parts

Unless otherwise specified, turn over all spare parts that were provided by the luminaire manufacturer, including one set of installation instructions for each luminaire type, and a set of special tools where required for luminaire adjustment or tamper-proof hardware, to owner or general contractor. Obtain a delivery receipt.

3.19 Lamp List

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

4. High-Intensity Discharge (HID) Lighting Systems

4.1 Installation Using Conventional Construction

This section applies to high- and low-bay spaces in which HID lighting systems are attached to ceilings or ceiling structures utilizing conventional support and wiring methods.

4.1.1 Support

- a) Install and secure wireway and support system. In general, this means installing an outlet box, power hook kit, or a proprietary support and electrical connection device.
- b) Secure the supporting means to structure, bearing in mind the weight of the luminaire and its potential for swaying. If necessary, confirm with structural engineer that the luminaire support point is structurally adequate and meets the luminaire manufacturer's recommendations.
- c) Where required, install additional seismic supports capable of bearing the weight of the luminaire.

4.1.2 Wiring

- a) Install branch circuit, switch wiring, and through-wiring to other luminaires. Terminate conductors in junction box for connection to fixture. Make certain proper voltage tap is used and that other tap(s) are safely terminated. For luminaires powered using modular wiring systems *see 4.1.4*.
- b) Confirm proper phase and circuit connections, keeping in mind that HID lighting systems should be phase-rotated (adjacent lights on differing phases) to minimize stroboscopic effects (Annex B.)

4.1.3 Luminaire installation

- a) When specified or required, attach luminaire safety cable or chain to structure independent of raceway or primary support means. Safety cables or chains for luminaire parts such as a lens may be connected to the luminaire itself.
- b) Install luminaire using structural and stabilizing supports.
- c) Connect luminaire to power supply and energize.

4.1.4 Special provisions for modular wiring systems

- a) If luminaires were not factory-wired for modular wiring, prepare luminaires in staging area by installing and wiring modular connectors. Connect appropriate ballast tap and safely terminate other tap(s). Rotate phases of adjacent fixtures as described in 4.1.2 when selecting circuits during modular wiring connections.
- b) Install luminaire in accordance with 4.1.1 and 4.1.3.

4.2 Installation Using Industrial Lighting Track or Structural Wireways

This section applies to low- and high-bay spaces in which HID lighting systems are suspended and powered from an industrial lighting track or similar specific-purpose system.

4.2.1 Support

Install the lighting track or other support system. Secure to building structure as specified by manufac-

turer. Confirm appropriate support points and structural connections with structural engineer, if necessary, keeping in mind the quantity and weight of luminaires to be supported. Where required, install additional seismic supports capable of bearing the weight of the luminaire.

4.2.2 Wiring

Connect power supply and wire the lighting track. Confirm proper phase and circuit connections, keeping in mind that HID lighting systems should be phase-rotated (adjacent lights on differing phases) to minimize stroboscopic effects (Annex B).

4.2.3 Luminaire installation

Attach luminaire safety cable or chain to structure independent of raceway or primary support means. Attach a lens or accessory safety cable or chain to a suitable point, including to the luminaire itself. Connect luminaire to power supply and energize.

5. Fluorescent Lighting Systems

5.1 General

- a) Install branch circuits and outlet boxes.
- b) Make certain suspension and connection devices are suitable for the surrounding atmosphere and will not corrode.
- c) Install at least one central or two end structural support(s) for each luminaire. Depending on the means of support it may be necessary to provide additional structural and/or stabilizing supports.
- d) For continuous row mounting of fluorescent luminaires, order luminaires accordingly or use standard parts and accessories to produce a straight and aligned row. When a single power feed with branch circuit wiring routed through fixture bodies is used, each luminaire must have at least one structural support and be listed for through-wiring. Alternatively, harness devices or modular wiring may also be used.
- e) In lieu of standard boxes and suspension materials, specialized raceway, wireway or suspension devices or components (often provided by luminaire manufacturer) may be used according to manufacturer's instructions.
- f) Where required, install additional seismic supports capable of bearing the weight of the luminaire.

5.2 Suspended Luminaires

This section applies to industrial fluorescent lighting systems that are suspended from ceilings or structures utilizing conventional hanging and wiring methods.

