



Recommended Practice
for Installing

Exterior Lighting Systems



Published by
National Electrical
Contractors Association



Jointly developed with
Illuminating Engineering
Society of North America



An American National Standard

NECA/IESNA 501–2000

Recommended Practice for
**Installing Exterior
Lighting Systems**

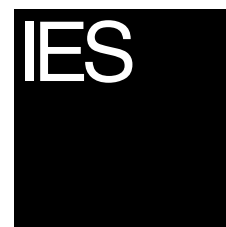
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(This foreword is not a part of the standard)

Foreword

National Electrical Installation Standards™ are intended 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:

“Exterior lighting systems shall be installed in accordance with NECA/IESNA-501, *Recommended Practice for Installing Exterior Lighting Systems*.”

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Everything in this publication is intended to comply with the edition of the *National Electric Code*® in effect at the time of publication. *NEIS* are not intended to duplicate *NEC*® requirements or to establish regulatory requirements for electrical construction. It is the responsibility of users of this stan-

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

Suggestions for revisions and improvements to this standard are welcome. They should be addressed to:

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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 outdoor applications on and near commercial, institutional, industrial and storage buildings, including but not limited to the following:

- Pole mounted spot lights, area lights, sports lights and floodlights
- Illuminated bollards
- Wall mounted sconces, wall bracket lights, and wall pack lights
- Above-ground mounted floodlights and spot lights
- In-ground floodlights and spotlights
- Step lights and other lights recessed into exterior walls and other concrete surfaces
- Canopy and soffit mounted surface lights
- Landscape lighting

1.2 Lighting Systems and Equipment Excluded

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

- Lighting systems for roadways, bridges or similar applications where special structural and/or civil engineering requirements prevail
- Lighting systems integral to or embedded in roadway or advertising signing

- Lighting systems designed for marine, aviation, rail, transit, or other specialized applications
- Lighting systems employed in petrochemical plants, power plants, or other applications where special environmental or regulatory conditions prevail
- Underwater and submersible lighting
- Portable lighting

1.3 Related Construction Materials

In addition to the luminaire(s), this recommended practice also covers related construction materials, including lamps, conduit, wire, various special screws and clips, and other related components and parts.

1.4 Related Construction Work

In some cases, the electrical contractor may build reinforced concrete foundations, dig and backfill trenches, and other similar work often associated with outdoor lighting. None of these activities are covered by this standard, and contractors engaging in these activities should consult with the appropriate standard(s) for that type of construction.

1.5 Regulatory and Other Requirements

All recommendations of this publication are intended to comply with the National Electric Code (ANSI/NFPA 70), and in general the typical recommendations of outdoor lighting equipment manufacturers. Installers should always comply with the NEC, applicable state and local codes, manufacturer's instructions, and contractual obligations, when installing exterior lighting, lighting systems designed for marine, aviation, rail, transit, or other specialized applications.

2. Definitions

Area light	A luminaire designed to be mounted onto a structure or top of a pole, and intended to illuminate an area such as a parking lot, driveway, or yard.	Luminaire	A complete unit consisting of a lamp or lamps together with the parts designed to distribute the light, to position and protect the lamps, and to connect the lamps to the power supply. A luminaire may include ballast, lens(es), louvers, reflectors, and/or structural or ornamental fittings.
Bollard	A ground-mounted luminaire generally less than 4 feet in height above grade.	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.
Canopy light	A ceiling surface-mounted luminaire designed for outdoor applications. Also called “soffit light.”	Portable luminaires	A luminaire designed with a cord-and-plug and intended to be moved from place to place. It is located and connected by building occupants.
Direct burial light	An in-ground luminaire designed for uplighting landscaping and building facades. Similar to well lights except not intended for use in concrete.	Recessed light	A luminaire designed to be recessed into ceilings, walls, or other structures, so as to have its aperture essentially flush with the adjacent surface.
Floodlight	A directional luminaire designed to be mounted on buildings, poles, or on the ground, and used to illuminate an area or large surface.	Sconce	A decorative luminaire mounted to a wall. See also <i>wall bracket</i> and <i>wall pack</i> .
High Intensity Discharge	High intensity discharge lamp. HID lamp types include mercury vapor, metal halide, and high pressure sodium (HPS). Because of similar application characteristics, low pressure sodium lamps are considered HID lamps for the purposes of this publication.	Sports light	A directional luminaire specially designed for lighting sports fields.