5.2.1 Support

- a) In general, use hanging device(s) supplied by the luminaire manufacturer, including clips and other accessories. Install these in accordance with the manufacturer's instructions.
- b) In some cases, use of ordinary construction materials such as chain or pipe may be appropriate to suspend luminaires. Follow manufacturer's recommendations regarding number and location of supports.
- c) Secure the hanging device(s) to building structural elements such as beams, decks, joists, etc. Make certain that the method of attachment is structurally adequate for the load, keeping in mind the additional load created by the moment arm of the suspension system. If necessary, reinforce the point of attachment using strut-type supports or other common electrical construction means.
- d) Where required, install additional seismic suspension devices that permit restrained sway during earthquakes. Determine that luminaire sway will not cause support failure or allow the luminaire to strike an adjacent structure.
- e) Where required, install a safety cable that is attached to the structure independently of the principal means of luminaire support.

5.2.2 Conventional wiring

- a) Locate and install an outlet box or other means of connection as recommended by the luminaire manufacturer. Connect the luminaire to the branch circuit using flexible cord, cable, or individual conductors as required by the type of suspension system (stem, chain, aircraft cable, etc.)

- b) For luminaires supplied with power by exposed cables or flexible cords feed, tie the cord to the supporting device to prevent sag and to minimize the potential for accidental snagging.

5.2.3 Modular wiring systems

- a) If luminaires were not factory-wired for modular wiring, prepare luminaires in staging area by installing and wiring modular connectors.
- b) Install modular wiring system and receptacles in area where luminaires will be located.
- c) Install luminaires.
- d) Install and secure modular whip, tying whip to luminaire support system to prevent sag and accidental snagging.

5.3 Surface Mounted Luminaires

This section applies to industrial fluorescent lighting systems mounted directly to building surfaces.

5.3.1 Support

- a) In general, install luminaire onto a structural, finished surface in the manner recommended by the luminaire manufacturer, using supplied hardware and other accessories. Follow the manufacturer's instructions.
- b) In some cases, luminaires may be primarily supported by an outlet box. Provide additional attachment points in accordance with the luminaire manufacturer's recommendations.
- c) Make certain that the method of attachment is structurally adequate for the load. If necessary, reinforce the point of attachment using strut-type supports or other common electrical supporting means.
- d) When specified or required, install a safety cable or chain that is attached to a structure independent of the principal means of luminaire support.

5.3.2 Wiring

- a) Locate and install an outlet box or other means of connection as recommended by the luminaire manufacturer.
- b) Connect branch wiring to luminaire, using devices such as wire connectors of proper capacity and temperature rating. Reinforce wire connections with electrical tape wherever vibration and/or extreme moisture is present.
- c) Modular Wiring Systems *see* 5.2.3.

6. Other Industrial Lighting Systems

6.1 Pendant-Mounted Luminaires

This section applies to vaportight, industrial shade type, exit sign, and other luminaires designed for pendant mounting.

- a) Determine the appropriate wiring method for the surrounding atmosphere and install branch circuits and outlet boxes accordingly.
- b) Secure a lighting outlet box to the building ceiling or structure at the intended location. Make certain that the box is sufficiently strong to support the weight and the moment arm of the luminaire.
- c) If structure is of stud construction, cut a matching hole in wallboard or other finish material. If masonry or concrete, set outlet box in wall if possible so that box opening is flush with wall. Otherwise, surface mount the box.
- d) Install fixture onto outlet box and make level. Where required, utilize an earthquake-qualified luminaire hanging device.
- e) Where required, install a safety cable or chain that is attached to a structure independent of the principal means of luminaire support.
- f) If necessary, add stabilizing screws and/or independent seismic support.
- a) Secure a lighting outlet box to the building wall structure at the location corresponding with the power feed knockout on the fixture body. If structure is of stud construction, cut a matching hole in wallboard or other finish material. If masonry or concrete, set outlet box in wall so that box opening is flush with wall, if possible; otherwise, use a surface-mounted box. Add extension rings as needed to bring outlet to face of wall. Complete wall and finish.
- b) Install branch circuit in an appropriate manner for the condition.
- c) Install fixture onto outlet and make level.
- d. 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.

6.2 Wall-Mounted Luminaires

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

6.3 Task Lighting

This section applies to industrial luminaires that are individually installed as task lights for machine tools, etc. The following recommendations are in addition to those for specific types of luminaires and mounting systems in Sections 4, 5, 6.1 and 6.2.

6.3.1 Support

- a) Confirm that the task luminaire is suitable for the application, including considerations for environment, physical damage, machine vibration or shock, etc.
- b) Determine that the structure or equipment to which the luminaire is to be attached is structurally sound and capable of supporting the luminaire with-

out damage, deflection, or interference with the process being illuminated. Add structural reinforcement using strut-type supports or other common electrical supporting means as required.

c) Because of the relationship between a task luminaire and the task itself, adjust the location of the luminaire, if possible, to optimize task illumination. *(NOTE: In some cases, the task light location may be critical to the task, so be certain to determine the exact required location from the owner.)*

d) Due to vibration and/or shock, rough service lamps or other accessories may be required.

6.3.2 Wiring

a) Determine the appropriate wiring method for the surrounding environment and install branch circuits and outlet boxes accordingly. This may require special routing to coordinate with the task or process being illuminated.

b) Keeping in mind any safety or structural considerations, connect the task luminaire to the branch circuit. Make certain that cable or whip connections are secured from sagging or possible snagging.

c) Install special control devices as required.

End of Standard

(Annexes are not a part of the standard)

Annex A: Reference Standards

This publication, when used in conjunction with the National Electrical Code (ANSI/NFPA 70) in and manufacturers' literature, provides sufficient information to install industrial lighting systems. The following publications may also provide useful information:

Illuminating Engineering Society of North America
120 Wall Street, 17th Floor
New York, NY 10005-4001
(212) 248-5000
(212) 248-5017 Fax
www.iesna.org

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

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 100-1999, *Standard for Electrical Drawing Symbols* (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 and Maintaining Exterior Lighting* (ANSI)

Annex B: Stroboscopic Effects

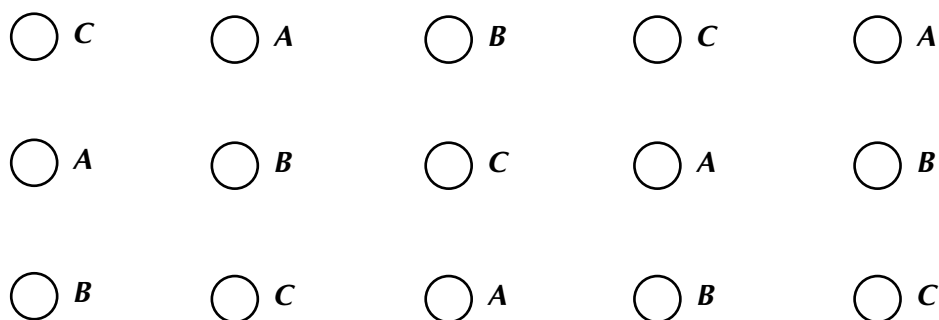
Industrial lighting often involves the illumination of workplaces where rotating machinery such as power tools are used. When illuminated with electric light derived from AC power systems in which the light pulses or strobos, resonant rotation frequencies can result in the appearance that the rotating device is standing still (i.e., not running). This is called a stroboscopic effect, and can create a serious potential hazard for power tool users and others. Stroboscopic effects can also have possible health impacts (nausea and vertigo) on some people who are sensitive to flickering lights.

Table B-1 describes the relative amount of flicker, or stroboscopic effect, among different electric lamp types used in industrial lighting systems. Stroboscopic effects can be minimized using the following techniques:

Phase Rotation

Typically, there are a number of luminaires in a space. By connecting them to the three phases of the AC power system in an rotated manner as illustrated below, the overlapping pulses of light tend to minimize stroboscopic effects, but not perfectly. This method is the minimum recommended practice for all industrial lighting systems.

Layout (Plan) View, Typical HID Luminaire System with Phases Rotated to Minimize Stroboscopic Effect



Supplemental Lighting

In industrial or storage occupancies with a general lighting system consisting of overhead HID or fluorescent lamps, additional lighting is often provided to illuminate specific tasks such as machines or other work areas. Providing supplemental lighting for these tasks using low-flickering sources such as incandescent lamps or electronically-ballasted fluorescent or compact fluorescent lamps can minimize or prevent any hazardous stroboscopic effect.

Table B-1 Flicker

Lamp	Degree of Problem	Methods of Reducing Stroboscopic Effects
Incandescent	Relatively low. Incandescent lamps demonstrate a small amount of flicker but thermal persistence minimizes its effects.	None required. Pure filtered DC power could be used to produce a totally non-flickering source.
Fluorescent and compact fluorescent	Potentially problematic using magnetic ballasts (low frequency operation). Persistence of lamp phosphors reduces flicker, but stroboscopic effects are still a concern. Relatively low using electronic ballasts (high frequency operation).	When operated in two-lamp configurations on a magnetic ballast, most lamps are connected to lead-lag to minimize flicker, but flicker can be a problem under some circumstances. On single lamp ballasts, flicker is higher and depending on lamp type, can represent a larger potential problem. Electronic ballasts virtually eliminate flicker.
HID lamps	Generally problematic.	Phase rotation or used with supplemental lighting. In some instances, electronic ballasts might be used to eliminate flicker.



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Standards & Safety
Index: NECA 502
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