Spotlight	A directional luminaire designed to be mounted on buildings, poles, or on the ground, and used to illuminate a specific object or small surface.	Wall bracket	A luminaire mounted to a wall, usually on a protruding arm or “bracket.” See also <i>sconce</i> and <i>wall pack</i> .
Staging area	An area in which luminaires are removed from packaging and prepared for installation, including installing whips, accessories, etc.	Wall pack	A wall-mounted luminaire designed for use as a security element or for area lighting. See also <i>sconce</i> and <i>wall bracket</i> .
Step light	A wall-mounted luminaire designed to be installed along a walk or steps, usually less than 4 feet above grade.	Wall light	An in-ground luminaire designed for uplighting landscaping and building facades. Similar to direct burial lights except suitable for use in concrete.
Surrounding atmosphere	The air surrounding the luminaire, taking into account moisture, temperature, salt or other corrosive vapors, dirt, dust, combustibles, etc.		

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 for palletized shipments and large and/or heavy objects such as poles and mast arms.
- 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 re-packed 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.)*
- e) Verify receipt of manufacturer(s) literature on luminaire installation and maintenance. Review this material and maintain it on site for reference.

3.1.2 Storage and protection

- a) Store material in a clean, dry, and secure location. Avoid places where water might accumulate or where significant airborne dust or dirt is present. If such a location is not available, wrap the material 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) Store large objects such as poles in location(s) where access for delivery, preparation and installation is appropriate. Outdoor storage may be acceptable as long as material is raised above the ground and in a manner consistent with the manufacturer's recommendations. Be especially careful to preserve material finish and to prevent denting or other physical damage.
- c) Stack or otherwise store equipment to prevent damage, observing warnings and stacking instructions on packaging or shipping materials.
- d) Organize storage with essential information such as luminaire type, project location, voltage, job tags, or labels for easy reference and access.
- e) Verify input voltage on ballasts and transformers.
- f) Do not stack boxes that are partially crushed even if the products are intact.
- g) Should an event occur that could damage stored material, such as a water leak, immediately reinspect 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. If forklifts or other equipment must be used to move large and/or heavy items like poles, make certain that the material is padded and protected from scrapes and other damage.

- c) Leave material in original packaging until ready to be prepared for installation.

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. For pole mounted lighting systems, identify and isolate a clean portion of a parking lot, driveway or service yard near the intended location for pole assembly and staging. Provide sufficient lumber, such as 4x4's or railroad ties, to support the poles. *(NOTE: Take care to prevent discoloring or other damage to poles and luminaires caused by stains, finishes, or treatments on the support materials.)*
- d) If necessary, establish a clear path for moving assembled luminaires from the staging area to the installation site.

3.2.2 Assuring structural readiness

Make certain that the structural support for the lighting systems is complete. In the case of luminaires employing concrete foundations, such as bollards and poles, make certain that the foundation has been constructed and that the concrete has been given sufficient time to cure.

3.2.3 Assuring electrical readiness

Make certain that the junction boxes and home runs are in place and ready for expansion. When local or supplementary grounding is required, make certain that ground rods, cables, etc. have been installed and are ready to make final connections.

3.3 Unpacking and Handling Material

3.3.1 (Partial) unpacking

- a) Remove material from shipping packaging only to the extent necessary. For large items to be stored on site,

consider utilizing shipping provisions such as pallets, etc. as a means for storing and moving materials.

- b) Leave protective covering(s) in place as long as possible. For extended storage of exterior lighting products, check with manufacturer to determine whether covering should be removed or replaced to prevent damage.

- c) For large items to be stored outdoors, such as poles and mast arms, determine whether the manufacturer recommends special measures to prevent damage prior to installation.

- d) Move material to staging area, using protective coverings or padding if needed.

3.3.2 Special care items

Carefully unpack lenses, louvers, trims, lamps, ballasts, and other items that are breakable, or easily marred or damaged. Set these items aside, using extra padding or other means to prevent damage.

3.4 Coordination With Other Trades

3.4.1 General

- a) Luminaire locations may need to be adjusted. To the extent possible, check proposed installation locations of other equipment with all trades prior to beginning any work in the area.

- b) Prior to installing structural foundations and underground wiring, contact the local utility underground mapping service and obtain information about existing utilities and rights of way.

- c) Because site work may involve responsible design parties such as a civil engineer or landscape architect, determine the specific party(s) responsible for design and coordination in the area of work. Some projects may have separate responsible parties for the site and buildings.

- d) Expect the architect, landscape architect, engineer, or lighting designer to coordinate systems and to reconcile interferences.

e) Expect the general contractor to coordinate the trades and to reconcile inter-trade coordination problems.

f) Advise the architect, landscape architect, engineer, lighting designer, and/or other consultants if luminaire locations have been compromised by coordination problems prior to roughing-in or installing luminaires.

3.4.2 General construction

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, foundations and other preparations for luminaires are in the correct places and of proper dimensions. If not, appropriate changes will be required before proceeding.

3.4.3 Mechanical systems

a) Determine that HVAC, plumbing, irrigation, storm sewer, sanitary sewer, water supply, gas lines, and fire protection systems are sufficiently complete to allow installation of lighting systems without future removal or damage to material.

b) Make certain fire protection sprinkler head locations are coordinated with the lighting installation. If not, appropriate changes will be required before proceeding.

c) Make certain that plumbing and fire protection piping, mixing boxes, duct work, 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.

3.4.4 Landscaping

a) Make certain that final grading has occurred and that the site landscaping materials, such as trees and other major plantings, are installed.

b) Make certain that the irrigation system is sufficiently complete to permit determination of exact type and location of irrigation device.

3.4.5 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 the NEC, giving lighting locations preference whenever possible.

3.4.6 Surrounding environment

a) Determine that luminaires and related wiring methods are suitable for the surrounding environment. Pay close attention to situations where “damp,” “wet,” “marine,” “salt water,” and/or other specific listings may be required.

b) Notify the architect, landscape architect, or engineer immediately upon identifying an improper listing or application.

3.5 Securing Equipment In Place

3.5.1 General

a) Consult the architectural, electrical, structural, civil and/or landscape plans, as well as manufacturer’s installation instructions, for the intended means of luminaire support.

b) Make certain that the supporting system is appropriate for the application, taking into account the surrounding air, soil, exposure, etc. Avoid direct contact of dissimilar metals, the use of steel parts, and other supporting materials subject to corrosion unless specifically directed to do so by the luminaire manufacturer or engineer.

c) When the manufacturer’s instructions indicate that the luminaire or related material requires a specific rough-in box or similar provision, use it as instructed.

d) Safety supports provided with luminaire components, such as reflectors, may be attached to the luminaire itself. *(NOTE: The addition of components such as chains that are not supplied with the luminaire may violate the product listing.)*

3.5.2 Watertightness

- a) Determine the watertight sealing and gasketing requirements of the installation, including those in the luminaire, between luminaire and box or support, and for related electrical components, such as in-ground junction boxes or transformers.
- b) Inspect gaskets, O-rings, and/or other water sealing components and replace defective, torn, dirty or used components prior to installation.
- c) When directed by luminaire manufacturer's instructions, use potting or sealing compounds. Do not substitute compounds unless approved by the manufacturer.

3.5.3 Basic installation

- a) Rough-in the luminaire according to manufacturer's instructions and as specified by the architect, landscape architect or engineer, or if neither is provided, then as described below.
- b) Secure the luminaire in place according to manufacturer's instructions, or as described below.

3.5.4 Wiring connections - general

- a) Check supply wires for temperature rating according to label on luminaire. If necessary, use tap conductors of the appropriate gauge and temperature rating from the fixture terminal connection to the branch circuit wiring. Make certain wiring is "wet" rated where this is required. Wiring exposed to the elements should be specifically listed and rated for the application, including resistance to UV radiation.
- b) Wire connectors should be of the proper capacity. Where subject to vibration, wrap twist-on wire connectors and conductors together with insulating tape. Where luminaire wiring connections are exposed or located below grade, use wire connectors designed for the purpose.
- c) Apply circuit identification to luminaires for safety and maintenance purposes. If label size and loca-

tion is not specified in the project documents, consult with owner.

- d) Utilize raceways and other wiring methods suitable for the surrounding atmosphere.

3.5.5 Conventional power wiring

- a) For luminaires that mount directly to a lighting outlet or junction box, install waterproofing gaskets and adapter rings or other intermediate accessories as required. Be certain to protect gaskets and finished parts of the luminaire from damage when doing so.
- b) For luminaires connected directly to electric power via a conduit entry into a splice or junction compartment, install the luminaire first and then complete the conduit entry or knockout and make-up terminations. Install junction box covers or other components with gaskets or ring seals carefully, to avoid damaging the seal material.
- c) When branch-circuit conductors are carried through raceways, junction boxes, or outlet boxes integral to the luminaire, make certain that the luminaire is listed for through-wiring. Observe markings or labels on the luminaire specifying the maximum size and number of through-wiring conductors permitted. (*NOTE: Conductors feeding the luminaire itself are not included in the through-wiring count.*)
- d) Make certain power is OFF before connecting power supply feeds. Use proper methods of tagging and locking out circuits prior to beginning work.
- e) Verify correct input voltage on ballasts and transformers.
- f) Connect the supply conductors, observing good electrical practice and assuring a good ground connection. Avoid making wiring splices inside of luminaires, except where the manufacturer's instructions specifically recommend this.
- g) Check luminaires and branch circuits for shorts before energizing.

h) Tag the luminaire or outlet box with panel and circuit number. If label size and location is not specified in the project documents, consult with owner.

3.5.6 Controls and special features

Determine whether luminaire has any special wiring requirements such as for control or emergency power. Follow system manufacturer wiring diagrams and recommendations.

3.6 Installation

a) Install the luminaire in its intended manner. Make certain the unit is level and/or plumb and tighten mounting hardware securely. Observe bolt torque and other specific installation recommendations.

b) Use only mounting hardware provided or specified by the manufacturer. Avoid using other hardware (such as spare or replacement bolts) because of problems such as poor fit or mismatched threads.

3.7 Temporary Lighting

If it is necessary to use permanent luminaires for temporary lighting, install and energize the minimum number of permanent luminaires needed to provide adequate light. Be certain to use only luminaire types that protect lamps from breaking. When construction is sufficiently complete, remove the temporary luminaires, disassemble, clean them thoroughly, re-lamp with new lamp(s), and install them along with other new luminaires to complete the lighting system installation.

3.8 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) 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 components — Parts whose visible surfaces which are scratched, scraped, oversprayed, or otherwise sufficiently ruined so as not to be repairable should be replaced with new parts.

d) Concealed components — 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.

3.9 Preliminary Field Adjustments

a) Review manufacturer's installation instruction, and markings or instructions on the luminaire itself, before making adjustments. If necessary, obtain any specific tools required for the adjustments.

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

c) If the luminaire can be aimed, adjust its rotation and elevation so as to point the beam in the intended direction. Tighten or lock adjusting hardware.
(NOTE: If the adjustment is part of an artistic process, see 3.16.)

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

3.10 Lamping and Accessories

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

b) Install the specified lamp for each luminaire. If none is specified, install the lamp type recommended by the luminaire manufacturer. (NOTE: In some instances lamps may be installed prior to installation of the luminaire. But as a general practice to prevent damage to lamps by handling, it is preferable to install lamps after the luminaire is secured.)

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

d) “Protected” type metal halide lamps should be used in luminaires with open bottoms, or when required by the luminaire manufacturer.

e) For luminaires that use HID, ensure that the lamp is appropriately matched to the ballast. This is especially important considering the numerous different combinations of HID lamps and ballasts that often exist for the same wattage.

f) In floodlights, area lights, and some other luminaire types, use of clear HID lamps may be critical for proper luminaire performance. Be certain to determine whether a clear or coated lamp is specified for a particular application.

3.11 Final Cleaning and Completion of Luminaire Installation

a) In general, do not complete installation until all other trades, especially landscaping and painting trades, 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 soft dry cloth or as recommended by the luminaire manufacturer.

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.

3.12 Testing

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

b) Repair or replace defective components.

c) Test emergency lighting features.

3.13 Lamp Burn-in

Burn all lamps in all luminaires for 100 hours prior to occupancy by Owner or tenant.

3.14 Site Clean-up

a) Organize used packing material according to type.

b) Recycle wooden pallets and shipping containers, cardboard and recyclable packing material like foamed “popcorn” if possible.

c) Dispose of non-recyclable packing materials appropriately.

d) Dispose of spent lamps and ballasts in accordance with warranty and regulatory environmental requirements.

e) Depending on terms of contract, clean up site as required.

3.15 Punchlist and Acceptance

(NOTE: This should precede the 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.

3.16 Aiming and Artistic Adjustments

a) For functional and/or artistic effect, adjust luminaires’ light distribution, rotation and elevation, and set lighting controls. Perform this work with participation and agreement of the owner, architect, engineer, and/or other consultants. It may be necessary to conduct some or all of this work after dark.

b) Advise the owner as to specific maintenance and adjustment procedures.

3.17 Spare Parts

Unless otherwise specified, turn over the following items to the owner or general contractor, and obtain a delivery receipt.

- All spare parts that were provided by luminaire manufacturer(s)
- One set of installation instructions for each luminaire type
- One set of special tools where required for luminaire adjustment or tamper-proof hardware.

3.18 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. Pole-Mounted Lighting Systems and Bollards

4.1 Site Layout and Coordination

a) Lay out and install conduits and luminaire foundations according to plans and specifications. Perform this work to coordinate with grading and/or landscaping work. Coordinate with other trades as necessary. Be certain to install local grounding devices where indicated. Make certain conduit lengths, bends, conduit fill, and locations of pulling points are within standards of proper wiring methods.

b) Notify the architect, landscape architect, and/or engineer of conflicts or site conditions preventing installation as designed.

c) Install branch circuit, switched and through wiring. In general, wire size should be increased to minimize voltage drop. Observe specific grounding, ground fault, and other wiring requirements of the project. Protect wires from damage if they are exposed during site work.

4.1.1 Preparation of luminaire

Prepare the luminaire, assembling parts as directed by manufacturer's instructions.

4.1.2 Lifting luminaire into place

Using a crane or other suitable lifting equipment, carefully raise the luminaire and gently lower it into mounting position. Maintain support while permanently securing luminaire. *(NOTE: To facilitate the inspection process, it may be advisable to notify the Authority Having Jurisdiction (AHJ) prior to lifting the luminaire into place.)*

4.1.3 Wiring

Connect to luminaire according to manufacturer's instructions and good practice.

4.2 Installation on Foundations

In addition to Section 4.1, this section applies to poles, bollards and other luminaires mounted to concrete foundations.

4.2.1 Foundation Construction

a) Install conduits, ground wires, and other indicated electrical work during form preparation. Provide adequate sweeps and extensions and make certain conduits coincide with luminaire manufacturer's recommendations.

b) Obtain manufacturer's bolt pattern and bolt requirements provide them to the contractor responsible for foundation construction. If luminaire manufacturer has provided bolts, turn them over to the foundation contractor and obtain a receipt.

c) Note that in some cases, the orientation of the bolt pattern may be critical. Make certain bolt pattern and orientation are correct before proceeding.

d) Observe concrete pour. Protect bolt threads and conduits from concrete damage, and clean electrical provisions immediately after pour. Assure that the concrete is flat and level where it engages the luminaire base.

4.2.2 Luminaire installation

a) Prepare and install grout per luminaire manufacturer's recommendations.

b) Make certain that pole base aligns with anchor bolts and lower pole into place.

c) Level pole and tighten anchor bolt nuts, observing pole manufacturer's torque recommendations.

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Install base cover if so equipped.

- d) Make wiring connections and replace cover plates.
- e) Install lamp(s).
- f) Adjust luminaire reflector pattern, if required.
- g) Make other luminaire adjustments, close and seal luminaire.
- h) Energize luminaire and observe proper operation.
- i) If so equipped, test operation of photoelectric switching device.

5. Recessed, Ceiling, and Wall-Mounted Lighting Systems

5.1 General

- a) Determine the appropriate wiring method for the surrounding atmosphere and install branch circuits and lighting outlets accordingly.
- b) Install additional support devices, such as masonry anchors, according to manufacturer's recommendations.
- c) Ensure a watertight installation by carefully reviewing and following manufacturer's recommendations.

5.2 Installation of Recessed Luminaires

In addition to 5.1, above, this section applies to luminaires recessed into exterior ceilings and soffits.

5.2.1 Support and installation of housing

- a) Determine considerations, if any, for the surrounding atmosphere. Make certain suspension and connection devices are suitable and will not corrode.
- b) After framing but before other trades and ceiling finish, install luminaire housing using hanging device(s) supplied by the luminaire manufacturer, including clips and other accessories. Follow the manufacturer's instructions.
- c) Secure the hanging device(s) to building structural elements such as beams, decks, or joists. Make certain that the method of attachment is structurally adequate for the load. If required to support heavy components, such as HID ballasts, reinforce the point of attachment using strut-type metal framing or other common electrical supporting materials.
- d) Where required, install a safety cable that is

attached to structure independent of the principal means of support.

5.2.2 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.
- b) Tag box with panel and circuit number.

5.2.3 Installation of trim

- a) Ensure that the luminaire housing and trim are compatible with the ceiling type and thickness, and advise the architect or engineer immediately if not. If possible, obtain extensions to permit trim to fit.
- b) Coordinate ceiling finish work with other trades. Make certain ceiling holes are properly cut and aligned with housings. Make sure incorrect or oversize holes are patched.
- c) Make certain housings are protected against paint or other damage during ceiling installation and finish.
- d) Install trim, lamp, and other specified accessories.

5.3 Installation of Surface-Mounted Luminaires

In addition to 5.1, above, this section applies to lighting systems mounted directly to building surfaces, including walls, ceilings, and other structures.

5.3.1 Support

- a) Determine considerations, if any, for the surrounding atmosphere. Make certain supporting and attaching devices are suitable and will not corrode.

- b) 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.
- c) In some cases, luminaires may be primarily supported by an outlet box. Provide additional attachment points per the luminaire manufacturer's recommendations.
- d) Follow manufacturer's recommendations for number and location of supporting locations.
- e) Make certain that the method of attachment is structurally adequate for the load. If necessary, reinforce the point of attachment using unistrut or other common electrical supporting materials.
- f) Where required, install a safety cable that is attached to a structure independent of the principal means of support.
- g) Where required, use suspension devices that permit and restrain sway during seismic events. Determine that luminaire sway will not cause support failure or allow the luminaire to strike an adjacent structure.
- f) Secure the luminaire, making it level or plumb as required.

5.3.2 Installation and wiring

- a) Locate and install an outlet box or other means of connection as recommended by the luminaire manufacturer.
- b) Tag box with panel and circuit number.
- c) Connect branch wiring to luminaire, using wires and devices such as wire nuts of proper capacity and temperature rating. Reinforce wire connections with electrical tape wherever vibration and/or extreme moisture is present.
- d) Observe manufacturer's watertightness recommendations.
- e) Install special control devices as required.

6. Ground-Mounted Lighting Systems

6.1 In-ground Luminaires

This section applies to incandescent, compact fluorescent, and HID luminaires designed for mounting flush with grade.

6.1.1 Well lights

- a) Construct the well, observing manufacturer's recommendations for drainage and specific soils and materials.
- b) Install branch circuit in an appropriate manner for the condition.
- c) Install fixture onto well and make level. Utilize additional grounding and/or anchoring device if required. Backfill and compact soil in an appropriate manner.
- d) Make up terminations and replace junction box covers.
- e) Install lamp and specified accessories.
- f) Adjust luminaire as indicated or directed. If directions are not provided, adjust luminaire so as to illuminate architectural or landscape features adjacent to the luminaire.

6.1.2 In-grade lights

- a) During concrete forming and reinforcing, excavate as required and install luminaire, observing manufacturer's recommendations. Backfill and compact soil as necessary.
- b) Install branch circuit in an appropriate manner for the condition.

c) Protect the luminaire's finished surfaces from concrete damage and observe concrete pour. Clean off as soon as possible after pour.

d) Utilize additional grounding and/or anchoring device if required.

e) Make up terminations and replace junction box covers.

f) Install lamp and specified accessories.

g) Adjust luminaire as indicated or directed. If directions are not provided, adjust it to illuminate the architectural or landscape features adjacent to the luminaire.

6.2 Above-grade Luminaires

This section applies to beacons, landscape lights and other luminaires mounted above grade, with an in-grade outlet or ballast compartment.

- a) Determine the method of providing power and of securing the luminaire, from manufacturer's instructions.
- b) Identify related components such as in-grade or above-grade junction boxes or compartments for ballasts or transformers, and determine their suitability for the application.
- c) Install branch circuit, including junction and pull boxes, in an appropriate manner for the condition. Provide local grounding and anchors as specified or required. If trenching is required, backfill and compact soil, adding markers as required by code or other local authority.

d) If the luminaire is to be mounted onto a concrete pad or other foundation, construct it according to plans and specifications and/or luminaire manufacturer's recommendations. It may be necessary to coordinate this work with the foundation contractor.

e) Install luminaire as recommended by manufacturer, and make it plumb and/or level if necessary.

6.3 Low-voltage Landscape Lighting

This section applies to lighting systems employing step-down transformers and exposed or concealed low voltage wiring to in-ground, on-ground, and aerial luminaires operating at less than 30 volts.

6.3.1 Branch-circuit wiring

a) Lay out and install conduits and transformers according to plans and specifications. Perform this work to coordinate with grading and/or landscaping work. Coordinate with other trades as necessary. Be certain to install local grounding devices where indicated. Make certain conduit lengths, bends, conduit fill, and locations of pulling points are within standards of proper wiring methods.

b) Make certain transformers are rated for the application and installed in a manner consistent with manufacturer's recommendations. Do not allow transformers or ballasts to remain exposed or improperly installed on the site.

c) Notify the architect, landscape architect, and/or engineer of conflicts or site conditions preventing installation as designed.

d) Install the branch circuit wiring. In general, wire size should be increased to minimize voltage drop. Observe specific grounding, ground fault, and other wiring requirements of the project. Protect wires from damage if they are exposed during site work.

e) Connect branch circuits to transformers. Set transformer taps per specifications or manufacturer's recommendations. Energize and test transformers for proper secondary voltage.

6.3.2 Low-voltage wiring

a) Determine number and gauge of homerun conductors. Because systems often employ a low-voltage center-tap conductor, consider using three wire homeruns as well as two wire. Carefully observe manufacturer's recommendations with respect to wire gauge, distance, two- or three-wire configuration, and voltage drop.

b) Lay out and install the low-voltage wiring system. Because low-voltage systems often employ direct-burial and/or exposed cables, make certain cables are of proper rating. If required, provide junction and splice boxes; otherwise, direct-burial splices may be permitted in accordance with manufacturer's instructions and the use of proper materials. **DO NOT COMPLETE OR CLOSE LUMINAIRE TAP JUNCTIONS AT THIS TIME.**

c) For above-grade and aerial components of low-voltage circuits, protect the wiring from physical damage and attach firmly to adjacent structures.

d) If required, attach luminaires to trees trunks or heavy limbs using suitable expanding devices. Avoid rigid attachments unless specifically directed to do so.

e) If required, install luminaires onto stakes driven into earth. If stakes allow height positioning of luminaires, set luminaires to illuminate landscape elements or as directed.

f) Energize and test system. Measure voltage at the tap to each luminaire. If the voltage drop is greater than 10 percent at any point in the system, correct this problem before proceeding.

g) Complete taps and place the low-voltage lighting system in operation.

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(This annex is not part of the standard)

Annex A: Reference Standards

This publication, when used in conjunction with the National Electrical Code and manufacturers' literature, provides sufficient information to install exterior lighting systems.

National Fire Protection Association
1 Batterymarch Park
P.O. Box 9101
Quincy, Massachusetts 02269-9101
(617) 770-3000 tel
(617) 770-3500 fax
www.nfpa.org

NFPA 70-1999, *National Electrical Code* (ANSI)

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

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

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

NECA 100-1999, *Symbols for Electrical Construction Drawings* (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 502-1999, *Recommended Practice for Installing Industrial Lighting Systems* (ANSI)



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